ISSN : 2349-6495(P) | 2456-1908 (O)

International Journal of Advanced Engineering Research and Science

(IJAERS)

An Open Access Peer-Reviewed International Journal

Journal DOI: 10.22161/ijaers

Issue DOI: 10.22161/ijaers.104

AI PUBLICATIONS

Vol.- 10 | Issue - 4 | Apr 2023

editor@ijaers.com | http://www.ijaers.com/

International Journal of Advanced Engineering Research and Science

(ISSN: 2349-6495(P)| 2456-1908(O))

DOI: 10.22161/ijaers

Vol-10, Issue-4

April, 2023

Publisher

AI Publication

Email: editor.ijaers@gmail.com; editor@ijaers.com

Web: www.ijaers.com

International Editorial/ Reviewer Board

Editor in Chief

- **Dr. Swapnesh Taterh (Chief-Editor),** Amity University, Jaipur, India

Cheif Executive Editor

- **S. Suman Rajest,** Vels Institute of Science, Technology & Advanced Studies, India chief-executive-editor@ijaers.com

Associate Editors

- **Dr. Ram Karan Singh ,** King Khalid University, Guraiger, Abha 62529, Saudi Arabia
- **Dr. Shuai Li,** University of Cambridge, England, Great Britain

Editorial Member

- **Behrouz Takabi,** PhD, Texas A&M University, Texas, USA
- **Dr. Gamal Abd El-Nasser Ahmed Mohamed Said,** Port Training Institute (PTI), Arab Academy For Science, Technology and Maritime Transport, Egypt
- **Dr. Hou, Cheng-I ,** Chung Hua University, Hsinchu Taiwan
- **Dr. Ebrahim Nohani,** Islamic Azad University, Dezful, IRAN.
- **Dr. Ahmadad Nabih Zaki Rashed,** Menoufia University, EGYPT
- **Dr. Rabindra Kayastha ,** Kathmandu University, Nepal
- **Dr. Dinh Tran Ngoc Huy,** Banking and Finance, HCM, Viet Nam
- **Dr. Engin NAS,** Duzce University, Turkey
- **Dr. A. Heidari,** California South University (CSU), Irvine, California, USA
- **Dr. Uma Choudhary,** Mody University, Lakshmangarh, India
- **Dr. Varun Gupta,** National Informatic Center, Delhi, India
- **Dr. Ahmed Kadhim Hussein,** University of Babylon, Republic of Iraq
- **Dr. Vibhash Yadav,** Rajkiya Engineering College, Banda. UP, India
- **Dr. M. Kannan,** SCSVMV University, Kanchipuram, Tamil Nadu, India
- **José G. Vargas-Hernández,** University of Guadalajara Periférico Norte 799 Edif. G201-7, Núcleo Universitario Los Belenes, Zapopan, Jalisco, 45100, México
- **Dr. Sambit Kumar Mishra,** Gandhi Institute for Education and Technology, Baniatangi, Bhubaneswar, India
- **DR. C. M. Velu,** Datta Kala Group of Institutions, Pune, India
- **Dr. Deependra Pandey,** Amity University, Uttar Pradesh, India
- **Dr. K Ashok Reddy,** MLR Institute of Technology, Dundigal, Hyderabad, India
- **Dr. S.R.Boselin Prabhu,** SVS College of Engineering, Coimbatore, India
- **N. Balakumar,** Tamilnadu College of Engineering, Karumathampatti, Coimbatore, India
- **R. Poorvadevi,** SCSVMV University, Enathur, Kanchipuram, Tamil Nadu, India
- **Dr. Subha Ganguly,** Arawali Veterinary College, Sikar, India
- **Dr. P. Murali Krishna Prasad,** GVP College of Engineering for Women, Visakhapatnam, Andhra Pradesh, India
- **Anshul Singhal,** Bio Instrumentation Lab, MIT, USA
- **Mr. Lusekelo Kibona,** Ruaha Catholic University, Iringa, Tanzania
- **Sina Mahdavi,** Urmia Graduate Institute, Urmia, Iran
- **Dr. N. S. Mohan,** Manipal Institute of Technology, Manipal, India
- **Dr. Zafer Omer Ozdemir,** University of Health Sciences,Haydarpasa, Uskudar, Istanbul, TURKIYE
- **Bingxu Wang,** 2721 Patrick Henry St Apt 510, Auburn Hills, Michigan, United States

Vol-10, Issue-4, April 2023

(10.22161/ijaers.104)

Detail with DOI (CrossRef)

Sociodemographic and clinical profile of women with uterine cervical cancer attended in an oncological hospital in the state of Acre, Brazil

Toniel Alves de Souza, Eder Ferreira de Arruda, Sandra Maria Sampaio Enes, Carolina Pontes Soares

DOI: 10.22161/ijaers.104.1

Page No: 001-009

Association of bacterial vaginosis to atypia in squamous cells of the cervix

Natalia Ferreira Carvalheiro, Jacinto da Costa Silva Neto, Julliano Matheus de Lima Maux, Luciano Lobo Gatti, Gabriel Vitor da Silva Pinto

DOI: 10.22161/ijaers.104.2

Page No: 010-024

Multiprofessional Care for a Patient with Gestational Diabetes

Vitor da Costa Nogueira, Eleonam Cleysson Tavares Brito, Jéssica Fernanda Mateus Noronha, João Baptista de Castro Netto, João Guilherme Barroso e Silva, Marco Antonio Miranda Pereira Filho, Maria Clara Mapurunga Guimarães, Maria Heloise Rosende Sampaio, Pedro Assis Rocha, Pedro Augusto Ximenes DE lira, Luis Felipe Cutrim Martins

DOI: 10.22161/ijaers.104.3

Page No: 025-036

Morphometric analysis of the Ekole River as a consequence of climate change: A case study in Yenagoa, Bayelsa State, Nigeria

Jonathan Lisa Erebi, Digha Opaminola Nicholas

DOI: 10.22161/ijaers.104.4

Page No: 037-044

The Illusion of a Marshall Plan for Africa

Abdelhamid Nechad, Meryem Bahha, Mohammed Rhalma

DOI: 10.22161/ijaers.104.5

Page No: 045-053

Perceptions of players in the wood-energy market on the effects of their activities on the dynamics of the vegetation cover in the western part of the Plateaux Region in Togo

Komla Uwolowudu Amegna

DOI: 10.22161/ijaers.104.6

Page No: 054-062

VCO Rancidity Analysis refers to Fermentation Time that Produced by Gradual Heating Method

Toar Daniel Malingkas, Nelly Selvia Tongkeles, Damianus Manesi, Resti Fadillah, Onesimus Ke Lele, Desak Ketut Tri Martini, Elesta Banamtuan

DOI: 10.22161/ijaers.104.7

Page No: 063-068

Design and Building of Servo Motor Portable Coconut Peller Machine

Damianus Manesi, Imanuel A. Tnunay, Elkana B Lopo, Jemssy R. Rohi, Boy Bistolen

DOI: 10.22161/ijaers.104.8

Page No: 069-073

Water Quality Assessment using GIS based Multi-criteria evaluation (MCE) and Analytical Hierarchy Process (AHP) Methods in Yenagoa Bayelsa State, Nigeria
Eteh Desmond Rowland, Samuel Oseji, Erazua Iziegbe, Osi Nnamdi Claude, Abaye Ebinyo Oreikio
DOI: 10.22161/ijaers.104.9

Page No: 074-084

Childhood/ Pediatric Cancer: Nursing care in oncopediatrics with a central focus on humanization
Joelma Erculano Bragança Montovanelli, Adgeane Batista de Araújo, Erika Ferreira Silva Bittencourt, Hentony Clayton Lima Pinto , Vanessa Soares dos Reis de Marins, Luciana Teixeira Chaves Rodrigues, Luciana Santos de Santana, Gleisimar Lima Silva, Elizamar de Souza Silva, Josiane Alves dos Santos, Welesmar Barros dos Santos, Cleitineia da Silva Souza, Renata Perfetti de Souza, Hedelson José da Silva, Amanda Soares de Souza, Dulcilene Custódio da Cruz, Patricia Santos De Souza, Gleison Faria, Flaviane Cristina da Silva, Edson Alan Mora Cavalheiro, Aline de Souza Gude, Francisco Leandro Soares de Souza, Tais Loutarte Oliveira, Renata Gatto de Morais, Rhamayana Maria da Conceição, Vitória de Oliveira Peres, Daniele Silva de Almeida, Aline Fontes Alves, Cleidiane Barbosa Malaquias, Solange da Silva Boni, Letícia Ferreira Gomes, Michele Alves Primo, Marco Rogério da Silva, Andriele Vancini Sanches, Rayanne Cavalcante do Nascimento
DOI: 10.22161/ijaers.104.10

Page No: 085-096

Calculating gross photosynthesis in C3 and C4 metabolisms
Benjamim Pereira da Costa Neto
DOI: 10.22161/ijaers.104.11

Page No: 097-098

Associativism as strategy of reaching territorial rights, programs, projects and public policies of rural development: The case of the São Francisco do Mainã community, Manaus, AM
Lindomar de Jesus de Sousa Silva, Gilmar Antonio Meneghetti, José Olenilson Costa Pinheiro, Alessandro Carvalho, Marcos Roberto Brito de Carvalho, Rafael de Lima Erazo, Francisco Mateus da Silva
DOI: 10.22161/ijaers.104.12

Page No: 099-107

Constructed Wetlands: Technology for Removing Drug Concentration from Water
Krisna Ridzi Kathar, Naema Wasim, Simone da Silva, Alexandre dos Santos Pyrrho, Márcia C.B.N. Varricchio
DOI: 10.22161/ijaers.104.13

Page No: 108-119

Study of the extraction process of the Pleurotus citrinopileatus mushroom and evaluation of the biological activity of the extract
Thanh Xuan Nguyen Thi, Phuong Anh Nguyen Thi, Mai Anh Le, Hoang Anh Nguyen, Manh Ha Nguyen, Hoai Phuong Nguyen Thi
DOI: 10.22161/ijaers.104.14

Page No: 120-127

International Journal of Advanced Engineering Research and Science (IJAERS)
Peer-Reviewed Jounal
ISSN: 2349-6495(P) | 2456-1908(O)
Vol-10, Issue-4; Apr, 2023
Journal Home Page Available: https://ijaers.com/
Article DOI: https://dx.doi.org/10.22161/ijaers.104.1

Sociodemographic and clinical profile of women with uterine cervical cancer attended in an oncological hospital in the state of Acre, Brazil

Perfil sociodemográfico e clínico de mulheres com câncer do colo uterino atendidas em um hospital oncológico no estado do Acre, Brasil

Toniel Alves de Souza[1], Eder Ferreira de Arruda[2], Sandra Maria Sampaio Enes[3], Carolina Pontes Soares[4]

[1]Acadêmico de medicina do Centro de Ciências da Saúde e do Desporto da Universidade Federal do Acre, Brasil.
[2]Mestre em Saúde Coletiva, Especialista em Saude Pública, docente do curso de Enfermagem do Centro do Centro Universitário UNINORTE Acre, Brasil.
[3]Doutora em Ciências, docente do curso de Enfermagem, do Centro de Ciências da Saúde e do Desporto da Universidade Federal do Acre, Brasil.
[4]Pós-doutora, Doutora e Mestre em Ciências Morfológica, docente do curso de medicina do Centro de Ciências da Saúde e do Desporto da Universidade Federal do Acre, Brasil.

Received: 25 Feb 2023,

Receive in revised form:25 Mar 2023,

Accepted: 02 Apr 2023,

Available online: 11 Apr 2023

***Keywords*— Cervical cancer, Gynecology, Epidemiology.**

***Palavras-chaves*— Câncer do colo uterino, Ginecologia, Epidemiologia.**

***Abstract*—** *Introduction: Gynecological cancers are among the most common in women worldwide, with cervical cancer (CC) being the most frequent type and considered an important public health problem. Methodology: This is a descriptive, cross-sectional, observational study with a quantitative approach, in which 76 women who were being treated for CC in 2020 were interviewed through a questionnaire. The data were entered and reviewed in a program spreadsheet editor and analyzed in a statistical program, where the absolute and relative frequencies of the variables of interest were calculated. Results: It was observed that 27.6% of the women were between 41 and 50 years old, 72.4% were brown, 35.5% had not completed elementary school, 53.9% were married or in a stable relationship, 43.4% had a paid job and 56.6% had a monthly family income of one minimum wage, with 38.2% having menarche at the age of 12 years or less, 65.8% reported their first sexual intercourse at 16 or more years of age, 48.7% had five or more pregnancies, 55.3% had no history of miscarriage, 64.5% used or are using hormonal contraceptives, 60.5% did not undergo regular Pap smear tests and 58.82% had a diagnosis of CC at an advanced stage. Conclusion: Socioeconomic vulnerability, early onset of sexual life, multiparity, low adherence to the preventive examination and diagnosis at na advanced stage were the main characteristics of patients affected by CC.*

***Resumo*—** *Introdução: Os cânceres ginecológicos estão entre os mais comuns em mulheres no mundo, sendo o câncer de colo do útero (CCU) o*

tipo mais frequente e considerado um importante problema de saúde pública. Metodologia: Trata-se de um estudo observacional descritivo, de corte transversal, com abordagem quantitativa, no qual, por meio de questionário, foram entrevistadas 76 mulheres que estavam em tratamento para CCU no ano de 2020. Os dados foram digitados e revisados em programa editor de planilhas e analisados em programa estatístico, onde foram calculadas as frequências absolutas e relativas das variáveis de interesse. Resultados: Foi observado que 27,6% das mulheres estavam na faixa etária de 41 a 50 anos, 72,4% eram pardas, 35,5% cursaram o ensino fundamental incompleto, 53,9% se encontravam casadas ou com união estável, 43,4% desenvolviam atividade remunerada e 56,6% tinham renda familiar mensal de um salário mínimo, sendo que 65,8% relataram a sexarca com 16 ou mais anos de idade, 48,7% tiveram cinco ou mais gestações, 64,5% utilizaram ou fazem uso de métodos contraceptivos hormonais, 60,5% não realizavam exame de colpocitologia oncótica de forma regular e 58,82% tinham diagnóstico do CCU em estádio avançado. Conclusão: Vulnerabilidade socioeconômica, início precoce da vida sexual, multiparidade, baixa adesão ao exame preventivo e diagnóstico em estadio avançado foram as principais características das pacientes acometidas pelo CCU.

I. INTRODUÇÃO

O câncer é um conjunto de mais de 100 doenças diferentes ocasionadas pelo crescimento celular descontrolado que podem comprometer diversas estruturas do organismo do humano, inclusive o colo uterino, levando ao câncer de colo uterino (CCU) ou também denominado câncer cervical[1].

Os cânceres ginecológicos estão entre os cânceres mais comuns em mulheres. O câncer de colo uterino (CCU) é o tipo mais frequente[2]. De fato, é um dos principais problemas de saúde pública no mundo[3].

Em 2020, foi estimado aproximadamente 604 mil novos casos de CCU e mais de 342 mil mortes em todo o mundo. Diante disso, o câncer cervical é um impasse global crescente para todas as nações. Estudos recentes apresentaram que o CCU representou 7,5% de todas as mortes por câncer feminino[4]. Sendo 90% dessas mortes em países classificados entre baixa e média renda[5].

Diante disso, é evidente que o CCU é uma neoplasia maligna muito comum que afeta centenas de milhares de mulheres em todo o mundo, com o número de casos aumentando anualmente[6,7].

No Brasil, o CCU é a terceira neoplasia maligna mais diagnosticada em mulheres, e a quarta causa de falecimento nessa população. Além disso, 16.590 casos de CCU foram esperados para o ano de 2022, com um risco estimado de 15,43 casos a cada 100 mil mulheres[8].

Na região Norte do Brasil, o CCU tem expressivos dados que demonstram alta incidência de casos, mesmo sendo uma das neoplasias, relativamente, mais fáceis de diagnóstico e melhores percentuais de cura quando observado em fase inicial. Segundo informações do Instituto Nacional de Câncer (INCA), de 2019, o CCU se destaca como o primeiro mais incidente na região Norte do Brasil, com estimativa de 1.970 casos por 100.000 mulheres para o ano de 2020[8].

No Estado do Acre, estima-se que o CCU foi o segundo mais incidente em mulheres, ficando atrás do câncer de mama. Ademais, ainda para o referido ano, são esperados 90 casos de câncer cervical em todo o Estado e 70 casos somente para capital Rio Branco[8].

Dessa forma, é evidente que o câncer cervical é um relevante problema de saúde pública, pois afeta centenas de milhares de mulheres em todo o mundo e no Brasil, com o número de casos e óbitos aumentando anualmente, além de demandar um grande investimento de recursos públicos em medidas de prevenção e tratamento. Portanto, é necessário entender os fatores relacionados à este agravo a fim de auxiliar no melhoramento nos programas de rastreio, contribuir com as estratégias de prevenção e ampliar o conhecimento sobre à epidemiologia do CCU no estado do Acre.

Com o desígnio de subsidiar o entendimento do CCU no estado do Acre, permitindo aperfeiçoamento nos programas de rastreio e prevenção, este trabalho tem como objetivo identificar as principais características de mulheres em tratamento para o câncer do colo uterino na Unidade de Alta Complexidade em Oncologia

(UNACON) do Hospital de Câncer do Acre, localizado na cidade de Rio Branco.

II. MATERIAIS E MÉTODOS

Trata-se de um estudo observacional descritivo, de corte transversal e com abordagem quantitativa, realizado com mulheres atendidas no Hospital de Câncer do Acre (HCAC). É válido ressaltar que a referida unidade hospitalar, única referência especializada em tratamento oncológico no estado do Acre, trata-se de uma instituição de natureza pública, responsável pelo atendimento da demanda do Sistema Único de Saúde (SUS) no estado do Acre.

O Hospital de Câncer do Acre, cadastrado pelo Ministério da Saúde (MS) como unidade de alta complexidade em Oncologia (UNACON), iniciou suas atividades no ano de 2007. O público-alvo da unidade são os pacientes com diagnóstico oncológico confirmado por histopatologia, mielograma ou biologia molecular, para fins de tratamento especializado nos serviços de quimioterapia, cirurgia, radioterapia e multiprofissional[8].

O serviço de quimioterapia é dividido em dois setores: farmácia de manipulação e salas de infusão, nas categorias adulto e infantil. Em 2020, foram realizadas 7.431 sessões de aplicação de quimioterápicos injetáveis, distribuídas entre 1.914 pacientes de hormonioterapia. Ademais, o serviço de emergência funciona como serviço de pronto atendimento 24 horas, para atendimento de todos os pacientes cadastrados na unidade que necessitem de atendimento de urgência relacionado a complicações do tratamento da doença oncológica de base e outras intercorrências clínicas[8].

A amostra de estudo foi constituída por 76 mulheres, onde foram calculaos com base na média anual de 92,6 pacientes em tratamento contra o CCU nos anos de 2017, 2018 e 2019, utilizando um intervalo de confiança de 95% e um percentual de margem de erro de 5%.

Foram incluídas, por conveniência, mulheres com idade mínima de 18 anos, diagnosticadas com CCU, que estavam em tratamento na unidade oncológica e voluntariamente aceitaram participar das atividades e ações propostas assinando o Termo de Consentimento Livre Esclarecido (TCLE) antes do início das entrevistas. Por sua vez, foram excluídas as que não tinham condições físicas e psicológicas para responderem o questionário e as com diagnóstico não confirmado ou inconclusivo para CCU.

A pesquisa foi desenvolvida nos meses de janeiro e março de 2020 e para coleta de dados foi utilizado um questionário semiestruturado elaborado pelos autores com perguntas sobre as características sociodemográficas (idade, estado conjugal, escolaridade, profissão, renda) e clínicas/reprodutivas (sexarca, uso de método contraceptivo, histórico gestacional, adesão ao exame Papanicolau e estadiamento do CCU) das mulheres.

Os dados foram digitados e revisados no programa *Microsoft® Office Excel* 2016 e analisados no programa estatístico *Statistical Package for the Social Sciences* (SPSS), versão 21.0, onde foram calculadas as frequências absolutas e relativas para as variáveis de interesse.

Esta pesquisa foi submetida ao Comitê de Ética em Pesquisa local e aprovada com o parecer número 3.823.450 e CAAE 26966819.6.0000.8028.

III. RESULTADOS E DISCUSSÃO

3.1 Perfil Sociodemográfico

De acordo com a Tabela 1, observa-se que a faixa etária acima dos 30 anos de idade foi dominante, sobretudo as mulheres na faixa etária de 41 a 50 anos, correspondendo a 27,6% das entrevistadas. Resultado semelhante foram encontrado em um estudo realizado na cidade de Caruaru, estado do Pernambuco, no qual foi evidenciado a predominância de casos de CCU em mulheres de 40 a 59 anos[9].

Além disso, no presente estudo, foi observado que 9,21% das mulheres diagnosticadas com CCU, estavam na faixa etária acima de 64 anos. Tal dado também foi observado no estudo realizado em Caruaru, citado anteriormente, tendo em vista que as atuais recomendações das diretrizes brasileiras preconizam a realização do exame citopatológico em mulheres dos 25 aos 64 anos de idade[9,10].

Um outro estudo, no qual foram analisados 200 prontuários médicos de mulheres com 65 anos ou mais no Hospital Jhon H. Stroger, no Condado de Cook, nos Estados Unidos, observou que muitas mulheres mais velhas, especialmente mulheres de baixa renda, precisam continuar o rastreamento para CCU devido a históricos de rastreamento inadequados[11].

Ademais, 2,6% das mulheres do presente estudo tinham 30 anos ou menos (Tabela 1). Achado que corrobora com o fato de que o CCU é raro em mulheres até 30 anos. No entanto, sua incidência se eleva progressivamente até o pico na faixa etária de 45 a 50 anos, o que sugere o aumento da idade como um fator de destaque para o desenvolvimento do câncer cervical[12,13].

Referente à cor ou raça, 19,7% das entrevistadas neste estudo se autodeclararam brancas e 72,4% pardas. Em outra pesquisa realizada, onde se avaliou 77.317 casos de

CCU registrados na base de dados de Registros Hospitalares de Câncer (RHC) de todo o Brasil e nos registros do Estado de São Paulo (FOSP), também revelou essa predominância, mas em proporcão menor, 47,9% das mulheres acometidas pelo câncer cervical são de cor parda[12]. Além disso, outro estudo a partir da análise de 140 prontuários de mulheres com CCU, foi constado que 91,75% era de raça/cor não branca[9].

Ambos os estudos citados anteriormente, apresentam dados que corroboram com os achados deste trabalho, justificando a utilização da cor/raça como um marcador social, que contribui para a falta de acesso aos exames preventivos do CCU. Ademais, é válido destacar que a maioria da população do norte e nordeste se autodeclara parda[14].

Tabela 1. Frequência das variáveis sociodemográficas das mulheres com câncer do colo do útero (CCU) em tratamento em unidade de referência no município de Rio Branco, Acre, Brasil, 2020.

Variável	N	%
Faixa etária (anos)		
≤ 30	02	2,6
31-40	18	23,7
41-50	21	27,6
51-60	15	19,7
61-70	20	26,3
Cor/ Raça		
Parda	55	72,4
Negra	05	6,6
Branca	15	19,7
Indígena	01	1,3
Escolaridade		
Não alfabetizada	10	13,2
Ensino Fundamental Incompleto	27	35,5
Ensino Fundamental Completo	11	14,5
Ensino Médio Incompleto	04	5,4
Ensino Médio Completo	15	19,7
Ensino Superior	09	11,7
Situação Conjugal		
Solteira	28	36,8
Casada ou união estável	41	53,9
Divorciada	02	2,7
Viúva	05	6,6
Atividade remunerada		
Sim	33	43,4
Não	30	39,5
Aposentada	13	17,1
Renda familiar mensal (Salário Mínimo)*		
< 1	26	34,2
1	43	56,6
2 ou mais	07	9,2
Total	**76**	**100,0**

Nota: *Valor do SM em 2020 = R$ 1.045,00.
Fonte: Autores.

Em relação ao nível de escolaridade, observou-se a predominância do ensino fundamental incompleto (35,5%), conforme a Tabela 1. Do mesmo modo, em um estudo observacional que utilizou dados secundários do Sistema de Informação do Câncer do Colo do Útero (SISCOLO), realizado no Estado do Maranhão durante o ano de 2011, foi evidenciado que a maioria das mulheres tinha o ensino fundamental incompleto (51,2%)[15].

A literatura indica que o grau de escolaridade pode influenciar na detecção precoce do CCU, considerando que o menor nível de informação e entendimento pode resultar em baixa adesão às estratégias de prevenção[16]. No entanto, em estudo realizado na cidade de Porto Velho, Rondônia, mostrou que o nível de escolaridade das mulheres não interferiu na adesão ao exame preventivo do CCU, ainda que dados científicos relatem que a adesão ao exame está positivamente relacionada ao maior nível de instrução[17,18].

Ademais, observou-se no presente estudo que pouco mais da metade das mulheres, 53,9%, eram casadas ou viviam em união estável. O resultado encontrado está em concordância com o estudo realizado em um hospital público no Distrito Federal, entre janeiro de 2016 a dezembro de 2019, no qual identificou que 67% das pacientes referiram estabilidade conjugal[19].

No entanto, verificou-se maior risco de morte nas mulheres viúvas e solteiras quando comparadas às casadas, segundo estudo realizado no Rio de Janeiro. Pois as casadas possuem uma maior rede de suporte social e apresentam comportamentos mais saudáveis que aquelas não casadas, como por exemplo, a maior presença nos exames de rastreio para o CCU[20,21,22].

Infelizmente, neste estudo não foi investigado sobre o número de parceiros sexuais durante a vida antes do atual estado civil, tal variável seria importante, tendo em vista que a pluralidade de parceiros sexuais é um dos fatores de risco para CCU[23]. Pois, o CCU está associado à infecção persistente por subtipos oncogênicos do Papilomavírus Humano (HPV), especialmente o HPV-16 e o HPV-18, responsáveis por cerca de 70% dos cânceres cervicais[24].

No que se refere à atividade laboral, 43,4% das mulheres exerciam alguma atividade remunerada, 39,5% estavam desempregadas e 17,1% aposentadas. Percentual diferente foi encontrado em um estudo realizado em Recife, no qual, por meio de análise de banco de dados de 127 mulheres com diagnóstico de CCU, foi observado cerca de 85% destas não exerciam atividade profissional[25]. Neste ponto, é válido salientar o impacto econômico ocasionado pelo CCU na vida dessas mulheres, fato citado no estudo realizado no Instituto de Medicina Integral Prof. Fernando Figueira, localizado em Recife, no qual os autores identificaram que, entre as que deixaram de trabalhar por causa do CCU, a média mensal de rendimento perdido foi R$645,57[26].

No que concerne à renda mensal, observou-se que 56,6% tinham renda familiar bruta de um salário mínimo (Tabela 1), resultado semelhante foi encontrado em um estudo realizado em Florianópolis, onde os autores concluíram que a baixa condição socioeconômica é um dos fatores relacionados com o acometimento do CCU[27].

Portanto, pessoas com baixa renda e escolaridade, devido maior exposição aos fatores de risco e com dificuldade de acesso às informações e aos serviços de saúde de qualidade, fazem parte do grupo mais vulnerável às doenças crônicas não transmissíveis, dentre essas o câncer cervical. Esta associação é uma realidade sociodemográfica brasileira, em especial das mulheres que buscam atendimento no SUS[28].

3.2 Perfil Ginecológico e Obstétrico

Conforme a tabela 2, 32,8% das mulheres entrevistas nesse estudo iniciaram a vida sexual com menos de 16 anos de idade. Esse resultado se aproxima do estudo realizado pelo INCA, sobre a caracterização de mulheres com CCU atendidas no INCA por tipo histológico, no qual 40,7% haviam iniciado atividade sexual antes dos 16 anos[29].

Ainda sobre iniciação da vida sexual, sexarca precoce é um dos fatores de risco para desenvolvimento de CCU, pois a zona de transformação do epitélio cervical é mais proliferativa na puberdade e adolescência, desse modo estando mais vulnerável a alterações provocadas por agentes infecciosos, principalmente o HPV[30,31].

Em relação ao número de gestações, na tabela 2 é observado que 48,7% das participantes tiveram 5 ou mais gestações. De igual modo, na pesquisa realizada em Belém, Pará, também foi observado multiparidade, onde 55,6% das pacientes com CCU tiveram quatro ou mais gestações[32]. Em outro estudo 73,44% das mulheres com diagnóstico de CCU tiveram três ou mais gestações[9].

Analisando os fatores de risco para o CCU, nota-se que as mulheres com três ou mais gestações apresentam maior probabilidade de desenvolver a doença em relação às mulheres nulíparas[33]. Pesquisa semelhante mostrou que a ausência de filhos diminui a sobrecarga da mulher e permite que ela utilize seu tempo para cuidar de si, estudar e realizar exames preventivos, como o Papanicolau[34].

A análise quanto ao método contraceptivo mostrou que 64,5% utilizaram ou faziam uso de contraceptivo hormonal. Esse dado corrobora com o achado do estudo realizado na cidade de Valença, Rio de Janeiro, no qual foi identificado que a maioria (53,3%) das mulheres com lesões precursoras do CCU não utilizam nenhum método contraceptivo, e o anticoncepcional hormonal era o método utilizado por 76,5% das mulheres que faziam uso de algum método para evitar gravidez[35].

Tabela 2. Frequência das variáveis ginecológicas e obstétricas das mulheres com câncer do colo do útero (CCU) em tratamento em unidade de referência no município de Rio Branco, Acre, Brasil,2020.

Variável	N	%
Início da vida sexual (idade)		
≤ 13	8	10,5
14 - 15	17	22,3
16 - 17	26	34,2
≥ 18	25	32,8
Número de gestações		
0	2	2,6
1 - 2	14	18,4
3 - 4	23	30,2
≥ 5	37	48,7
Uso de contraceptivo hormonal		
Sim	49	64,5
Não	27	35,5
Adesão regular ao exame preventivo de CCU		
Sim	30	39,5
Não	46	60,5
Total	**76**	**100,0**

Fonte: Autores.

O uso de métodos contraceptivos hormonais por tempo superior a 12 anos, aumenta os riscos para desenvolver CCU, pois essas mulheres são mais propensas a serem sexualmente ativas e costumam ter menos relações sexuais com o uso de preservativos, tendo, consequentemente, maior risco de serem infectadas pelo HPV[36].

Em relação ao exame preventivo de CCU, uma das principais estratégias na prevenção e controle do CCU é sua detecção precoce, permitindo a implementação de tratamento eficaz, antes da ocorrência de morbidade mais grave. O exame de colpocitologia oncótica (exame Papanicolaou) é o principal método utilizado para detecção do CCU e suas lesões precursoras como estratégia de rastreamento[37]. Tal exame preventivo é indicado para a população alvo de 25 a 64 anos, a cada três anos, após dois exames anuais consecutivos normais[38].

Em seus estágios iniciais, o CCU geralmente não apresenta sinais e sintomas, esses só aparecem nos casos mais avançados[39]. Diante disso, o diagnóstico precoce é de extrema importância, tendo em vista que a cura pode chegar a 100% e a maioria dos casos não necessita de intervenções avançadas para tratamento[40].

Um estudo realizado com 160 mulheres em unidade básica de saúde no Acre, identificou que a maioria apresentou conhecimento, atitude e prática adequados frente o exame preventivo do CCU[41]. No entanto, no presente estudo observou-se que 60,5% das mulheres não realizavam exame de colpocitologia oncótica de forma regular.

Dessa forma, o controle do CCU ainda representa um impasse de saúde pública no Brasil, pois apesar do exame preventivo do CCU ser disponibilizado de forma gratuita no sistema público de saúde, sua cobertura ainda não está de acordo com o preconizado para redução das taxas de morbidade e mortalidade ocasionadas por esta doença. Ademais, as barreiras identificadas à adesão do exame preventivo dizem respeito às dificuldades da mulher e à organização dos serviços de saúde dentre os quais destacam-se: a vergonha para realizar o exame; medo; condições socioeconômicas e culturais; a dificuldade no acesso aos serviços de saúde bem como a qualidade dos serviços; o desconhecimento acerca da doença[32,42,43].

3.3 Estadiamento do câncer do colo do útero

A respeito dos tumores dos órgãos reprodutivos femininos, o padrão utilizado para estadiamento é o sistema da International Federation of Gynecology and Obstetrics (FIGO), que se baseia nos resultados dos exames físicos, de imagem e biópsias das lesões. Em resumo, de acordo com a FIGO os estágios do CCU variam de I a IV, sendo o IV um indicativo de que a doença está disseminada à distância[44].

No presente estudo, como exposto a seguir na Tabela 3, dentre o total de 76 participantes da amostra, 7 mulheres não tinham o estadiamento do CCU registrado no prontuário e não sabiam informar sobre tal dado. Sendo assim, observou-se que 57,35% das mulheres tinham diagnóstico de CCU no estádio III, momento em que a neoplasia já invadiu parte inferior da vagina ou paredes da

região pélvica, ou seja, estágio consideravelmente avançado do câncer[44].

Tabela 3. Estadiamento do Câncer do Colo do Útero (CCU) encontrado em mulheres em tratamento em unidade de referência no município de Rio Branco, Acre, Brasil, 2020.

Variável	N	%
Estadiamento		
I	6	7,35
II	23	33,82
III	39	57,35
IV	1	1,47
Total	**69**	**100**

Fonte: Autores.

Esse achado corrobora com o resultado do estudo realizado no Rio de Janeiro a partir de banco de dados do INCA, no qual foi identificado que entre um total de 37.638 casos de CCU registrados no Brasil entre 2000 e 2009, houve predomínio também do estágio III no momento do diagnóstico[45].

Ainda no mesmo estudo citado anteriormente, foi identificado que o principal fator associado ao estádio avançado de CCU foi o fator biológico (o tipo histológico carcinoma de células escamosas). No entanto, observou-se também que as disparidades socioeconômicas presentes no país estão associadas as estádio avançado da doença[45].

Ademais, é sabido que a principal ferramenta para o diagnóstico precoce do CCU é o exame preventivo, já preconizado no Brasil[38]. Porém, como observado no presente estudo (Tabela 2), o diagnóstico em estádio avançado do CCU também pode estar relacionado à baixa adesão ao exame preventivo, tendo em vista que a maioria das mulheres entrevistadas (60,5%) não realizavam regularmente o exame.

IV. CONCLUSÃO

Este estudo apresenta limitação que pode ter influenciado seus resultados, uma vez que a coleta dos dados foi realizada em hospital público, ou seja, de acesso gratuito à população, obviamente tendo seu público formado, em sua maioria, por sem grandes recursos financeiros. Em compensação, é válido destacar como ponto positivo deste trabalho o fato de ser pioneiro na caracterização dos casos de CCU no estado do Acre. Assim, os resultados aqui apresentados possivelmente servirão para melhoramento da gestão das redes de atenção primária à saúde da mulher acreana.

Concluímos que a vulnerabilidade socioeconômica, início precoce da vida sexual, multiparidade, baixa adesão ao exame preventivo e diagnóstico em estádio avançado foram as principais características de risco observadas entre as mulheres com CCU em atendimento no hospital de referência no Acre.

Diante disso, é necessário o desenvolvimento de novos estudos e estratégias relacionados à assistência social, ações de educação sexual, sensibilização sobre a importância do autocuidado e medidas de incentivo à adesão aos exames preventivos periódicos a fim de reduzir novos casos de CCU.

REFERÊNCIAS

[1] Brasil. (2002). *Falando sobre Câncer do Colo do Útero*. Rio de Janeiro: Instituto Nacional de Câncer.

[2] Ferlay, J., Soerjomataram, I., Dikshit R., Eser, S., Mathers, C., Rebelo, M., Parkin, D. M., Forman, D., & Bray, F. (2015). Cancer incidence and mortality worldwide: Sources, methods and major patterns in GLOBOCAN 2012. *Int. J. Cancer*, 136, 359-386. doi:10.1002/ijc.29210

[3] Piri, R., Ghaffari, A., Azami-Aghdash, S., Ali-Akbar, Y. P., Saleh, P., & Naghavi-Behzad, M. (2015). Ki-67/MIB-1 as a Prognostic Marker in Cervical Cancer - a Systematic Review with Meta-Analysis. *Asian Pacific journal of cancer prevention:APJCP*, *16*(16),6997–7002. doi:10.7314/apjcp.2015.16.16.6997

[4] Sung, H., Ferlay, J., Siegel, R. L., Laversanne, M., Soerjomataram, I., Jemal, A., & Bray, F. (2021). Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. *CA: a cancer journal for clinicians*, *71*(3), 209–249. doi:10.3322/caac.21660

[5] Vu, M., Yu, J. D., Awolude, O. A., & Chuang, L. (2018). Cervical Cancer Worldwide, Current Problems in Cancer. *Elsevier*,42(5),457-465. doi:10.1016/j.currproblcancer.2018.06.003

[6] Holman, L., & Lu, K. (2012). The Epidemiology of Endometrial Cancer. *Glob. libr. women's med.*, doi:10.3843/glowm.10236

[7] Schneider, S., Armbrust, R., Spies, C., du Bois A, Sehouli J. (2020). Prehabilitation programs and ERAS protocols in gynecological oncology: a comprehensive review. Arch Gynecol Obstet. Feb;301(2):315-326. doi: 10.1007/s00404-019-05321-7.

[8] Brasil. (2019). *Estimativa | 2020: Incidência de Câncer no Brasil*. Rio de Janeiro: Instituto Nacional de Câncer.

[9] Acosta, F. (2021). Conheça os serviços oferecidos pela Unidade de Alta Complexidade em Oncologia – Unacon. Recuperado em 16 dezembro, 2021, de https://agencia.ac.gov.br/conheca-os-servicos-oferecidos-pela-unidade-de-alta-complexidade-em-oncologia-unacon/.

[10] Silva, R. C. G., Silva, A. C. O., Peres, A. L., & Oliveira, S. R. (2018). Perfil de mulheres com câncer de colo do útero atendidas para tratamento em centro de oncologia. *Revista Brasileira de Saúde Materno Infantil*, 18(4), 703-710. doi:10.1590/1806-93042018000400002

[11] Brasil. (2016). *Diretrizes Brasileiras para o Rastreamento do Câncer do Colo do Útero.* Rio de Janeiro: Instituto Nacional de Câncer, 2 ed.

[12] Cejtin, H. E., & Schmidt, J. B. (2020). Prevalence of inadequate cervical câncer screening in low-income older women. *J Womens Health (Larchmt)*, v. 29(10), p. 1350-1353. doi:10.1089/jwh.2019.8017

[13] Thuler, L. C. S., Bergmann, A., & Casado, L. (2012). Perfil das Pacientes com Câncer do Colo do Útero no Brasil, 200-2009: Estudo de Base Secundária. *Revista Brasileira de Cancerologia*, 58(3), 351-357. doi: 10.32635/2176-9745.RBC.2012v58n3.583

[14] Kataki, A. C., Sharma, J. D., Krishnatreya, M., Baishya, N., Barmon, D., Deka, P., & Kalita, M. (2018). A survival study of uterine cervical patients in the North East India: Hospital-cancer registry-based analysis. *J Can Res Ther*, 14, 1089-93. doi:10.4103/0973-1482.184516

[15] Oliveira, B. L. C. A., & Luiz, R. R. (2019). Densidade racial e a situação socioeconômica, demográfica e de saúde nas cidades brasileiras em 2000 e 2010. *Revista Brasileira Epidemiologia*, 22: E190036. doi:10.1590/1980-549720190036

[16] Silva, D. S., Silva, A. M., Brito, L. M., Gomes, S. R., Nascimento, M. D. O. D., & Chein, M. B. (2014). Cervical cancer screening in the State of Maranhão, Brazil. *Ciência & Saúde Coletiva*, 19(1),163-70. Recuperado em 21 dezembro, 2021, de http://www.cienciaesaudecoletiva.com.br/en/articles/cervical-cancer-screening-in-the-state-of-maranhatildeo-brazil/12802

[17] Favoro, C. R. P. (2017). Perfil epidemiológico de mulheres com câncer de colo do útero atendidas em um hospital do interior paulista (Dissertação de Mestrado em Saúde Pública). Escola de Enfermagem de Ribeirão Preto, Universidade de São Paulo, Ribeirão Preto, Brasil.

[18] Lucena, L. T., Zãn, D. G., Crispim, P. T. B., & Ferrari, J. O. (2011). Fatores que influenciam a realização do exame preventivo do câncer cérvico-uterino em Porto Velho, Estado de Rondônia, Brasil. *Rev. Pan-Amazônica de Saude*, 2(2), 45-50. doi:10.5123/S2176-62232011000200007

[19] Amorim, V. M. S. L., Barros M. B. A., César, C. L. G., Carandina, L., & Goldbaum, M. (2006). Fatores associados a não realização do exame de Papanicolaou: um estudo de base populacional no Município de Campinas, São Paulo, Brasil. *Cadernos de Saúde Pública*, 22(11), 2329-2338. doi:10.1590/S0102-311X2006001100007.

[20] Donaire, B. G., Souza, S. M. P., Veras, L. P. C., & Souza, N. M. P. (2021). Avaliação do perfil epidemiológico de paciente com diagnóstico de Carcinoma Invasor de Colo Uterino. *Health Residencies Journal*, 2(10). doi:10.51723/hrj.v2i10.161

[21] Meira, K. C., Gama, S. G. N. da ., & Silva, C. M. F. P. da . (2011). Perfil de Mortalidade por Câncer do Colo do Útero no Município do Rio de Janeiro no Período 1999-2006. *Revista Brasileira de Cancerologia*, *57*(1), 7–14. doi:10.32635/2176-9745.RBC.2011v57n1.678

[22] Ikeda, A. I., Hiroyasu, I. S. O., Hideaki, T., Yoshihisa, F., & Tetsuya, M. (2007). Marital status and mortality among Japanese men and women: the Japan Collaborative Cohort Study. *BMC Public Health*, 7(73), 1-7. doi:10.1186/1471-2458-7-73

[23] Hemminki, K., & Li, X. (2003). Lifestyle and cancer: effect of widowhood and divorce. *Cancer epidemiology, biomarkers & prevention: a publication of the American Association for Cancer Research, cosponsored by the American Society of Preventive Oncology*, *12*(9), 899–904.

[24] Aggarwal, P. (2014). Cervical câncer: Can it be prevented?. *World Journal of Clinical Oncology*, 5(4), 775-80. doi:10.5306/wjco.v5.i4.775

[25] Bruni L, A. G., Serrano, B., Mena, M., Collado, J. J., Gómez, D., Muñoz, J., Bosch, F. X., & De Sanjosé, S. (2019). Human Papillomavirus and Related Diseases Report**.** Barcelona: ICO/IARC HPV Information Centre.

[26] Batista, M. G., Ramos, K. S., & Costa, C. B. A. (2017). Perfil Sociodemográfico e Clínico de Mulheres com Câncer do Colo do Útero Associado ao Estadiamento Avançado. *Rev. de Ciências da Saúde Nova Esperança*, 15(2), 77-87.

[27] Macedo, S. B., Freitas, L. E. B. R., Mendonça, L. R., Oliveira, J. L. R., Germano, L. M. M. A., & Domingues, M. T. S. (2016). *Custos do tratamento do Câncer de colo de útero sob a perspectiva das pacientes no Instituto de Medicina Integral Prof. Fernando Figueira – IMIP*. (Relatório do Programa de Bolsa de Iniciação Científica – CNPq-IMIP) – Faculdade Pernambucana de Saúde, Recife, Brasil.

[28] Dias, M., Mantovan, S. G. M., Zomkowski, K., Roussenq, S. C., Benetti, M., Sperandio, F. F., Kilian, C., & Tavares, M. G. S. (2021). Perfil Epidemiológico das Mulheres com Câncer Ginecológico: um estudo multicasos, no Sul do Brasil. *Brazilian Journal of Development*, 7(4), 37025-37035. doi:10.34117/bjdv7n4-254

[29] Malta, D. C., & Silva, J. B. J. (2013). O Plano de Ações Estratégicas para o Enfrentamento das Doenças Crônicas Não Transmissíveis no Brasil e a definição das metas globais para o enfrentamento dessas doenças até 2025: uma revisão. Epidemiologia e Serviços de Saúde, 22(1), 151-164. doi:10.5123/S1679-49742013000100016

[30] Rozario, S. do ., Silva, I. F. da ., Koifman, R. J., & Silva, I. F. (2019). Caracterização de mulheres com câncer cervical atendidas no Inca por tipo histológico. Revista de Saúde Pública, 53, 88. doi:10.11606/s1518-8787.2019053001218

[31] Instituto Nacional de Câncer - INCA. (2021). *Controle do Câncer do Colo do Útero: Fatores de Risco*. Rio de Janeiro: INCA. Recuperado em 28 março, 2021, de https://www.inca.gov.br/controle-do-cancer-do-colo-do-utero/fatores-de-risco

[32] Duarte, S. J. H., Matos, K. F., Oliveira, P. J. M., Matsumoto, A. H., & Morita, L. H. M. (2011). Fatores de risco para câncer cervical em mulheres assistidas por uma equipe de saúde da família em Cuiabá, MT, Brasil. *Ciencia y Enfermería*, 17(1), 71-80. Recuperado em 16 dezembro, 2021, de http://www.redalyc.org/articulo.oa?id=370441806008

[33] Silva, G. G. e, Furtado, L. L., Campos, A. C. A., Aviz, G. B. de, & Azevedo, V. D. C. de. (2020). Perfil do câncer do colo uterino e lesões precursoras em um ambulatório de

especialidades médicas. *Journal Health NPEPS*, *5*(2). Recuperado em 20 abril, 2022, de https://periodicos.unemat.br/index.php/jhnpeps/article/view/4639

[34] Anjos, S. J. S. B., Vasconcelos, C. T. M., Franco, E. S., Almeida, P. C., & Pinheiro, A. K. B. (2010). Fatores de risco para câncer de colo do útero segundo resultados de IVA, citologia e cervicografia. *Rev. da Escola de Enfermagem da USP*, 44(4), 912-920. doi:10.1590/S0080-62342010000400008

[35] Melo, E. M. F., Linhares, F. M. P., Silva, T. M., Pontes, C. M., Santos, A. H. S., & Oliveira, S. C. (2019). Câncer cervico-uterino: conhecimento, atitude e prática sobre o exame de prevenção. *Revista Brasileira de Enfermagem*, 72(Suppl 3), 25-31. doi:10.1590/0034-7167-2017-0645

[36] Ribeiro, C. B., Silveira, F. A., Coelho, J. M. R., & Seixas, J. A. (2021). Perfil epidemiológico das mulheres do município de Valença com lesões precursoras do câncer de colo do útero. *Revista Saber Digital*, *14*(3), 30–42. doi:10.24859/SaberDigital.2021v14n3.1196

[37] Almeida, A. P. F., & Assis, M. M. (2017). Efeitos colaterais e alterações fisiológicas relacionadas ao uso contínuo de anticoncepcionais hormonais orais. *Rev. Atualiza Saúde*, 5(5), 85-93, jan./jun. Recuperado em 16 dezembro, 2021, de https://atualizarevista.com.br/wp-content/uploads/2022/05/efeitos-colaterais-e-alteracoes-fisiologicas-relacionadas-ao-uso-continuo-de-anticoncepcionais-hormonais-orais-v-5-n-5.pdf

[38] Brasil. (2019). *Citologia em meio líquido para rastreamento de câncer de colo de útero e lesões precursoras*. Brasília: Ministério da Saúde, (497), 12-15.

[39] Instituto Nacional de Câncer - INCA. (2021). *Detecção precoce do câncer*. Rio de Janeiro: INCA. Recuperado em 19 outubro 2021, de https://www.inca.gov.br/publicacoes/livros/deteccao-precoce-do-cancer.

[40] Líbera, C. L. D., Teixeira, L. A. F., Almeida, D. A., & Zeferino, M. G. M. (2012). Avaliação do perfil e o conhecimento ds mulheres sobre o exame citopatológico no município de São Sebastião do Paraíso - MG. *Revista de Iniciação Científica da Libertas*, 2(2), 85-99. Recuperado em 19 outubro 2021, de http://www.libertas.edu.br/revistas/index.php/riclibertas/article/view/30/0

[41] Camargo, A.C. (2020). Centro Integrado de Diagnóstico, Tratamento, Ensino e Pesquisa. *Cartilha: Câncer do colo do útero*. Recuperado em 16 dezembro, 2021, de https://accamargo.org.br/sites/default/files/2020-07/cartilha_cancerdecolodeutero.pdf

[42] Mesquita, A. D. de, Teles, K. K. N., Silva, S. C. B. da, da Silva, F. R., Lima, L. K. C., Costa, R. S. L. da, & Arruda, E. F. de. (2020). Conhecimentos, atitudes e práticas de mulheres frente ao exame preventivo do câncer do colo uterino/ Knowledge, attitudes and practices of women in the face of preventive cervical cancer test/ Conocimiento, actitudes y practicas de mujeres en la cara. *Journal Health NPEPS*, *5*(1), 261–275. Recuperado em 16 dezembro, 2021, de https://periodicos.unemat.br/index.php/jhnpeps/article/view/4184

[43] Andrade, M. S, Almeida, M. M. G., Araújo, T. M., & Santos, K. O. B. (2014). Fatores associados a não-adesão ao Papanicolau entre mulheres atendidas pela Estratégia Saúde da Família em Feira de Santana – Bahia, 2014. *Rev. Epidemiologia e Serviços de Saúde*, 23(1), 111-20. doi:10.5123/S1679-49742014000100011

[44] Ferreira, E. S., Paranhos, S. B., Margotti, E., Silva, S. M. & Barboza, S. C. (2020). Os motivos de não-adesão ao exame preventivo de câncer de colo uterino e ações educativas em uma região marajoara. *Enfermagem Brasil*, 19(2), 130-137. doi:10.33233/eb.v19i2.3118

[45] Bhatla, N., Aoki, D., Sharma, D. N., & Sankaranarayanan, R. (2018). Cancer of the cervix uteri. *International Journal of Gynecology & Obstetrics*, 143 (2), 22-36. doi:10.1002/ijgo.12611

[46] Thuler, L. C. S., Aguiar, S. S., & Bergmann, A. (2014). Determinantes do diagnóstico em estádio avançado do câncer do colo do útero no Brasil. *Revista Brasileira de Ginecologia e Obstetrícia*, 36(6):237-43. doi:10.1590/S0100-720320140005010

International Journal of Advanced Engineering Research and Science (IJAERS)
Peer-Reviewed Jounal
ISSN: 2349-6495(P) | 2456-1908(O)
Vol-10, Issue-4; Apr, 2023
Journal Home Page Available: https://ijaers.com/
Article DOI: https://dx.doi.org/10.22161/ijaers.104.2

Association of bacterial vaginosis to atypia in squamous cells of the cervix

Associação da vaginose bacteriana a atipias em células escamosas do colo uterino

Natalia Ferreira Carvalheiro[1], Jacinto da Costa Silva Neto[2], Julliano Matheus de Lima Maux[2], Luciano Lobo Gatti[1], Gabriel Vitor da Silva Pinto[1]

[1]Centro Universitário de Ourinhos – UNIFIO.
[2]Universidade Federal de Pernambuco, Centro de Ciências Biológicas.

Received: 27 Feb 2023,

Receive in revised form:25 Mar 2023,

Accepted: 03 Apr 2023,

Available online: 11 Apr 2023

***Palavras-chave*— Câncer Cervical; Gardnrella vaginalis; HPV; Infecção; Microbiota Vaginal.**

***Keywords*— Cervical Cancer; Gardnerella vaginalis; HPV; Infection; Vaginal Microbiota.**

***Abstract*—** *Considered the sexually transmitted infection (STI) with the highest incidence worldwide, HPV in 1992 was recognized by the WHO as a necessary condition for the development of cervical cancer (CC). Its transmission occurs by direct contact with the squamous epithelium of the skin and mucosa, which can cause benign lesions such as warts and papillomas or malignant lesions such as neoplasia. In balance, the vaginal microbiota consists mainly of gram positive bacilli that have the function of maintaining the health of the genital tract, in addition to preventing infections caused by pathogenic microorganisms. The aim of the present study is to correlate changes in the vaginal microbiota with atypical changes in cervical squamous cells. This is an exploratory literature review of 15 articles found in the search sources Scientific Electronic Library Online (SCIELO), Google Scholar, Lilacs, using keywords "Atypias in Squamous Cells", "HPV", "Cancer of the Cervix", "Vaginal Microbiota". The imbalance of the normal microbiota can occur due to internal and external factors that provide the total or partial replacement of this environment by other types of bacteria, highlighting the role of Gardnrella vaginalis, which causes bacterial vaginosis (BV). Studies suggest that the presence of BV may be a cofactor for HPV infection. According to some authors, the composition of the vaginal microbiota associated with infection by the HPV virus can be explained by conditions of alkalinization of the vaginal pH, increasing susceptibility to sexually transmitted infections, which automatically increases the risk of HPV infection. In a study carried out in London, it was revealed that women with the presence of BV and, respectively, a reduction in Lactobacillus ssp., associated with the worsening of the disease, represent a greater risk of developing precursor lesions of CC. Given the above, it was possible to establish a relationship between changes in the vaginal microbiota and atypical cellular changes in the cervix. In this way, it was verified the importance of the stable vaginal microbiota for the health of the uterus, and that in conditions of imbalance, it provides an inhospitable environment for the normal microbiota, favoring the proliferation of*

bacteria that make the vaginal environment susceptible to HPV infections. This, in turn, promotes precursor lesions, which, when not diagnosed and treated in time, can result in the development of invasive cervical lesions.

Resumo *— Considerada a infecção sexualmente transmissível (IST) de maior incidência mundial, o HPV em 1992 foi reconhecido pela OMS como condição necessária para o desenvolvimento do câncer cervical (CC). Sua transmissão ocorre por contato direto com o epitélio escamoso da pele e mucosa, a qual pode causar lesões benignas como verrugas e papilomas ou malignas como neoplasia. Em equilíbrio a microbiota vaginal é constituída principalmente de bacilos gram positivos que possuem como função a manutenção da saúde do trato genital, além de prevenir infecções causadas por microrganismos patogênicos. O objetivo do presente estudo é correlacionar as alterações na microbiota vaginal com alterações atípicas em células escamosas do colo uterino. Trata-se de uma revisão da literatura, de caráter exploratório de 15 artigos encontrados nas fontes de busca Scientific Eletronic Library Online (SCIELO), Google Acadêmico, Lilacs, utilizadas palavras-chave "Atipias em Células Escamosas", "HPV", "Câncer do Colo do Útero", "Microbiota vaginal". O desequilíbrio da microbiota normal pode ocorrer devido a fatores internos e externos que proporcionam a substituição total ou parcial deste ambiente por outros tipos de bactérias, destacando o papel da Gardnrella vaginalis, a qual ocasiona a vaginose bacteriana (VB). Estudos sugerem que a presença de VB pode ser um cofator para a infecção por HPV. Segundo alguns autores a composição da microbiota vaginal, associado a infecção pelo vírus do HPV pode ser explicada por condições de alcalinização do pH vaginal, aumentando a susceptibilidade a infecções sexualmente transmissíveis, que, automaticamente, eleva o risco de infecção por HPV. Em um estudo realizado em Londres, revelou que mulheres com presença de VB e, respectivamente, redução de Lactobacillus ssp., associado ao agravamento da doença, representa um risco maior a desenvolver lesões precursoras do CC. Diante do exposto, foi possível estabelecer relação entre as alterações da microbiota vaginal com as alterações celulares atípicas do colo uterino. Desta forma, verificou-se a importância da microbiota vaginal estável para a saúde do útero, e que em condições de desequilíbrio, proporciona um ambiente inóspito para a microbiota normal, favorecendo a proliferação de bactérias que tornam o ambiente vaginal susceptível a infecções por HPV. Esta por sua vez, promove lesões precursoras, que quando não diagnosticadas e tratadas a tempo, podem resultar no desenvolvimento de lesões cervicais invasivas.*

I. INTRODUÇÃO

A prevalência de lesões cervicais do colo do útero varia de acordo com a região geográfica e o nível socioeconômico. De acordo com a OMS, os países com as taxas mais altas de câncer do colo do útero são aqueles de baixa renda. Em 2020, estima-se que 604.000 mulheres foram diagnosticadas com câncer cervical em todo o mundo. Cerca de 342.000 mulheres morreram da doença. O número de mortes por ano é projetado para atingir globalmente aproximadamente 416.000 mulheres em 2035 (WHO, 2021). O câncer cervical representa um dos cânceres mais evitáveis da atualidade, e a cada 2 minutos uma mulher morre em decorrência dessa doença (Beddoe, 2019).

No Brasil, o câncer do colo do útero é o terceiro tipo de câncer mais comum em mulheres, com uma estimativa de 16.590 novos casos para cada ano do triênio 2020-2022, com um risco estimado de 15,43 casos a cada 100 mil mulheres de acordo com o Instituto Nacional de Câncer (INCA), sendo o segundo mais incidente nas Regiões Norte

(21,20/100 mil), Nordeste (17,62/100 mil) e Centro-Oeste (15,92/100 mil) do país sem considerarmos o câncer de pele não melanoma. Além disso, em 2017, foram registrados 6.385 óbitos por câncer do colo do útero no país (INCA, 2021).

A OMS em 1992 reconheceu o Papilomavírus humano (HPV) como condição necessária para o desenvolvimento do câncer cervical. Considerada a infecção sexualmente transmissível (IST) de maior incidência mundial, estima-se que exista aproximadamente cerca de 630 milhões de pessoas infectadas pelo vírus no mundo todo (WHO, 2016). O HPV refere-se a um vírus DNA que afeta o trato anogenital, podem ser de baixo e alto risco oncogênico, os do tipo de baixo risco estão relacionados ao desenvolvimento lesões benignas como condilomas genitais e, enquanto os de alto risco estão associados a lesões intraepiteliais escamosas de alto grau e aos carcinomas. (Muñoz, 2003; Carvalho *et al*. 2021).

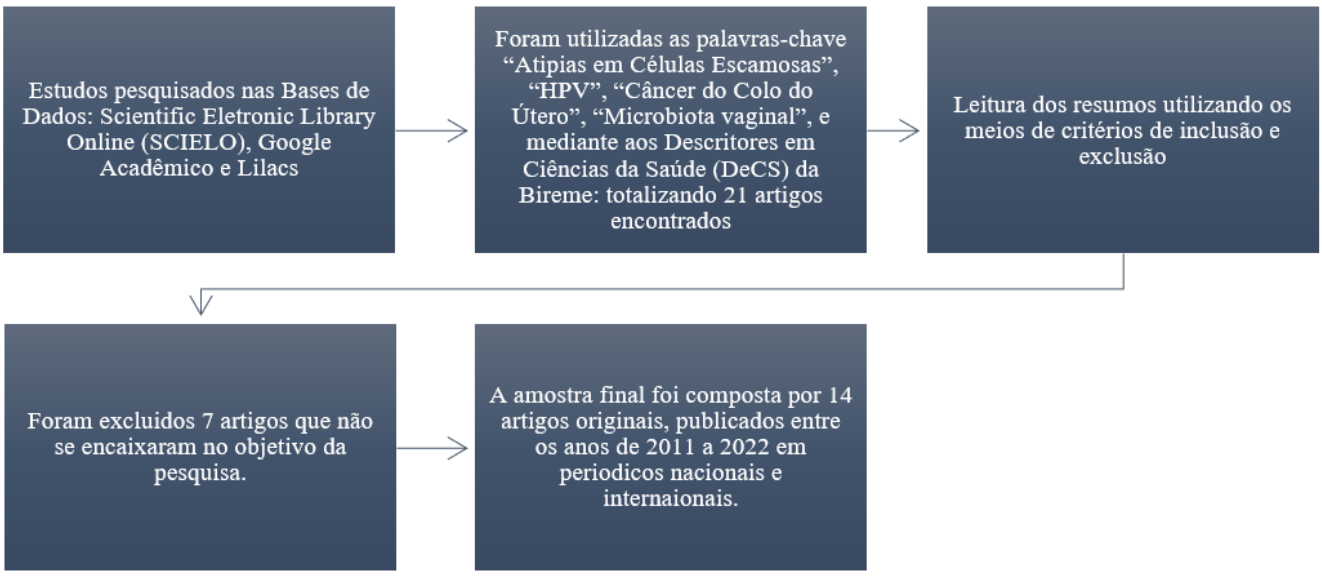
O rastreamento do câncer do colo uterino é feito através do exame Papanicolau (Haider *et al*., 2013). O material analisado é coletado por meio de uma raspagem nas regiões da endocérvice e ectocérvice, a qual busca identificar alterações nucleares e citoplasmáticas de caráter pré-canceroso, além de conseguir reconhecer agentes da microbiota vaginal e associá-los a reatividades celulares, mesmo que não seja seu principal objetivo. (Halford, 2002; American Cancer Society, 2022).

A microbiota vaginal é constituída principalmente de bacilos gram positivos que possuem como principal função a manutenção da saúde do trato genital, com a finalidade de prevenir infecções causadas por microrganismos patogênicos. (Machado *et al*., 2016). O desequilíbrio deste ambiente ou qualquer alteração relacionada a sua composição pode favorecer a proliferação destes microrganismos e por consequência, junto a outros fatores, provocar alterações celulares. (Murray *et al*., 2011).

Apesar de ter grande representatividade na saúde e no bem estar da mulher, a atuação da microbiota como fator protetor e/ou auxiliador de lesão cervical é assunto pouco discutido e divulgado, ocasionando em escassos trabalhos científicos que tratam de indicativos dessa possível associação. Por isso, o correto diagnóstico, manejo e tratamento destas alterações pode ser negligenciado, tendo sua conduta baseado exclusivamente em critérios clínicos. O objetivo do presente estudo é correlacionar as alterações na microbiota vaginal com atipias em células escamosas do colo uterino.

II. METODOLOGIA

Trata-se de uma revisão da literatura, de caráter exploratório. As fontes de busca usadas na seleção dos artigos foram às bases de dados: Scientific Eletronic Library Online (SCIELO), Google Acadêmico e Lilacs. Para a busca dos artigos foram utilizadas palavras-chave “Atipias em Células Escamosas”, “HPV”, “Câncer do Colo do Útero”, “Microbiota vaginal”, selecionadas mediante consulta aos Descritores em Ciências da Saúde (DeCS) da Bireme: materiais de ensino, microbiologia e educação superior (teaching materials, microbiology, education higher/ materiales de enseñanza, microbiología, educación superior). A partir das combinações desses descritores, foram localizadas 21 publicações. Para seleção dos artigos foi realizada, inicialmente, a leitura dos resumos das publicações com o objetivo de refinar a amostra por meio de critérios de inclusão e exclusão.



Como critérios de inclusão foram selecionados artigos em língua portuguesa e inglesa com texto completo disponível. Foram excluídos da pesquisa artigos em outras línguas, artigos cuja população estudada incluía gestantes e mulheres que estavam em uso de antimicrobianos sistêmicos ou tópicos nos últimos 30 dias, além de artigos de revisão narrativa. Foram incluídos artigos originais publicados entre 2011 a 2022 em periódicos nacionais e internacionais que apresentaram informações sobre as palavras chaves descritas acima. Foram excluídos artigos que não se encaixaram no objetivo da pesquisa. A amostra final foi composta por 14 artigos.

III. DESENVOLVIMENTO

Caracterização da microbiota vaginal e o diagnóstico da vaginose bacteriana

A microbiota vaginal desempenha um papel importante na manutenção da saúde do aparelho reprodutor feminino. Essa, quando saudável, é considerada uma importante barreira biológica contra microrganismos patogênicos. O principal constituinte responsável pela microbiota normal é o *Lactobacillus spp* (lactobacilos aeróbicos e anaeróbicos), compondo predominantemente 95% da microbiota normal, apresentando também com frequência significante *Peptococcus spp, Staphylococcus epidermidis, Corynebacterium vaginale, Gardnerella vaginalis, Mobiluncus spp., Bacteroides spp, Eubacterium spp, Escherichia coli, Streptococcus spp*, entre outras. (Silvino *et al*., 2006; Nardis *et al*., 2013).

Os *Lactobacillus spp* são capazes de converter o glicogênio produzidos pelas células escamosas em ácido lático, transformando o pH vaginal ácido (pH 3 à 4,5). Esta acidez serve como proteção ao ambiente vaginal, dificultando a entrada e proliferação de microrganismos, diminuindo a ocorrência de processos inflamatórios e alterações celulares que podem causar doenças. (Gajer *et al*., 2012; Lee *et al*., 2013).

O desequilíbrio da microbiota normal pode ocorrer devido a fatores internos, sejam eles por variações hormonais, sistema imunológico e estado emocional, além de fatores externos, como o uso de anticoncepcionais, dieta, tabagismo, hábito higiênico íntimo, ducha vaginal, múltiplos parceiros, relação sexual entre mulheres e ausência do uso de preservativos. (Bagnall & Rizzolo, 2017).

A substituição total ou parcial desta microbiota pode ocorrer por outros tipos de bactérias, primordialmente a espécie *Gardnerella vaginalis*, sendo o agente etiológico da vaginose bacteriana (VB) pelas alterações causadas pela mesma (Teixeira, 2018; Marconi *et al*., 2015; Luchiari *et al*., 2016).

Porém outros agentes microbianos também podem estar associados a esta substituição, assim como os *Mobiluncus spp*, *Mycoplasma hominis*, os protozoários *Trichomonas vaginalis* e os fungos *Candida spp*. (Lessa *et al.* 2012).

O exame físico da VB se caracteriza pela presença de corrimento branco-acinzentado, homogêneo e com odor fétido (cheiro de peixe). (Bagnall & Rizzolo, 2017). Estas caraterísticas estão associadas a processos que ocorrem durante a VB, como a liberações de aminas e ácidos orgânicos que levam a esfoliação das células epiteliais da vagina que, juntamente com a presença do pH básico, faz com que a *Gardnrella vaginalis* possua a capacidade e aderência a membrana das células, formando as *clue-cells* (Figura 1). (Ferrada, 2012).

A bacteriscopia pós-coloração de GRAM realizada em esfregaços cérvico-vaginal é o método mais aplicado pelos laboratórios no diagnóstico de vaginose bacteriana, juntamente com o sistema de classificação definido por Nugent *et al.,* (1991) são considerados padrão ouro. No *score* de NUGENT, para cada morfotipo bacteriano é quantificado e pontuado em uma escala de 0 a 10, valores acima de 7 são considerados positivos para VB, entre 0 a 3 considerada microbiota normal e de 4 a 6 classificada como microbiota intermediária. (Filho *et al*., 2010).

Apesar de ser um exame preventivo, com o objetivo de analisar as características citomorfológicas do colo uterino e graduar suas alterações celulares, o método de Papanicolau tem potencial para diagnosticar VB, assim como observar outros microrganismos. (Filho *et al*., 2010).

3.2 Vaginose bacteriana e risco de infecção pelo Papilomavirus Humano

Existem mais de 200 genótipos do vírus do HPV, sendo que cerca de 60 tipos podem infectar o trato anogenital, os mais frequentes de alto risco oncogênico são os do tipo 16 (maior tempo de *clearance*) e 18 (Febrasgo, 2021). O HPV é transmitido através do contato direto com a pele ou mucosa infectada, que, ao interagir com as células epiteliais, leva a formação de lesões na região perianal, além de uma causa cada vez mais importante de câncer de cabeça e pescoço (Bosch & de Sanjosé, 2003; D'Souza *et al*., 2014; Aksoy *at al.* 2017; Galati *et al*., 2022).

Estas lesões podem ser benignas, sendo estas formações de verrugas e papilomas; ou malignas, como neoplasias. Entretanto, a atuação exclusiva do HPV não é suficiente para o desenvolvimento neoplásico, sendo necessário a atuação de outros fatores associados a este, assim como o tipo viral, coinfecção com outros patógenos

(alteração da microbiota vaginal) predisposição genética, fatores externos entre outros. (Schiffman *et al.*, 2016; Teixeira, 2018).

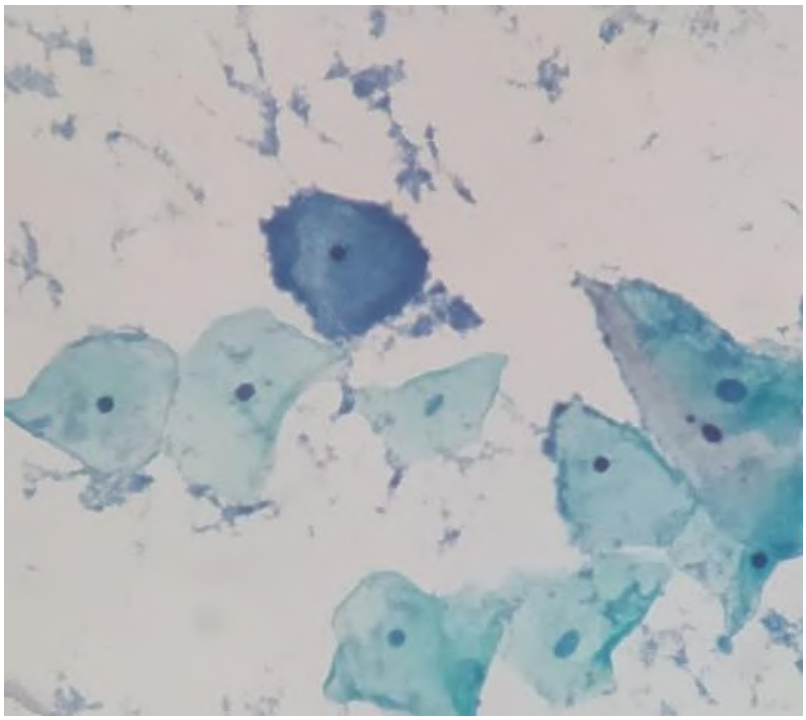


Fig.1: Clue-cells.

Fonte: elaborado pelo autor (2023).

Com alta capacidade de escape, o vírus consegue atravessar o epitélio mais superficial do colo do útero e penetrar nas camadas mais profundas do tecido epitelial, sem ser detectado pelo sistema imune do hospedeiro. O vírus pode atuar de duas formas no organismo, a primeira utiliza do hospedeiro para produzir suas cópias virais, aumentando assim a carga viral circulante, e a segunda forma o vírus se integra ao DNA do hospedeiro expressando suas oncoproteinas, dando início a um processo oncogênese. (Zur Hausen, 2002).

O vírus do HPV penetra através de microfissuras ou lesões presente no epitélio escamoso do colo (Figura 2), se adere ao interior das células epiteliais mais profundas, a qual pode permanecer em latência, ou iniciar o processo de amplificação viral e diferenciação da célula hospedeira. (Doorbar, *et al.* 2012).

O potencial oncogênico do HPV está intimamente ligada aos genes E6 e E7 responsáveis por codificar suas oncoproteínas que inativam os supressores tumorais p53 e a proteína do Retinoblastoma (pRB) da célula infectada. Estas proteínas conseguem interferir na transformação e imortalização celular, resultando no desenvolvimento de neoplasias. (Münger; Howley, 2002).

A infecção pelo HPV está intimamente ligada ao desenvolvimento de lesões precursoras e do câncer do colo do útero, contudo as alterações microbiológicas no ambiente vaginal podem contribuir na evolução destas lesões. Estas alterações compreendem na presença de ISTs como a triconomíase provocada pela *Trichomonas vaginalis* e vaginoses bacterianas, estas causadas pelo aumento de bactérias anaeróbias (Misra *et al*., 2009; Rodriguez *et al*, 2012).

Segundo alguns autores, a composição da microbiota vaginal, associado a infecção pelo vírus do HPV pode ser explicada por duas condições: o primeiro refere a alcalinização do pH vaginal, aumentando a susceptilbilidade a ISTs, que, automaticamente, eleva o risco de infecção por HPV (Huh, 2009; Teixeira, 2018), e a segunda relaciona o desenvolvimento de bactérias patogênicas com as lesões causadas pelo HPV na mucosa vaginal. (Watts *et al*., 2005; Teixeira, 2018).

Estudos sugerem que a presença de VB pode ser um cofator que auxilia a infecção por HPV, tornando ambiente vaginal mais susceptível ao vírus (Gao *et al.*, 2013; Pereira, 2018). Shannon *et al* (2017) sugerem que exista um aumento de 60% na infecção por HPV em mulheres com VB associada.

Em estudo realizado por Teixeira (2018), de 80 amostras analisadas, 17 casos eram de mulheres portadoras HPV, e destas, 12 apresentaram VB. Segundo Gao *et al*., (2013) e Lin *et al.*, (2018) a microbiota vaginal destas mulheres apresentam padrões caraterísticos que levam ao desenvolvimento de uma microbiota mais heterogênea e com bactérias prevalentes, como a *Gardnerella vaginalis*, *Lactobacillus gasseri*, *Lactobacillus gallinarum e Lactobacillus iners*.

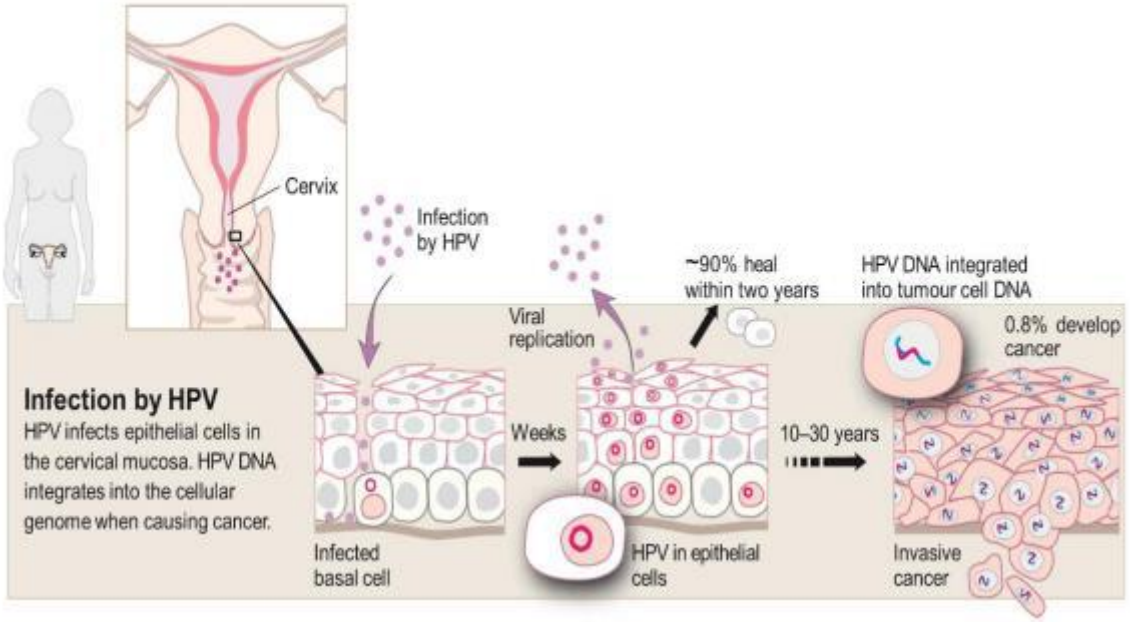


Fig2: Mecanismo de infecção do HPV.

Fonte: The Nobel Committee for Physiology or Medicine 2008, Harald zur Hausen, Françoise Barré-Sinoussi, Luc Montagnier.

3.3 Vaginose bacteriana, persistência e *clearance* do vírus HPV

Existem fatores determinantes que podem estar relacionados a persistência do HPV no organismo, assim como a imunossupressão, infecção pelo Vírus da Imunodeficiência Humana (HIV), mulheres com idade avançada, tabagismo e VB. (Cruz & Melo, 2010).

Quando a infecção pelo HPV persiste, pode ocorrer o desenvolvimento de ASC-US (*atypical squamous cells of undetermined significance*) ou LSIL (*low-grade squamous intraepithelial lesion*) são categorias de lesões cervicais induzidas pelo vírus, ASC-US é uma categoria de diagnóstico citológico que se refere à presença de células escamosas atípicas no esfregaço cervical, mas sem a presença de células sugestivas de lesão intraepitelial escamosa de baixo grau LSIL ou de alto grau (HSIL). Já LSIL é uma categoria de diagnóstico que se refere à presença de células escamosas anormais, porém com alterações celulares limitadas a um terço ou menos da espessura do epitélio (Trottier & Franco, 2006). Caso o vírus persista, pode desenvolver lesão do tipo HSIL e o carcinoma cervical invasivo, como consequência, a não eliminação viral. (Koshiol *et al*., 2008; INCA, 2021).

Estudos sugerem que o desvio de flora vaginal possui papel significativo no desenvolvimento de lesões intraepiteliais causadas pelo HPV, em especial associados à espécie de *Gardnerella vaginalis,* presentes na maioria dos casos HPV positivo. (Di Paola *et al.*, 2017).

A *Gardnerella vaginalis* possui fatores de virulência importantes no processo de infecção e permanência desta bactéria no ambiente vaginal, com capacidade de produzir enzima específica (sialidase), responsável por degradar o ácido siálico das células epiteliais, facilitando a adesão da bactéria na superfície das células. (Swidsinski *et al*, 2005; Lewis *et al*, 2012). Com a adesão, inicia a formação de um biofilme, que irá favorecer a proteção destas bactérias contra a ação de compostos liberados pelos *Lactobacillus sp*., desta forma torna-se viável a sobrevida e permanência destes microrganismos ao epitélio vaginal. (Severi *et al*., 2007; Hardy *et al*., 2017).

Estudos sugerem que o gene codificador da enzima sialidase, produzido pela *Gardnerella_vaginalis*, esteja associado a persistência do HPV no organismo (Di Paola *et*

al.2017). Achados reforçam o efeito negativo da microbiota vaginal alterada para a eliminação do dos genótipos de HPV 16 e 18 e indicam uma possível associação entre espécies produtoras de sialidase com a persistência viral, porém estudo realizado por Belleti (2022) tenha sido estatisticamente significativo.

A presença de VB provoca o aumento de interleucina-10 (IL-10), capaz de interferir negativamente na resposta das células T CD4+ Th1, importante na resposta imune contra o vírus do HPV, que em condições normais, favorece a fagocitose da célula infectada (Cohen *et al*. 1999; El-Sherif *et al.* 2001). No trabalho realizado por Campos (2011), de 173 mulheres estudadas, 47 apresentaram VB e 47 apresentam infecções pelo HPV, destes 47 casos positivos para VB, 41 amostras foi observada *clue cells*, característico de *Gardnerella vaginalis*, porém foram confirmados apenas 43 casos através da cultura. Deste grupo (VB provocada por *Gardnerella vaginalis*) 11 mulheres possuíam HPV, e ao dosarem as citocinas, confirmar a presença de IL-2, IL-6, IL-10, IL-12, IFN-γ e TNF-α.

A infecção por *Chlamydia trachomatis* também tem sido associado à persistência do HPV, sua entrada no hospedeiro gera um processo inflamatório e promove um ambiente propício (quadro inflamatório crônico) à infecção e persistência do vírus e, consequentemente, lesão cervical. (Silins, 2005). Segundo Bautista *et al*., (2016), a ocorrência de VB em mulheres tem se mostrado um fator importante para a infecção por *Chlamydia trachomatis.*

3.4 Disbiose e fator de risco para a infecção do HPV

A infecção e persistência de alguns tipos virais do HPV, juntamente com alteração da microbiota vaginal, são condições necessárias para o desenvolvimento do câncer do colo do útero. (Ferraz *et al*, 2012; Zeferino *et al*, 2006; Zattoni *et al*, 2013).

A VB é considerada a principal disbiose da microbiota vaginal, onde a microbiota é predominantemente substituída por outros tipos de bactérias. (Muzny, 2019).

A partir de resultados obtidos em um estudo realizado em Londres, Mitra (2016), revelou que mulheres com presença de VB e respectivamente, com redução de *Lactobacillus ssp*., associado ao agravamento da doença, representa um risco maior a desenvolver LSIL e HSIL. Resultado similar em estudo um realizado por Baisley *et al*., (2020) em meninas adolescentes na Tanzania a qual associaram a presença de bactérias como *Gardnerella vaginalis* e *Atopobium vaginae* e a redução de *Lactobacillus spp* na microbiota vaginal, com infecções por HPV.

Além disso, Mitra (2016) associa a disbiose, provocada pela VB e pela infecção do HPV, responsáveis por induzir um ambiente propício e favorável para integração do DNA viral ao genoma humano, resultando em especial, o aumento das proteínas E6 e E7, responsáveis pela transformação celular.

Segundo Silva *et al*., (2014) a VB isoladamente poderia não ser responsável pela infecção do HPV e resultante do aparecimento de lesões precursoras, porém é considerável aceita-la como um dos co-fatores de risco, assim como o tabagismo, imunossupressão e diversos parceiros sexuais. Estes cofatores facilitam a evolução da LSIL, HSIL e propriamente o câncer cervical invasivo.

Um estudo que analisou 2.000 mulheres, observou uma maior prevalência da infecção pelo HPV em mulheres com VB comparadas a mulheres com microbiota normal, observaram ainda uma maior associação a genótipos de HPV de alto risco, destacando os tipos 51 e 52, sugerindo que estratégias de prevenção, diagnóstico e tratamento adequado das alterações de microbiota não devem ser negligenciadas. (Wenyu *et al*. 2021).

Por fim, uma revisão sistemática e meta-análise publicada em 2012 avaliou 21 estudos que investigaram a associação entre VB e câncer do colo do útero. Os resultados mostraram que mulheres com VB tinham um risco maior de desenvolver câncer do colo do útero em comparação com mulheres sem a condição (Gillet *et al*. 2012).

IV. RESULTADOS

QUADRO/TABELA DE RESULTADOS

O estudo resultou em 14 artigos que visam elucidar a importância da microbiologia como fator facilitador de atipia.

Autor/ano[ref]	Metodologia	Resultados/achados	Conclusão
Baisley *et al* /2020	Pesquisa Experimental	Das 385 meninas que participaram do estudo, foi detectado HPV em 125 (com e sem sexo anterior). Os genótipos de alto risco em 70 meninas com infecção por HPV, a qual o	A prevalência de HPV entre meninas adolescentes na época do início da vida sexual foi alta. No entanto, a prevalência da maioria

		genótipo mais comum foi o HPV-16 (presente em 15 meninas). Das 186 meninas que não relataram sexo anterior, 32 tinham HPV detectável. Os *Lactobacillus* sp e bactérias associadas à vaginose bacteriana foram associadas negativa e positivamente, respectivamente, com o HPV.	dos genótipos vacinais foi baixa, indicando que estender a faixa etária da vacinação contra o HPV nessa região pode ser custo-efetivo.
Belleti, *et al* /2020	Pesquisa Experimental	Dos cinco grupos associados, os L*actobacillus* representou o gênero mais abundante da microbiota cérvico-vaginal nos três grupos, enquanto sua diminuição devido ao crescimento de bactérias anaeróbicas (gêneros *Gardnerella* , *Prevotella* , *Atopobium* , *Escherichia/Shigella* e *Streptococcus* , associados à vaginose bacteriana) também foi observado em três grupos.	O grupo IV - caracterizada por possuir baixa concentração de *Lactobacillus* spp. e maior proporção de bactérias anaeróbicas foi considerada como fator de risco para a persistência do HPV e o *Atopobium spp* e o gene da sialidase de *G. vaginalis* como marcadores microbianos da persistência do HPV.
Brotman *et al* / 2014	Pesquisa Experimental	De um total de 937 amostras, em média 29 amostras, apresentaram prevalência de HPV. A comunidades bacterianas vaginais dominadas por *Lactobacillus gasseri* tiveram a taxa de remissão de HPV mais rápida, e uma baixa comunidade de *Lactobacillus* com altas proporções do gênero *Atopobium* teve a taxa mais lenta em comparação com comunidades bacterianas vaginais dominadas por *L. crispatus*	A microbiota vaginal dominada por *L. gasseri* foi associada ao aumento da depuração de HPV detectável. A amostragens longitudinais frequentes são necessárias para avaliação da associação entre detecção de HPV e microbiota.
Campos, A. C /2011	Pesquisa Experimental	Foram identificados 47 casos de vaginose bacteriana. A presença de pH vaginal > 4,5 mostrou resultado significativo ao aparecimento de HPV, ao se analisar a regressão logística multivariada, os fatores de risco independentes para a presença de vaginose bacteriana foram: ter mais de um parceiro sexual nos últimos 5 anos e ter mais de 3 relações sexuais por semana. Já na presença de HPV os fatores independentes foram: estado civil casado e pH 4,5. Verificou-se através da dosagem das citocinas que as IL-2 e IL-12 mostraram maior concentração nos	Concluiu-se que na análise univariada que ter mais de um parceiro sexual nos últimos 5 anos e realizar mais de 3 relações sexuais por semana são fatores independentes associados à VB e a alcalinização da vagina provavelmente seja um fator predisponente às infecções pelo HPV e a resposta imune

		casos de mulheres com vaginose bacteriana e HPV.	
Gao, W. *et al* /2013	Estudo transversal	Foram encontrados maior diversidade biológica na microbiota vaginal de mulheres com HPV positivo *Lactobacillus*, incluindo *L. gallinarum, L. iners e L. gasseri*, foi o gênero predominante detectado em todas as mulheres. Nenhuma diferença foi pontuada entre mulheres HPV positivas e HPV negativas. A *Gardnerella vaginalis* também foi encontrada em maior frequência em mulheres HPV positivo.	Em comparação com mulheres HPV-negativas, a diversidade bacteriana da microbiota vaginal de mulheres HPV-positivas é mais complexa e diferenciada.
Gillet, E *et al* / 2012	Revisão Sistemática e Metanálise	Dos 329 artigos, foram selecionados 17 estudos transversais e 2 estudos de incidência.	Embora a maioria dos estudos fosse transversal e a heterogeneidade fosse alta, esta meta-análise confirma uma conexão entre vaginose bacteriana neoplasia intra-epitelial cervical.
Mitra *et al*./2016	Pesquisa Experimental	A análise dos grupos revelou aumento na prevalência de microbiota diversa e diminuição de Lactobacillus spp. com aumento da gravidade da doença, independentemente do tipo de HPV. A microbiota vaginal em HSIL foi caracterizado por níveis mais altos de *Sneathia sanguinegens* e *Peptostreptococcus anaerobius* e níveis mais baixos de *Lactobacillus jensenii* em comparação com LSIL.	Os resultados sugerem que o avanço da gravidade da lesões intraepiteliais cervical está associado ao aumento da diversidade da microbiota vaginal e pode estar envolvido na regulação da persistência viral e progressão da doença.
Mitra *et al*./2020	Pesquisa Experimental	Foram usados o sequenciamento de DNA bacteriano de amostras vaginais de 87 mulheres entre 16 a 26 anos com lesões intraepiteliais cervical não tratadas para determinar se a composição da microbiota vaginal afeta as taxas de regressão da lesão ao longo de 24 meses.	Foi demonstrado que as mulheres com um microbioma dominante de *Lactobacillus* no início do estudo têm maior probabilidade de ter doença regressiva em 12 meses. A redução de *Lactobacillus* spp. junto a presença de espécies do tipo *Megasphaera, Prevotella timonensis* e *Gardnerella vaginalis* estão associados com persistência de lesões intraepiteliais cervical e regressão mais lenta.

Santella, B *et al* /2022	Pesquisa Experimental	Das 31 mulheres (HPV positivo e negativo) recrutadas para o estudo, o principal filos identificados na microbiota vaginal destas, foram *Firmicutes, Bacteroidetes , Proteobacteria* e *Acti nobacteria* . O filo de *Actinobacteria , Proteobacteria e Bacteroides* foi mais representado em pacientes com HPV positivo. *Lactobacilli* representou o gênero dominante, com uma alta porcentagem. *Gardnerella vaginalis , Enterococcus spp., Staphy lococcus spp., Proteusspp*., e *Atopobium* foram os mais representados em pacientes com HPV positivo.	Uma microbiota vaginal alterada pode desempenhar um papel funcional na infecção cervical, progressão e eliminação do HPV.
Shannon *et al* /2017	Pesquisa Experimental	Das 59 mulheres que participaram do estudo, 36 era HPV negativo e 23 eram positivo, destas 13 eram do tipo de HPV de alto risco. Após 6 meses de acompanhamento, apenas 21 dos pacientes HPV positivo compareceram , destes 11 eram HPV negativos (grupos eliminação), 8 ainda estavam infectados pelo mesmo subtipo de vírus e 2 eliminaram um subtipo de HPV mas foram infectados recentemente ou persistentemente por outro subtipo.	A eliminação do HPV foi associada ao aumento das células de *Langerhans* e a infecção pelo HPV com as quimiocinas IP-10 e MIG elevados. Indivíduos com HPV apresentaram com mais frequência a microbiota cérvico-vaginal com mais diversidade e menos propensos a ter predominancia de *L. gasseri* como microbiota.
Silva, B. L *et al* /2014	Estudo Exploratório, Documental, com abordagem Quantitativa	A cobertura do Papanicolau foi de 26,59%. A Candida sp foi mais prevalente nas mulheres <25 anos, já *Gardnerella vaginalis*, *Trichomonas vaginalis* e HPV a ocorrência foi semelhante nas mulheres <25 e de 25-59 anos.	A cobertura do Papanicolau foi inferior ao preconizado e as ações preventivas não atenderam as necessidades locais, pois os dois grupos apresentaram-se igualmente vulneráveis ao câncer de colo de útero, denotando a necessidade de ampliar a faixa etária preconizada
Teixeira, P /2018	Estudo transversal	Os resultados mostraram prevalência de vaginose de 32,5% utilizando o método de bacterioscopia pós-coloração de Gram e 27,7% utilizando o método citológico, com uma concordância de 90,1% entre os métodos. Os fatores de risco relacionados com o desenvolvimento	O método citológico é eficaz e aplicável ao diagnóstico de vaginose, sendo os fatores de risco para essa doença o uso de DIU, o tabagismo e o histórico prévio de vaginose. Os patógenos

		de vaginose foram: tabagismo, uso de DIU e histórico prévio de vaginose. Não foi detectada a presença de *Chlamydia trachomatis* pelo método de Gram, mas 1 caso foi detectado pelo citológico e 20 pela PCR. Somente 1 caso de infecção por *Neisseria gonorrhoeae* foi detectado utilizando o método de Gram e dois utilizando a PCR. O patógeno *Trichomonas vaginalis* foi detectado pelo método citológico em 20 casos e 13 pela PCR. HPV foi detectado em 17 casos, sendo 12 em mulheres com vaginose.	*Trichomonas vaginalis* e HPV apresentaram-se mais frequentes em mulheres com vaginose
Wei B *et al* /2022	Pesquisa Experimental	A diversidade de espécies da microbiota vaginal foi diferente entre grupos normais, HPV de alto risco e grupos com diferentes graus de lesões cervicais. Com a ocorrência da infecção pelo HPV de alto risco e o desenvolvimento das lesões cervicais, a diversidade de espécies da microbiota vaginal aumentou e tornou-se mais complexa e desequilibrada. Além de que foi observado a diminuição gradual de L. spp, em ocorrência a infecção por HPV de alto risco e de lesões cervicais.	Os achados observados no estudo, podem fornecer informações sobre a patogênese do câncer cervical e ajudar a melhorar a detecção precoce e a prevenção de lesões pré-cancerosas cervicais.
Wenyu, L *et al*/2021	Pesquisa Experimental	A taxa de infecção por HPV nas 2.000 mulheres em estudo foi de 16,2% Em comparação com indivíduos HPV negativos, a prevalência de vaginose bacteriana foi maior no papilomavírus humano de alto risco. Em pacientes com lesões cervicais a taxa de prevalência de vaginose bacteriana foi maior do que em pacientes com lesão intraepitelial negativa ou malignidade.	Verificou-se que a vaginose bacteriana está relacionada com infecções por HPV-51, -52 e lesões cervicais.

V. DISCUSSÃO

A microbiota vaginal é composta por uma variedade de micro-organismos, incluindo bactérias, fungos e vírus, que vivem em simbiose no trato genital feminino. Essa comunidade microbiana desempenha um papel crucial na manutenção do equilíbrio ecológico e na prevenção de infecções. No entanto, a interação entre a microbiota vaginal e o HPV ainda é pouco compreendida (Brotman *et al*., 2014; Mortaki *et al*., 2020).

Um estudo realizado por Brotman e colaboradores (2014) demonstrou que mulheres com microbiota vaginal anormal apresentaram maior probabilidade de infecção pelo HPV do que mulheres com microbiota vaginal saudável. Além disso, outro estudo conduzido por Mitra e colaboradores (2020) mostrou que a presença de determinadas espécies de bactérias benéficas na vagina está associada à regressão de LSIL.

Por outro lado, a presença de espécies de bactérias prejudiciais, como *Gardnerella vaginalis*, pode aumentar a probabilidade de infecção pelo HPV e a progressão das lesões cervicais induzidas pelo vírus. Um estudo realizado por Santella e colaboradores (2022) também apontou uma microbiota vaginal alterada pode desempenhar um papel funcional na infecção cervical, progressão e eliminação do HPV.

A relação entre as alterações da microbiota vaginal e o HPV tem sido amplamente estudada na literatura científica. Existem várias evidências científicas que sugerem uma relação entre as alterações na microbiota vaginal e a infecção pelo HPV, bem como a progressão das lesões precursoras do câncer cervical. Um estudo realizado por Mitra *et al*. (2015) mostrou que a presença de bactérias anaeróbicas, como Gardnerella vaginalis e Atopobium vaginae, em mulheres infectadas pelo HPV, foi associada a um risco aumentado de desenvolver lesões cervicais de alto grau. Além disso, outro estudo de Lee et al. (2013) mostrou que a composição da microbiota vaginal pode afetar a resposta imune local à infecção pelo HPV, o que pode influenciar a progressão das lesões cervicais.

Outro estudo realizado por Wei *et al*. (2022) mostrou que a estrutura da microbiota de mulheres normais, infectados por algum genótipo de HPV de alto risco e grupos com diferentes graus de lesões cervicais eram diferentes, microbiota vaginal mais diversa são observadas em mulheres infectadas por HPV de alto risco em comparação com mulheres com microbiota menos diversa, além do observado declínio gradativo da população lactobacilar com a ocorrência de infecção por genótipos de HPV de alto risco e o desenvolvimento de lesões cervicais.

Em conjunto, esses estudos sugerem que as alterações na microbiota vaginal podem ter um papel importante na suscetibilidade à infecção pelo HPV e na progressão das lesões cervicais. Portanto, a manutenção da saúde vaginal pode ser uma estratégia importante para prevenir a infecção pelo HPV e o desenvolvimento de lesões cervicais induzidas pelo vírus. É importante ressaltar que mais pesquisas são necessárias para entender melhor a relação entre a microbiota vaginal e o HPV e como a manipulação da microbiota pode ser usada como uma estratégia de prevenção e tratamento.

VI. CONCLUSÃO

Diante do exposto, foi possível estabelecer relação entre as alterações da microbiota vaginal com as alterações celulares atípicas do colo uterino, desta forma verificou-se a importância da microbiota vaginal estável para a saúde do colo do útero, e que em condições de desequilíbrio, proporciona um ambiente inadequado para a microbiota normal, favorecendo a proliferação de microorganismos que tornam o ambiente vaginal susceptível a infecções por HPV. Esta por sua vez, quando persistente e associada a outros fatores relacionados ao hospedeiro e ao próprio vírus, promove lesões precursoras que quando não diagnosticadas e tratadas a tempo, podem resultar no desenvolvimento no câncer cervical invasivo.

REFERÊNCIAS

[1] American Cancer Society. (2022). Cervical cancer prevention and early detection. Recuperado em 4 de março de 2023, de https://www.cancer.org/21ância/cervical-cancer/prevention-and-early-detection.html.

[2] Aksoy, P.; Gottschalk, E.Y., & Meneses, P.I. (2017). HPV entry into cells. *Rev Mutat Res*. *P.13-22*.

[3] Baisley, K.J.; Andreasen, A.; Irani, J.; Nnko, S.; Changalucha, J.; Crucitti, T.; Francis, S.; Holm, C.; Hayes, R.J.; Buvé, A., & Watson-Jones, D. (2020). HPV prevalence around the time of sexual debut in adolescent girls in Tanzania. *Sexually Transmitted Infections*. V. 96, nº.3. p. 211-219.

[4] BAGNALL, P., & RIZZOLO D. (2017). Bacterial vaginosis: A practical review. *Publish ahead– of-print*.

[5] Beddoe AM. Elimination of cervical cancer: challenges for developing countries. Ecancermedicalscience. 2019 Nov 12;13:975. doi: 10.3332/ecancer.2019.975. PMID: 31921346; PMCID: PMC6946419.

[6] Belleti R, Marcolino LD, Novak J, Ferreira CST, do Nascimento Bolpetti A, da Silva Pinto GV, de Oliveira AP, da Silva MG, Marconi C. (2022). Cervicovaginal loads of Gardnerella spp. are increased in immunocompetent women with persistent high-risk human papillomavirus infection. J Med Microbiol. 2022 May;71(5). doi: 10.1099/jmm.0.001527.

[7] Bosch, F. X., & de Sanjosé, S. (2003). The epidemiology of human papillomavirus infection and cervical cancer. Disease Markers, 19(2-3), 91-97. Doi: 10.1155/2003/504584.

[8] Brotman, R. M., Shardell, M. D., Gajer, P., Tracy, J. K., Zenilman, J. M., Ravel, J., & Gravitt, P. E. (2014). Interplay between the temporal dynamics of the vaginal microbiota and human papillomavirus detection. The Journal of Infectious Diseases, 210(11), 1723-1733. Doi: 10.1093/infdis/jiu330

[9] Campos, A. C. C. (2020). *Avaliação de Citocinas na Secreção Endocervico-vaginal de pacientes com vaginose bacteriana e Papílomas Vírus Humano.* (Dissertação de Doutorado). Universidade Federal de Goiás. Instituto de Patologia Tropical e Saúde Pública, GO, Brasil.

[10] Carvalho, N. S.; Silva, R. J., Val, I. C., Bazzo, M. L., & Silveira, M. F. Protocolo Brasileiro para Infecções Sexualmente Transmissíveis 2020: infecção pelo papilomavírus humano (HPV) (2021). *Epidemiologia e Serviços de Saúde*, v. 30.

[11] Coelho, J. D. (2015). *Prevalência de infecção por herpes simples em mulheresatendidas pelo Sistema Único de Saúde município de Porto Velho–RO entre os períodos de 2012 a 2014.* (Monografia de Graduação em Biomedicina). Faculdade São Lucas. Porto Velho – RO, Brasil.

[12] Cohen, C.; Plummer, F.; Mugo, N.; Maclean, I.; Shen, C., & Bukusi, E. (1999). Increased interleukin-10 in the the endocervical secretions of women with non-ulcerative sexually transmitted diseases: a mechanism for enhanced HIV-1 transmission? *AIDS. P.327-32*.

[13] Cruz, F., & Melo, V. (2010). Fatores associados à persistência da infecção pelo HPV na cérvice uterina. *Revista Femina*.v.1, p. 423-27.

[14] Damacen, A.M; Luz, L.L., & Mattos, L. E. (2017). Rastreamento do câncer do colo do útero em Teresina, Piauí: estudo avaliativo dos dados do Sistema de Informação do Câncer do Colo do Útero, 2006-2013. *Epidemiol Serv Saude*.

[15] D'Souza G, Gross ND, Pai SI, Haddad R, Anderson KS, Rajan S, Gerber J, Gillison ML, Posner MR. Oral human papillomavirus (HPV) infection in HPV-positive patients with oropharyngeal cancer and their partners. J Clin Oncol. 2014 Aug 10;32(23):2408-15. doi: 10.1200/JCO.2014.55.1341. Epub 2014 Apr 28. PMID: 24778397; PMCID: PMC4263818.

[16] Di Paola, M., Sani, C., Clemente, A.M. et al. (2017). Characterization of cervico-vaginal microbiota in women developing persistent high-risk Human Papillomavirus infection. *Sci Rep***,** v.7, p. 1-12.

[17] Doorbar, J.; Quint, W.; Banks. L, et al. (2012). The biology and life-cycle of Human Papillomaviruses. *Vaccine. p. 55-70*.

[18] El-Sherif, A.; Seth, R.; Tighe, P., & Jenkins, D. (2001). Quantitative analyses of IL-10 mRNA levels in normal cervix and human papillomavirus type 16 associated cervical precancer. *J Pathol*. *p.179-185*.

[19] Federação Brasileira das Associações de Ginecologia e Obstetrícia (FEBRASGO) (2021). *Programa Vacinal para Mulheres*. Ed. 2, São Paulo: Recuperado de https://www.febrasgo.org.br/em/revistas/item/1261-programa-vacinal-das-mulheres.

[20] Ferrada, D. B. (2012). *Identificación 22ornal22ibilidadead antimicrobiana de Gardnrella vaginalis em pacientes Del consultóriode salud "Jose Dionisio Astaburuaga"de Talca***.** (Dissertação de Graduação). Universidade de Talca, Talca, Chile.

[21] Ferraz, L.C; Santos, R.A.B., & Discacciati, M.G. (2012) Ciclo celular, HPV e evolução da neoplasia intraepitelial cervical: seleção de marcadores biológicos. *J Health Sci Inst. P.107-11*.

[22] Filho, D. S. C.; Diniz, C. G., & Dasilva, V. L. (2010). Bacterial vaginosis: clinical, epidemiologic and microbiological features. *HU Revista Juiz*, v.36, *p.223-230*,

[23] Gajer, P, Brotman, R. M., Sakamoto, J., Schütte, U. M. E., Zhong, X., Koenig, K., Fu, L., Zhanshan, Ma., Zhou, X., Abdo, Z., Forney, L. J., & Ravel, J. (2012). Temporal dynamics of the human vaginal microbiota. *Science translational medicine*. v. 4, n. 132, *p. 132*.

[24] Galati L, Chiocca S, Duca D, Tagliabue M, Simoens C, Gheit T, Arbyn M, Tommasino M. (2022). HPV and head and neck cancers: Towards early diagnosis and prevention. Tumour Virus Res. 2022 Dec;14:200245. doi: 10.1016/j.tvr.2022.200245. Epub 2022 Aug 13.

[25] Gao, W., Weng, J. L., Gao, Y., Chen, X. (2013). Comparison of the vaginal microbiota diversity of women with and without human papillomavirus infection: a cross-sectional study. *BMC infectious diseases*. v. 13, n. 1, *p. 271*.

[26] Gillet, E., Meys, J. F. A., Verstraelen, H., Verhelst, R., De Sutter, P., Temmerman, M., & Vanden Broeck, D. (2012). Association between bacterial vaginosis and cervical intraepithelial neoplasia: systematic review and meta-analysis. PloS one, 14(1), e0210269. doi: 10.1371/journal.pone.0210269.

[27] Haider, G, Parveen, Z, Anjum, F., & Munir, A. (2013). Pap smear, an importante screening tool to detect precancerous stage of carcinoma of cervix. *JAMC***.** v.25, *p. 26-27*.

[28] Halford, J. A. Cytological features of chronic follicular cervicitis in liquid-based specimens: a potential diagnostic pitfall. *Cytopathology*. v.13, *p. 364-370*, 2002.

[29] Hardy L, Jespers V, Van den Bulck M, Buyze J, Mwambarangwe L, Musengamana V, Vaneechoutte M, Crucitti T. (2017). The presence of the putative Gardnerella vaginalis sialidase A gene in vaginal specimens is associated with bacterial vaginosis biofilm. PLoS One. 2017 Feb 27;12(2):e0172522. doi: 10.1371/journal.pone.0172522. eCollection 2017.

[30] Huh, W. K. Human papillomavirus infection: a concise review of natural history. *Obstet Gynecol***,** v.114, *p.139-143*, 2009.

[31] *Incidências.* Rio de Janeiro. RJ, Brasil. Recuperado de https://https://docs.bvsalud.org/biblioref/2019/04/988200/parametros-tecnicos-colo-do-utero_2019.pdf.

[32] Instituto Nacional de Câncer José Alencar Gomes da Silva – Inca (2021). *Incidências.* Rio de Janeiro. RJ, Brasil. Recuperado de https://https//www.inca.gov.br/controle-do-cancer-do-colo-do-utero/dados-e-numeros/incidência.

[33] Koshiol, J.; Lindsay, L.; Pimenta, J.M.; Poole, C.; Jenkins, D., & Smith, J.S. (2008). Persistent human papillomavirus infection and cervical neoplasia: a systematic review and metaanalysis. *Am J Epidemiol*. v.168, *p.123-37*.

[34] Lee, J.E.; Lee, S.; Lee, H.; Yun-Mi. C.; Lee K.; Han, M. J.; Sung, J., & Ko, G. P. (2013). Association of the vaginal microbiota with human papillomavirus infection in a Korean twin cohort. *PLoS One*. v.8.

[35] Lessa, P; Ribeiro, S; Lima, D; Nicolau, A; Damasceno, A., & Pinheiro, A. (2012). Presença de lesões intraepiteliais de alto grau entre mulheres privadas de liberdade: Estudo documental. *Rev Latino Am Enferm*. v. 20, *p. 354-61*.

[36] Lewis, W.; Robinson, L.; Perry, J.; Bick, J.; Peipert, J.; Allsworth, J., & Lewis, A. (2012). Hydrolysis of secreted sialoglycoprotein immunoglobulin a (IgA) in ex vivo and biochemical models of bacterial vaginosis. *J Biol Chem*. v.287, *p. 2079-89*.

[37] Lin, W., Jiang, W., Hu, X., Gao, L., Ai, D., Pan, H., Niu, C., Yuan, K., Zhou, X., Xu, C., & Huang, Z. (2018). Ecologicl Shifts of Supregingival Microbiota in Association with Pregnancy. *Frontiers in Cellular and Infection Microbiology***.** v.8, *p. 1-11*.

[38] Luchiari, H. R.; Fereira, C. S. T., Golim, M. A.; Silva, M. G., & Marconi, C. (2016). Cervicovaginal bacterial count and failure of metronidazole therapy for bacterial vaginosis. *International Journal of Gynecology and Obstetrics*. v.132, *p. 297-301*.

[39] Machado, D., Castro, J., Palmeira, A. O., Martinez, J., & Cerca, N.(2016) Bacterial vaginosis biofilms: challenges to current therapies and emerging solutions. *Front Microbiol*.

[40] Marconi, C.; Duarte, M. T.; Silva, D. C., & Silva, M. G. Prevalence of and risk factors for bacterial vaginosis among women of reproductive age attending cervical screening in southeastern Brazil. *Int J Gynaecol Obstet. p.137–141*, 2015.

[41] Secretaria de Assistência à Saúde e Instituto Nacional de Câncer (INCA), Ministério da Saúde (2002). Falando sobre o câncer do colo do útero. Rio de Janeiro – RJ, Brasil. 1ª ed.

[42] Misra, J.S., Srivastava, S., Singh, U., & Srivastava, A.N. (2009). Risk-factors and strategies for control of carcinoma cervix in India: hospital based cytological screening experience of 35 years. *Indian J. Cancer*.

[43] Mitra A, MacIntyre DA, Lee YS, Smith A, Marchesi JR, Lehne B, Bhatia R, Lyons D, Paraskevaidis E, Li JV, Holmes E, Nicholson JK, Bennett PR, Kyrgiou M. Cervical intraepithelial neoplasia disease progression is associated with increased vaginal microbiome diversity. Sci Rep. 2015 Nov 17;5:16865. Doi: 10.1038/srep16865. PMID: 26574055; PMCID: PMC4648063.

[44] Mitra A, MacIntyre DA, Ntritsos G, Smith A, Tsilidis KK, Marchesi JR, Bennett PR, Moscicki AB, Kyrgiou M. The vaginal microbiota associates with the regression of untreated cervical intraepithelial neoplasia 2 lesions. Nat Commun. 2020 Apr 24;11(1):1999. doi: 10.1038/s41467-020-15856-y. PMID: 32332850; PMCID: PMC7181700.

[45] Mortaki D, Gkegkes ID, Psomiadou V, Blontzos N, Prodromidou A, Lefkopoulos F, Nicolaidou E. Vaginal microbiota and human papillomavirus: a systematic review. J Turk Ger Gynecol Assoc. 2020 Sep 3;21(3):193-200. doi: 10.4274/jtgga.galenos.2019.2019.0051. Epub 2019 Sep 30. PMID: 31564082; PMCID: PMC7495129.

[46] Muñoz, N., Bosch, F. X., de Sanjosé, S., Herrero, R., Castellsagué, X., Shah, K. V., Snijders, P. J., Meijer, C. J., & International Agency for Research on Cancer Multicenter Cervical Cancer Study Group (2003). Epidemiologic classification of human papillomavirus types associated with cervical cancer. *The New Englan23ornalal of medicine*, *348*(6), 518–527.

[47] Murray, P.R. (2011). *Microbiologia Médica*. 6ª ed. Rio de Janeiro: Elsevier.

[48] Muzny, C. A., Taylor, C. M., Swords, W. E., Tamhane, A., Chattopadhyay, D., Cerca, N., & Schwebke, J. R. (2019). An Updated Conceptual Model on the Pathogenesis of Bacterial Vaginosis. *The Journal of infectious diseases*, *220*(9), 1399–1405.

[49] Nardis, C.; Mosca, L., & Mastromarino, P. (2013). Vaginal microbiota and viral sexually transmitted diseases. *Ann Ig* v. 25, n. 5, *p. 443-456.*

[50] Nugent R. P., Krohn, M.A., & Hillier, S.l. (1991). Reliability of Diagnosing Bacterial Vaginosis is Improved by a Standardized Method of Gram stain Interpretation. *Journal of Clinical Microbiology*, v. 29, n. 2, *p. 297-301*.

[51] Pereira, M. (2018). *Influência da microbiota vaginal na incidência de lesões intraepiteliais cervicais HPV-induzidas*. (Dissertação de Mestrado). Universidade Federal de Juiz de Fora, Instituto de Ciências Biológicas. Programa de Pós-Graduação em Ciências Biológicas: Imunologia e Genética, MG, Brasil.

[52] Rodriguez, C.C., Sanchez, B.E., & Alba, A. (2012). Evaluation of Association between Vaginal Infections and High-Risk Human Papillomavirus Types in Female Sex Workers in Spain. *Obstet Gynecol.*

[53] Santella B, Schettino MT, Franci G, De Franciscis P, Colacurci N, Schiattarella A, Galdiero M. Microbiota and HPV: The role of viral infection on vaginal microbiota. J Med Virol. 2022 Sep;94(9):4478-4484. Doi: 10.1002/jmv.27837. Epub 2022 May 16. PMID: 35527233; PMCID: PMC9544303.

[54] Santos, T. G., Carvalho, D. P., & Lima, V. A. (2020). Prevalência de Actinomyces sp., Bacilos supracitoplasmáticos, Chlamydia trachomatis, Herpes simplex e Trichomonas vaginalis em exames cervicais citopatológicos na Bahia entre 2006 e 2014. *XIX SEPA, UNIFACS, p. 12.*

[55] Silva, B.L., Santos, R.N.L.C., Ribeiro, F.F., Ribeiro, F.F., Anjos, U.U., & Ribeiro. K.S.Q.S. (2014). Prevention of cervical cancer and the expansion of the risk age. *Rev Enferm UFPE on line*. V.8, *p.1482-90*.

[56] Schiffman, M., Doorbar, J., Wentzensen, N., de Sanjosé, S., Fakhry, C., Monk, B. J., Stanley, M. A., & Franceschi, S. (2016). Carcinogenic human 23apilomavírus infection. *Nature reviews. Disease primers*, *2*, 16086.

[57] Silins, I., Ryd, W., Strand, A., Wadell, G., Törnberg, S., Hansson, B. G., Wang, X., Arnheim, L., Dahl, V., Bremell, D., Persson, K., Dillner, J., & Rylander, E. (2005). Chlamydia trachomatis infection and persistence of human papillomavirus. *International journal of cancer*, *116*(1), 110–115.

[58] Shannon, B., Yi, T. J., Perusini, S., Gajer, P., Ma, B., Humphrys, M. S., Thomas-Pavanel, J., Chieza, L., Janakiram, P., Saunders, M., Tharao, W., Huibner, S., Shahabi, K., Ravel, J., Rebbapragada, A., & Kaul, R. (2017). Association of HPV infection and clearance with cervicovaginal immunology and the vaginal microbiota. *Mucosal immunology*, *10*(5), 1310–1319.

[59] Severi, E., Hood, D., & Thomas, G. (2007). Sialic acid utilization by bacterial pathogens. *Microbiology*. V.53.

[60] Silvino, M.C.M., Giraldo, P.C., Vicentini, R.M.R., & Júnior, J.E. (2006). Microbiota Vaginal no pré e pós-operatório de cirurgias ginecológicas. *DST– J Bras Doenças Sex Transm.* V. 18, n 3, *p. 168-171*.

[61] Swidsinski, A., Mendling, W., Loening-Baucke, V., Ladhoff, A., Swidsinski, S., & Hale, L. (2005). Adherent biofilms in bacterial vaginosis. *Obstet Gynecol***.** V.106, *p.1013–23.*

[62] Teixeira, P. (2018). *Prevalência e fatores assosciados à vaginose bacteriana em mulheres atendidas pelo SUS no município de Ouro Preto / MG.* (Dissertação de Mestrado). Programa de Pós Graduação em Ciências Farmacêuticas da Escola de Farmácia, da Universidade Federal de Ouro Preto, MG, Brasil.

[63] Trottier, H., & Franco, E. L. (2006). The epidemiology of genital human papillomavirus infection. Vaccine, 24S3, S1-S15. Doi: 10.1016/j.vaccine.2006.05.031.

[64] Watts, D. H., Fazzari, M., Minkoff, H., Hillier, S. L., Sha, B., Glesby, M., Levine, A. M., Burk, R., Palefsky, J. M., Moxley, M., Ahdieh-Grant, L., & Strickler, H. D. (2005). Effects of bacterial vaginosis and other genital infections on the natural history of human papillomavirus infection in HIV-1-infected and high-risk HIV-1-uninfected women. *The Journal of infectious diseases*, *191*(7), 1129–1139.

[65] Wei B, Chen Y, Lu T, Cao W, Tang Z, Yang H. Correlation between vaginal microbiota and different progression stages of cervical cancer. Genet Mol Biol. 2022 Mar 18;45(2):e20200450. doi: 10.1590/1678-4685-GMB-2020-0450. PMID: 35320337; PMCID: PMC8967114.

[66] Wenyu, L., Zhang, Q., Chen, Y., Dong, B., & Sun, P. (2021). The prevalence of human papilomavírus and bacterial vaginosis among young women in China: a cross-sectional study. *BMC Women's Health*. v.21, *p.1-10.*

[67] World Health Organization (WHO). (2016). Information Centre on HPV and Cervical Cancer (HPV Information Centre). Human papillomavirus and related cancers in world. Summary Report 2016**.** *Geneva*.

[68] World Health Organization. Regional Office for South-East Asia. (2021). Regional implementation framework for elimination of cervical cancer as a public health problem: 2021–2030. World Health Organization. Regional Office for South-East
Asia. https://apps.who.int/iris/handle/10665/344762.
Licença: CC BY-NC-SA 3.0 IGO.

[69] Zattoni, M., Antico, A.F., Cabbia, C., Odoni, O.J., & Discacciati, M.G. (2012). Relação entre vaginose bacteriana e atipias celulares diagnosticadas pelo exame de Papanicolaou. *J Health Sci Inst*. v. 31, *p. 235-238.*

[70] Zeferino, L.C., & Derchain, S.F. (2006). Cervical cancer in the developing world. *Best Pract Res Clin Obstet Gynaecol*.v.20, *p.339-54.*

[71] Zur Hausen, H. (2002). Papillomaviruses and cancer: from basic studies to clinical application. *Nat Rev Cancer*. *2(5)*, 342-50.

International Journal of Advanced Engineering Research and Science (IJAERS)
Peer-Reviewed Journal
ISSN: 2349-6495(P) | 2456-1908(O)
Vol-10, Issue-4; Apr, 2023
Journal Home Page Available: https://ijaers.com/
Article DOI: https://dx.doi.org/10.22161/ijaers.104.3

Multiprofessional Care for a Patient with Gestational Diabetes

Assistencia Multiprofissional a Paciente Com Diabetes Gestacional

Vitor da Costa Nogueira[1], Eleonam Cleysson Tavares Brito[2], Jéssica Fernanda Mateus Noronha[2], João Baptista de Castro Netto[2], João Guilherme Barroso e Silva[2], Marco Antonio Miranda Pereira Filho[2], Maria Clara Mapurunga Guimarães[2], Maria Heloise Rosende Sampaio[2], Pedro Assis Rocha[2], Pedro Augusto Ximenes DE lira[2], Luis Felipe Cutrim Martins[2]

[1]Pesquisador e Acadêmico do curso de Medicina da FACULDADE DE CIENCIAS HUMANAS, EXATAS E DA SAÚDE DO PIAUÍ-PARNAÍBA (FAHESP-IESVAP)
[2]Acadêmicos (as) do curso de Medicina da FACULDADE DE CIENCIAS HUMANAS, EXATAS E DA SAÚDE DO PIAUÍ-PARNAÍBA (FAHESP-IESVAP)

Received: 26 Feb 2023,

Receive in revised form: 31 Mar 2023,

Accepted: 06 Apr 2023,

Available online: 12 Apr 2023

***Keywords*— Teamwork: Care; Diabetes Mellitus; Gestation.**

***Palavras-chave*— Trabalho em equipe: Cuidados; Diabetes Mellitus; Gestação.**

Abstract— *The gestational diabetes is a complication that occurs during pregnancy characterized by an increase in the glycemic index (increase in blood sugar level) discovered for the first time during pregnancy. Objective: to describe the importance of multidisciplinary care for pregnant women with diabetes. Methodology: this was an integrative literature review with a qualitative approach. Results: The teamwork of points out assistance strategies, health maintenance and quality of life, pointed out the main health education actions based on scientific technical knowledge and skills of multidisciplinary competence to develop health education that contribute to the effectiveness of self-care by through modifying or maintaining healthy habits and strengthening self-confidence. Conclusion: It is necessary to prioritize actions related to health promotion and prevention of complications, making educational interventions essential in care, favoring the empowerment of people with chronic conditions.*

Resumo— *O diabetes gestacional é uma intercorrência que ocorre na gestação caracterizada por um aumento no índice glicêmico (aumento do nível de açúcar no sangue) descoberto pela primeira vez durante a gravidez Objetivo: descrever a importância da assistencia multiprofissional a gestante com diabetes. Metodologia: tratou-se de uma revisão integrativa da literatura com uma abordagem qualitativa. Resultados: O trabalho em equipe da apontam estratégias de assistência, manutenção da saúde e qualidade de vida, apontaram as principais ações de educação em saúde a partir dos conhecimentos técnicos científicos e habilidades de competência multidisciplinar para desenvolver educação*

em saúde contribuem na eficácia do autocuidado por meio da modificação ou da manutenção de hábitos saudáveis e do fortalecimento da autoconfiança. Conclusão: È necessário priorizar ações relacionadas a promoção da saúde e prevenção de complicações, tornando as intervenções educativas essenciais nos atendimentos, favorecendo o empoderamento das pessoas em condições crônicas.

I. INTRODUÇÃO

O diabetes gestacional é uma intercorrência que ocorre na gestação e deve ser identificada no pré-natal, sendo esta uma síndrome do metabolismo energético de várias fontes cuja etiologia ainda não é clara. É caracterizada por um aumento no índice glicêmico (aumento do nível de açúcar no sangue) descoberto pela primeira vez durante a gravidez. O diabetes ocorre porque o pâncreas não tem a capacidade de produzir quantidade suficiente de insulina. Atendendo às necessidades físicas, o diagnóstico é feito através de check-ups regulares na avaliação do pré-natal, que ocorre na maioria dos casos entre a 24ª e 28ª semanas de gravidez (ESPANADORADO et al., 2021).

O diabetes gestacional é uma alteração metabólica prejudicial à saúde da mulher gestante e do transcorrer do pré-natal é rastreada através de um conjunto de ações que têm como funções a prevenção, promoção da saúde, diagnóstico e tratamento ao mesmo tempo, visando trazer um bom desfecho da gravidez para a gestante e melhoria da sua qualidade de vida e saúde (BORGES et al., 2021).

Aproximadamente 7% das gestações estão relacionadas a complicações maternas e infantis, resultando em mais de 200.000 casos de diabetes gestacional registrados no sistema único de saúde a cada ano, sendo uma das principais causas de morbimortalidade materna no país (OLIVEIRA et al., 2022).

Os fatores de risco para DMG são sobrepeso ou obesidade, hipertensão ou pré-eclâmpsia, idade igual ou superior a 35 anos, parentes de primeiro grau com histórico familiar de diabetes, malformações, síndrome dos ovários policísticos, altura materna baixa de 1,5 metros, crianças grandes. História médica obstétrica, morte fetal ou de recém-nascidos.

Os sintomas de diabetes mais facilmente reconhecidos são: poliúria, polidipsia, polifagia e perda de peso inconsciente. Esses sintomas permitem que os profissionais avaliem com mais proficiência as mulheres grávidas para investigar outros sintomas que causam a suspeita clínica de DMG, como fadiga, fraqueza, letargia, coceira na pele e genital e infecções repetidas (MARTINEZ-CRUZ *et al.*, 2021). A taxa de detecção de diabetes gestacional é altamente recomendado devido à incidência de resultados adversos Mãe para feto; porque, quando o diagnóstico é tardio ou Tratamento e parcial. Assim sendo, este estudo surgiu da seguinte problemática: Quais evidenciam cientificas fundamentam a assistencia multiprofissional a gestante com diabetes mellitus durante o pré-natal?

Portanto a importância desse trabalho e fundamental para diagnóstico precoce da DMG cuidado aprimorado profissional-paciente. A recomendação das organizações em saúde é realizar pelo menos seis consultas de pré-natal, usar vacinas, realizar exames laboratoriais de diagnóstico para as inspeções de rotina e fornecer suplementos e medicamentos para as diversas intercorrências e alterações fisiológicas e metabólicas encontradas nesse período (OLIVEIRA et al., 2022).

Não existe um consenso sobre qual método é mais eficaz para o diagnóstico de DMG, pois todas as gestantes devem ser acolhidas e acompanhadas para que ocorra o monitoramento da glicemia durante todo o período gestacional, independentemente da presença ou não dos fatores de risco, através da glicemia em jejum solicitada logo na primeira consulta do pré-natal, e nos demais trimestres. De acordo com a OPAS (2017) a indução do trabalho de parto (LIO) é frequentemente sugerida para reduzir os resultados adversos maternos e fetais.

O diabetes na gravidez está associado a um risco aumentado de natimorto à medida que a gravidez progride. Portanto, o aumento da morbimortalidade neonatal associado ao parto antes de 39 semanas de gestação deve ser equilibrado com o aumento do risco de natimorto com conduta expectante. Para a reconstrução das práticas de saúde com maior integralidade, efetividade e acesso dos usuários, o tema humanização vem sendo divulgado e debatido no campo da saúde e, principalmente, no âmbito hospitalar. Ao analisar as ações de humanização afirmadas pelo Ministério Federal a partir da construção histórica dos serviços de saúde pública brasileira, percebe-se que há uma modificação dos serviços de saúde (MORLANDO et al., 2021).

No entanto, acredita-se que ainda é necessário alavancar com iniciativas mais eficazes para a garantia e a ampliação do acesso com equidade, proporcionando as usuários do serviço de saúde, ações mais adequadas quando se refere ao atendimento á diabetes gestacional Este estudo visa contribuir com um maior entendimento e informação às

pessoas acerca da assistencia a gestante com diabetes e a importancia do multitpofissionalismo no cuidado as intercorrencias gestacionais.

Há levantamentos científicos que relatam a finalidade de mostrar o protagonismo do cuidado compartilhado, suas atribuições, contribuições a acima de tudo, sua relevância dentro dos serviços de saúde no processo saúde-doença, seja no âmbito intra como extra-hospitalar, visando um maior entendimento e esclarecimento da sociedade com o intuito de melhorar progressivamente a atenção da assistência à saúde da gestante no ciclo gravídico-puerperal. Esta pesquisa teve como objetivo principal descrever a importância da assistencia multiprofissional a gestante com diabetes.

II. MÉTODO

O presente estudo tratou-se de uma revisão integrativa da literatura com uma abordagem qualitativa. Este procedimento foi escolhido por possibilitar a síntese e análise do conhecimento científico já produzido sobre o tema da assistencia multiprofissional a gestante com diabetes. Esta revisão utilizou a metodologia proposta no estudo de Oliveira et al. (2016). (MENDES; SILVEIRA; GALVÃO, 2019).

De acordo com Ercole, Melo e Alcoforado (2014), a revisão integrativa de literatura é um método que tem como finalidade sintetizar resultados obtidos em pesquisas de maneira sistemática, ordenada e abrangente, mediante diferentes metodologias. É denominada integrativa porque fornece informações mais amplas sobre um assunto, constituindo um corpo de conhecimento e podendo ser direcionada para a definição de conceitos, revisão de teorias ou análise metodológica dos estudos. Este método proporciona a combinação de dados da literatura teórica e empírica.

A temática em questão determinou a construção da estratégia PICo, que representa um acrônimopara Paciente (P), Intervenção (I) e Contexto (Co), na qual foi utilizada para a geração da questão norteadora desta revisão integrativa da literatura: “Quais evidenciam cientificas fundamentam a assistencia multiprofissional a gestante com diabetes mellitus durante o pré-natal?”

Para a localização dos estudos relevantes, que respondessem à pergunta de pesquisa, utilizou-se de descritores indexados e não indexados (palavras-chave) nos idiomas português, inglês e espanhol. Os descritores foram obtidos a partir do Medical Subject Headings (MESH), dos Descritores em Ciências da Saúde (DeCS) e dos títulos CINAHL, como mostra o Quadro 2.

Consultou-se por meio de descritores e palavras-chave as bases de dados PubMed da National Library of Medicine; BVS (Biblioteca Virtual da Saúde), coordenada pela BIREME e composta de bases de dados bibliográficas produzidas pela Rede BVS, como LILACS, além da base de dados Medline e outros tipos de fontes de informação e SciElo(Scientific Electronic Library Online).

Quadro 1 – Elementos da estratégia PICO e descritores utilizados – Parnaíba,PI, Brasil, 2023.

	Elementos	Mesh	Decs	DECs SciElo	Palavras-chave
P	”Gestante”	“Pregnancy’	“Gravidez“ pregnancy” “Glicodelina’	“Pregnancy’	Gestante
I	“Assistência a saúde”	“health Care”	“Assistência dá saúde”	“health Care”	“Assistência á saúde”

			“Home Health		
Co	“Diabetes gestacional”	“Diabetes, Gestational’	“Diabetes Gestacional” “Diabetes, Gestacional” “Diabetes Gestacional’	“Diabetes, Gestational’	“Diabetes gestacional”

Fonte: Descritores, Títulos e Palavras-chave

Para a localização dos estudos relevantes, que respondessem à questão da pesquisa, utilizou-se de descritores indexados nos idiomas português, inglês e espanhol. Os descritores foram obtidos a partir do Descritores em Ciências da Saúde (DeCS) e Medical Subject Headings (MESH), como mostra o Quadro 1.

Os termos utilizados durante a pesquisa foram classificados e combinados nos bancos de dados, resultando em estratégias específicas de cada base.

Quadro 2 – Estratégias de busca utilizadas nas bases de dados BIREME, PUBMED e SciElo – Parnaíba-PI, Brasil, 2023.

BASE DE DADOS	ESTRATÉGIA DE BUSCA	RESULTADOS	FILTRADOS	SELECIONADOS
BIREME (descritores Decs)	(gestantes) AND (diabetes) AND (cuidados) AND (fulltext:("1")) AND (year_cluster:[2017 TO 2022])	123	40	2
PUBMED (descriptors MeSH)	(DIABETES GESTACIONAL) AND (HEALTH CARE) AND PRE Filters: Full text, in the last 5 years, Humans - PubMed	807	426	4
SCIELO	((GESTATIONAL DIABETES) AND (FM T)) AND ((CARE) AND (FM T)) AND (2017-2023)	469	169	4

Fonte: Bases de dados.

Como critérios de inclusão utilizaram-se estudos disponíveis em sua totalidade, publicados nos últimos cinco anos, de 2017 até 2023, nos idiomas Português, Espanhol e Inglês. Foram excluídos da busca inicial capítulos de livros, resumos, textos incompletos, teses, dissertações, monografias, relatos técnicos e outras formas de publicação que não artigos científicos completos.

A análise para seleção dos estudos foi realizada em duas fases, a saber: na primeira, os estudos foram pré-selecionados segundo os critérios de inclusão e exclusão e de acordo com a estratégia de funcionamento e busca de cada base de dados. Nesta etapa foram analisadas as informações coletadas nos artigos científicos e criadas categorias analíticas que facilitou a ordenação e a sumarização de cada estudo. Essa categorização foi realizada de forma descritiva, indicando os dados mais relevantes para o estudo.

Para realização da categorização dos estudos selecionados, foi utilizado um instrumento denominado de matriz de síntese ou matriz de análise, que permite analisar separadamente cada artigo, extrair e organizar os dados tanto num nível metodológico quanto em relação aos resultados das pesquisas. Tal instrumento possibilitou a síntese dos artigos, salvaguardando suas diferenças, criando categorias analíticas que facilitem a ordenação e sumarização de cada estudo.

III. RESULTADOS

Os resultados foram analisados e expostos em quadros para facilitar o reconhecimento dos dados e compreensão. A tabela 1 traz a Distribuição das publicações incluída segundo a abordagem do estudo, delineamento da pesquisa, idioma, classificação de evidência, grau de recomendação, procedência e distribuição temporal. Parnaíba-PI, Brasil, 2023. (N=10).

VARIÁVEIS	N	%
Abordagem do estudo		
Qualitativo	06	60
Quantitativo	04	40
Delineamento da pesquisa		
Revisão Sistemática	03	30
Ensaio Clínico Randomizado	02	20
Caso-controle	01	10
Transversal	02	20
Coorte	02	20
Idioma		
Inglês	06	60
Português	02	20
Espanhol	02	20
Classificação da evidência		
Um	03	30
Dois	02	20
Três	02	20
Cinco	02	20
Seis	01	10
Grau de Recomendação		
A	10	100

O quadro 3 traz a caracterização dos dados quanto ao autor, ano, periódico publicado, e principais resultados e faz uma classificação dos estudos selecionados com os principais achados sobre a assistência de enfermagem a gestante com diabetes milito com covid-19, obtidas através da matriz de síntese dos estudos destacados para essa revisão integrativa.

Quadro 3- Publicações incluídas segundo o número de ordem; título do artigo; autor (es); grau de evidencia; objetivo principal; perfil amostral e principais resultados. Parnaíba-Pi, 2023. (N=10)

N° DE ORDEM E BASE	TÍTULO DO TRABALHO	AUTORES	GRAU DE EVIDÊNCIA	OBJETIVO PRINCIPAL	PERFIL AMOSTRAL	PRINCIPAIS RESULTADOS
1 BIREME	Perfil clínico de pacientes com diabetes gestacional e incidência de complicações neonatais em um centro de referência materno-fetal colombiano	PRECIADO et al., 2020	A5	Determinar o perfil clínico de pacientes com diabetes gestacional (DG) e a incidência de complicações neonatais.	Estudo descritivo de uma coorte retrospectiva de gestantes com DG segundo critérios HAPO/ (IADPSG) .	As mulheres com diabetes gestacional neste estudo, tinham hábitos de vida irregulares, alimentação irregular, sobrepeso ou obesidade.
2 BIREME	COVID-19 e estratégias de autocuidado para mulheres com diabetes mellitus gestacional	MORADI et al., 2020	A1	Avaliar as estratégias de autocuidado para mulheres com DMG durante a pandemia de COVID-19.	Trata-se de uma revisão sistemática da literatura, onde foram inclusos 25 artigos relacionados de 2011 a 2020 e 3 diretrizes foram revisadas.	Os cuidados a gestante foram direcionados a prevenção do covid e de agravos gestacionais. Adotou-se aos protocolos de saúde da OMS e as diretrizes do pré-natal para reduzir impactos ao binômio mãe-filho.
3 PUBMED	Foram identificados diferentes fatores que podem aumentar esse risco e, por sua vez, justificar a maior probabilidade de desenvolver doença cardiovascular.	PAGOTTO et al., 2020	A6	Estimar a mudança na prevalência de DMG e obesidade em um período de 11 anos.	Análise das gestações atendidas na enfermaria de obstetrícia de um hospital geral entre 2001 e 2018. Foram excluídas da análise aquelas mulheres que eram diabéticas antes da gravidez.	Esta informação pode ser empregada para gerenciar os recursos de saúde e enfocar na prevenção da obesidade, assim como no diagnóstico precoce e precoce do DMG para evitar ou reduzir suas complicações que têm um grande impacto na saúde da população adultos e pediátrica.
4 PUBMED	Prevenção do Diabetes Mellitus Gestacional (DMG) e Probióticos: Mecanismo de Ação: Uma Revisão	HOMAYOUNI et al., 2020	A1	Revisar os estudos sobre a prevenção do diabetes gestacional e avaliar os potenciais efeitos benéficos dos probióticos no diabetes gestacional e seu	Trata-se de uma revisão sistemática, foram selecionados artigos compilados por meio de ensaios clínicos indexados no PubMed, Science Direct, Cochran e	Evidências experimentais e clínicas suportam a suposição de que a modulação da microbiota intestinal via microrganismos

				possível mecanismo de ação.	Medlib entre 2000 e 2001,	probióticos pode ser eficaz na prevenção do diabetes mellitus gestacional.

(Continua...)

Quadro 3 - Publicações incluídas segundo o número de ordem; título do artigo; autor (es); grau de evidencia; objetivo principal; perfil amostral e principais resultados. . Parnaíba-Pi, 2023. (N=10)

N° DE ORDEM E BASE	TÍTULO DO TRABALHO	AUTORES	GRAU DE EVIDÊNCIA	OBJETIVO PRINCIPAL	PERFIL AMOSTRAL	PRINCIPAIS RESULTADOS
5 **PUBMED**	Uso da metforminana prevenção da diabetes gestacional na grávida obesa não diabética: uma revisão baseada na evidência	OLIVEIRA et al., 2022	A5	Esclarecer o papel da metformina na prevenção da diabetes gestacional (DG) na grávida obesa não diabética.	Foram pesquisadas meta-análises, revisões sistemáticas, ensaios clínicos controlados e randomizados e diretrizes clínicas publicados entre maio de 2010 e maio de 2020, nas línguas portuguesa e inglesa.	A metformina não diminui o risco de desenvolver DG (nível de evidência 1). Reforça-se a manutenção das boas práticas preventivas do médico de família, através do aconselhamento pré-concecional, da identificação precoce de grávidas com obesidade e da abordagem atempada de alterações de estilo de vida.
6 **PUBMED**	Tratamentos para mulheres com diabetes: uma visão geral das revisões periódicas Cochrane	MARTINS et al., 2018	A1	Fazer uma síntese completa das análises das sistemáticas Cochrane sobre os benefícios e os danos das intervenções para o tratamento do DMG.	Tratou-se de uma revisão sistemática da literatura. Os participantes das revisões sistemáticas Cochrane eram mulheres diagnosticadas com DMG recebendo qualquer forma de tratamento para	A mudança no estilo de vida (incluindo pelo menos alimentação saudável, atividade física e auto monitoramento da glicemia) foi a única intervenção que mostrou possíveis melhorias na saúde das mulheres e seus bebês. As

					DMG (conforme identificado pela revisão). Foram excluídas mulheres com diabetes tipo 1 e tipo 2.	intervenções de mudança no estilo de vida podem reduzir o número de bebês grandes.
7 **SCIELO**	Navegando em uma 'Tempestade Perfeita' no Caminho para a Prevenção do Diabetes Mellitus Tipo 2 Após o Diabetes Gestacional : Lições de Narrativas de Pacientes e Provedores.	MCCLLOSKY et al., 2019	A5	Elucidar como as experiências relatadas por pacientes e profissionais convergem para facilitar ou impedir o acompanhamento após o DMG e (2) obter recomendações para mudanças no nível do sistema para melhorar a prevenção nas principais transições de cuidados.	Realizamos entrevistas em profundidade com 30 pacientes com DMG e 29 prestadores de serviços de maternidade, especialidade e atenção primáriaem uma rede hospitalar de segurança urbana, e utilizaram uma análise temática em três níveis para interpretar suas narrativas.	Para os entrevistados da prática propõem inovações de sistemas para abrir a comunicação entre as especialidades do provedor, a fim de preencher o abismo entre os **cuidados** reprodutivos e a prevenção do curso de vida.

Continua...

QUADRO 3 - Publicações incluídas segundo o número de ordem; título do artigo; autor (es); grau de evidencia; objetivo principal; perfil amostral e principais resultados. . Parnaíba-Pi, 2023. (N=10)

N° DE ORDEM E BASE	TÍTULO DO TRABALHO	AUTORES	GRAU DE EVIDÊNCIA	OBJETIVO PRINCIPAL	PERFIL AMOSTRAL	PRINCIPAIS RESULTADOS
8 **SCIELO**	O Efeito da Educação em Saúde Associada à Intervenção Psicológica Personalizada no Resultado da Gravidez de Gestantes com	HE et al 2022	A3	Estudar o efeito da educação em saúde combinada com intervenção de enfermagem psicológica personalizada no resultado da gravidez de gestantes	170 pacientes com DMG internados no Guangdong Women and Children Hospital de janeiro de 2018 a dezembro de 2018 foram selecionados como sujeitos do estudo e divididos	A educação em saúde personalizada pode fortalecer a compreensão dos pacientes sobre a doença do DMG e melhorar a conscientização positiva dos pacientes sobre o DMG.

	Diabetes Mellitus Gestacional			com **diabetes gestacional** melito (DMG).	aleatoriamente em dois grupos.	
9 **SCIELO**	Intervenções para prevenir que mulheres desenvolvam diabetes mellitus gestacional: uma visão geral das Revisões Cochrane	GRIFFITH et al., 2020	A1	Resumir as evidências das revisões sistemáticas Cochrane sobre os efeitos das intervenções para prevenir o DMG.	Pesquisamos no Cochrane Database of Systematic Reviews (6 de agosto de 2019) com as palavras-chave 'diabetes gestacional' OU 'DMG' para identificar revisões que pré-especificam o DMG.	Uma combinação de exercício e dieta, suplementação com mio-inositol, suplementação com vitamina D e metformina foram de possível benefício na redução do risco de DMG, mas são necessárias mais evidências de alta qualidade.
10 **SCIELO**	Importância da reclassificação pós-parto do diabetes gestacional para prevenção de complicações a médio e longo prazo**.**	MV et al 2020	A2	Avaliar as diferentes recomendações e a eficácia da reclassificação pós-parto, bem como a incidência, fatores de risco e medidas preventivas para o desenvolvimento do DM	Participação de usuários com diabetes mellitus tipo 2. Foram identificados diferentes fatores que podem aumentar esse risco e, por sua vez, justificar a maior probabilidade de desenvolver doença cardiovascular.	É fundamental que a reclassificação dessas mulheres seja considerada como uma oportunidade para identificar precocemente uma alteração no metabolismo glicêmico e desenvolver medidas preventivas para evitar o desenvolvimento de DM2 e suas complicações.

Os estudos analisados nesta pesquisa trouxeram diversas analises sobre a diabetes mellitus na gestação e apontaram estratégias de assistência, manutenção da saúde e qualidade de vida, as principais ações de educação em saúde a partir dos conhecimentos técnicos científico e habilidades de competência da equipe multidisciplinar para desenvolver educação em saúde contribuem na eficácia do autocuidado por meio da modificação ou da manutenção de hábitos saudáveis e do fortalecimento da autoconfiança (PRECIADO et al., 2020; MORADI et al., 2020; PAGOTTO et al., 2020).

As ações de educação em saúde permitem aos profissionais de saúde levar informações de saúde a população e os estudos evidenciam que a ideia atinge bons resultados como facilitador das atividades educativas para o autocuidado, fazendo com que os pacientes conheçam suas condições cônicas de saúde e as dimensões dos comportamentos de autocuidado foram estabelecidos tais como alimentação, controle glicêmico, atividade física, monitorização da glicemia, cuidados com os pés, esquema medicamentoso (HOMAYOUNI et al., 2020; OLIVEIRA et al., 2022; MARTINS et al., 2018; MCCLLOSKY et al., 2019).

Diversos autores apontam a importância da realização de visitas domiciliares, atividades comunitárias ou em grupos de educação em saúde, marcação de vagas na agenda ou um horário de fácil acesso ao profissional para que as gestantes tenham melhor assistência e sejam diagnosticadas o mais precoce possível para facilitação das intervenções de saude a gestante com diabetes gestacional (PEDRINI et al., 2020; FERNANDEZ et al., 2020; SAMPAIO et al., 2020).

As estrategias de cuidados interdisciplinar e multidisciplinar possuem reflexos em todos os processos assistenciais na saúde da gestante, assim sendo, durante o pré-natal deve ser avaliar a gestante constantemente; realizar exame físico e complementar através da solicitação de exames para melhor acompanhamento da gestação. Pode-se dizer que esses fatores também podem fortalecer a adesão à dieta alimentar, a monitorização da glicemia e o uso de medicamentos, pois ter esses espaços individuais e/ou coletivos pode fazer com que a pessoa com DM tenha mais contato com o serviço e maior oportunidade de resolução quanto a essas dimensões dos cuidados individuais da gestante (SAMPAIO et al., 2020; ZHANG et al., 2019; PEDRINI et al., 2020).

IV. DISCUSSÃO

Os dados apresentados nesta pesquisa relacionados aos cuidados multiprofissionais a gestante com diabetes mellitus foram evidenciados por diversos estudos e traçam uma linha do conhecimento cientifico a respeitos das condutas de saúde a gestante com DM; os principais diagnósticos voltados para DMG e as principais ações de saúde, seja elas intervenções simples, seja solicitação de exames complementares; encaminhamento a equipe multiprofissional no sentido da prevenção de agravos; promoções da saúde e recuperação ou reabilitação da gestante com DMG.

Assim sendo, Jones et al. (2019) realizou um estudo com foco na gravida com diabetes mellitus e apontou em seus resultados que toda gestação e pós-parto representam uma janela crítica para iniciar intervenções direcionadas para melhorar a saúde cardiometabólica. Contudo esse período de intervenções a saúde possuem uma lacuna e fatores muito importantes na assistência a gestante, segundo o autor, na gestação todas as intervenções devem ser baseadas nos riscos e benefícios, promovendo melhores práticas a saúde e menores riscos ao binômio mãe-filho.

Neste mesmo sentido, Oliveira et al. (2022) apontou em seu estudo, também voltado para a saúde da mulher gravida com diabetes mellitus que na gestação as intervenções são voltadas para manutenção da vida, redução dos riscos e melhora da qualidade de vida da gestante e filho. No período pós-parto, quando se volta para os riscos, foi percebido que permanecem abaixo do ideal e variam substancialmente, por fim, o autor concluiu seu estudo apontando a necessidade de mais pesquisas são necessárias, incluindo dados confiáveis em nível populacional para informar o progresso equitativo para atender às diretrizes informadas por evidências e morbidades coexistentes, como transtornos de saúde mental.

Corroborando com o autor citado outrora, Borges et al. (2021) trouxe a luz do debate os principais fatores de risco para o desenvolvimento de diabetes gestacional e segundo o autor, os hábitos de vida, hábitos alimentares, sedentarismo, obesidade, uso de substancias tóxicas (fumo; maconha; cocaína e etc), são fatores condicionantes e determinantes para o desenvolvimento da DMG. Por outo lado, o mesmo autor aponta que as complicações da diabetes se dividem em agudas e crónicas, assim descreve que as complicações agudas abrangem a hipoglicemia, hiperglicemia, estada hiperosmolar e a cetoacidose diabética.

Complementado Borges et al. (2021), os autores Oglak; Obut (2021) defenderam que as complicações crónicas compreendem a retinopatia, nefropatia, cardiopatia isquêmica, neuropatias, doença cerebrovascular e vascular periférica. As doenças degenerativas que mais ocorrem são o infarto agudo do miocárdio, arteriopatia periférica, o acidente vascular cerebral e a microangiopatia. Oliveira et al. (2022) corrobora com os estudos vigentes e revela que as complicações decorrentes da diabetes mellitus gestacional trazem implicações e limitações graves e metabólicas a saúde da mulher em qualquer fase gestacional e que todo profissional deve saber conduzir a assistência a saúde da mulher gravida para prevenir complicações como a DMG.

V. CONCLUSÃO

Este estudo abordou os cuidados multiprofissionais a gestante com diabetes mellitus, os dados analisados apontaram para os fatores condicionantes e determinantes como os hábitos de vida irregulares, o sobrepeso ou obesidade, as limitações nutricionais e excessos alimentares, o uso ou abuso de substancias toxicas durante a gestação e o estilo de vida sedentário são fatores de grandes impactos a saúde materna-infantil. Entretanto, os estudos trouxeram informações importantes para profissionais de saúde no cuidado as gestantes com diabetes mellitus durante o pré-natal.

As limitações deste estudo se deram por alguns fatores como a indisponibilidade de estudos novos com altos níveis de evidencias e graus de recomendações nas bases de dados gratuitas. Outras limitações evidenciadas foram estudos sem base cientificam baseadas em opiniões próprias e relatos de experiências. O profissional de saúde deve ser considerado como uma peça fundamental ao paciente com diabetes mellitus, tendo em vista que a prevenção é fundamental e deve der utilizada como a ferramenta que tem por função a busca ativa dos casos novos de pacientes com diabetes mellitus, visando assim reduzir os principais problemas que essa doença pode desenvolve.

A assistência multiprofissional a gestante com diabetes mellitus é fundamental para redução dos fatores determinantes e condicionantes, dos impactos a saúde do binômio mãe-filho, melhoria da qualidade de vida. A equipe multidisciplinar deve atuar de forma contínua na prevenção e promoção de saúde que é de grande relevância para o autocuidado de pacientes com diabetes mellitus, sendo eles responsáveis por toda assistência, planejar ações de atendimento específicos para cada caso. Portanto, é necessário priorizar ações relacionadas a promoção da saúde e prevenção de complicações, tornando as intervenções educativas essenciais nos atendimentos, favorecendo o empoderamento das pessoas

em condições crônicas.

REFERÊNCIAS

[1] BORGES, Francisca Edinária de Sousa et al. Fatores de risco para a Síndrome de Burnout em profissionais da saúde durante a pandemia de Covid-19. **Rev Enferm Atual In Derme**, v. 95, n. 33, 2021.

[2] BARROS, Grasiela Martins et al. Risk factors for constant glycemic variability in pregnant women: a case-control study. **Revista Brasileira de Enfermagem [online].** 2020, v. 73, suppl 5 [Accessed 3 April 2022] , e20180983. Available from: <https://doi.org/10.1590/0034-7167-2018-0983>. Epub 07 Aug 2020. ISSN 19840446. https://doi.org/10.1590/0034-7167-2018-0983.

[3] CABRERA-FIGUEREDO, Ignacio et al . Perfil lipídico materno como predictor de diabetes gestacional. **AMC**, Camagüey , v. 25, n. 2, e7797, abr. 2021 . Disponible en http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S1025-02552021000200010&lng=es&nrm=iso . accedido en 01 mayo 2022. Epub 01Abr-2021.

[4] ERRICO, L. S.; BICALHOU, P. G.; OLIVEIRA, T. C. F. L.; MARTINS, E. F. The work of nurses in high-risk prenatal care from the perspective of basic human needs. **Revista Brasileira de Enfermagem** [online]. 2018, v. 71, suppl 3 [Acessado 6 Outubro 2021] , pp. 1257-1264. Disponível em: <https://doi.org/10.1590/0034-71672017-0328>. Acesso em: 05.10.2021;

[5] ESPANA-DORADO, Socorro Andrea et al . Prevalence of gestational diabetes and identification of associated factors and maternal-perinatal outcomes in Colombia following the implementation of the IADPSG criteria. **rev.fac.med.**, Bogotá , v. 69, n. 2, e200, June 2021 . Available from <http://www.scielo.org.co/scielo.php?script=sci_arttext&pid=S0120-00112021000200200&lng=en&nrm=iso . access on 29 Apr. 2022. Epub July 13, 2021. https://doi.org/10.15446/revfacmed.v69n2.80195.

[6] FERNANDES, C. N.; BEZERRA, M. M. M. O Diabetes Mellitus Gestacional: Causa e Tratamento. **Rev. Mult. Psic**. V.14, N. 49 p. 127-139, Fevereiro/2020 - ISSN 19811179. Disponível em: ID on line. Revista de psicologia (emnuvens.com.br). Acesso em: 29.09.2021;

[7] FERNANDEZ, N PALACIOS et al . Correlaciones de biomarcadores del primer trimestre con el peso fetal y con el peso materno en embarazadas con diabetes gestacional. **Rev. argent. endocrinol. metab.**, Ciudad Autónoma de Buenos Aires , v. 57, n. 4, p. 11-20, dic. 2020 . Disponible en http://www.scielo.org.ar/scielo.php?script=sci_arttext&pid=S1851303420200004000011&lng=es&nrm=iso . accedido en 19 abr. 2022.

[8] GRANDI, C.; TAPIA, J.L.;CARDOSO, V. C.Impact of maternal diabetes mellitus on mortality and morbidity of very low birth weight infants: a multicenter Latin America study ☆, ☆ Please cite this article as: Grandi C, Tapia JL, Cardoso VC. Impact of maternal diabetes mellitus on mortality and morbidity of very low birth weight infants: a multicenter Latin America study. **J Pediatr (Rio J**). 2015;91:234-41. ☆☆ ☆☆ Study conducted at Department of Pediatrics, Faculty of Medicine, Catholic University, Santiago, Chile. . Jornal de Pediatria [online]. 2015, v. 91, n. 3 [Accessed 5 October 2021] , pp. 234-241. Disponível em: <https://doi.org/10.1016/j.jped.2014.08.007>. Acesso em: 04.10.2021;

[9] GRIFFITH R.J.et al. Intervenções para prevenir que mulheres desenvolvam diabetes mellitus gestacional: uma visão geral das Revisões Cochrane**. Cochrane Database of Systematic Reviews** 2020, Edição 6. Art. Nº: CD012394. DOI: 10.1002/14651858.CD012394.pub3. Acesso em 23 de maio de 2022.

[10] GUERRA J.V.V. et al. Diabetes gestacional e assistência pré-natal no alto risco. Rev enferm UFPE Disponível em: https://pesquisa.bvsalud.org/portal/resource/pt/biblio101022

[11] HE, R. *et al.* The Effect of Health Education Combined with Personalized Psychological Nursing Intervention on Pregnancy Outcome of Pregnant Women with Gestational Diabetes Mellitus. **BioMed Research International**, *[s. l.]*, p. 1–6, 2022. DOI 10.1155/2022/3157986. Disponível em: https://search-ebscohost-com.ez68.periodicos.capes.gov.br/login.aspx?direct=true&db=c8h&AN=155845620&lang=pt-br&site=ehost-live&scope=site . Acesso em: 23 maio. 2022.

[12] HERNANDEZ, Teri L et al. "Nutrition therapy within and beyond gestational diabetes." ***Diabetes research and clinical practice*** vol. 145 (2018): 39-50. doi:10.1016/j.diabres.2018.04.004

[13] HOMAYOUNI, Aziz et al. "Prevention of Gestational Diabetes Mellitus (GDM) and Probiotics: Mechanism of Action: A Review**."** ***Current diabetes reviews*** vol. 16,6 (2020): 538-545. doi:10.2174/1573399815666190712193828

[14] JONES, Emily J et al. "Continued Disparities in Postpartum Follow-Up and Screening Among Women With Gestational Diabetes and Hypertensive Disorders of Pregnancy: A Systematic Review." ***The Journal of perinatal & neonatal nursing*** vol. 33,2 (2019): 136-148. doi:10.1097/JPN.0000000000000399

[15] MACEDO, Maísa Mara Lopes et al. Adesão e empoderamento de usuários com diabetes mellitus para práticas de autocuidado: ensaio clínico randomizado* * Extraído do projeto de dissertação "Avaliação do empoderamento na educação em grupo de diabetes Mellitus: ensaio clínico randomizado", Universidade Federal de Minas Gerais, 2016. **. Revista da Escola de Enfermagem da USP [online].** 2017, v. 51 [Acessado 29 setembro 2021] , e03278. Disponível em: https://doi.org/10.1590/S1980-220X2016050303278 . Epub 18 Dez 2017. ISSN 1980-220X. https://doi.org/10.1590/S1980-220X2016050303278.

[16] MACHADO, Raphaela Corrêa Monteiro et al. A gestante e o processo de viver com diabetes mellitus. Cadernos Saúde Coletiva [online]. 2021, v. 29, n. 4 [Acessado 27 Abril 2022] , pp. 595-603. Disponível em: <https://doi.org/10.1590/1414462X202129040329>. Epub

10 Jan 2022. ISSN 2358-291X. https://doi.org/10.1590/1414-462X202129040329.

[17] MARTINEZ-CRUZ, Carlos F. et al . Body mass index in offspring of mothers with diabetes mellitus: follow-up at 2, 4, 6, and 8 years of age. **Bol. Med. Hosp. Infant. Mex.**, México , v. 78, n. 5, p. 395-403, oct. 2021 . Disponible en <http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S1665-11462021000500395&lng=es&nrm=iso>. accedido en 30 abr. 2022. Epub 04-Oct2021. https://doi.org/10.24875/bmhim.20000311.

[18] MARTIS R. et al. Treatments for women with gestational diabetes mellitus: an overview of Cochrane systematic reviews. **Cochrane Database of Systematic Reviews** 2018, Issue 8. Art. No.: CD012327. DOI: 10.1002/14651858.CD012327.pub2. Accessed 23 May 2022.

[19] MASTELLA, Livia S. et al. Influence of maternal weight gain on birth weight: a gestational diabetes cohort**. Archives of Endocrinology and Metabolism [online].** 2018, v. 62, n. 1 [Accessed 7 April 2022] , pp. 55-63. Available from: https://doi.org/10.20945/2359-3997000000009 . ISSN 2359-4292. https://doi.org/10.20945/2359-3997000000009.

[20] MCCLOSKEY, L. *et al.* Navigating a "Perfect Storm" on the Path to Prevention of Type 2 Diabetes Mellitus After Gestational Diabetes: Lessons from Patient and Provider Narratives. **Maternal & Child Health Journal**, *[s. l.]*, v. 23, n. 5, p. 603–612, 2019. DOI 10.1007/s10995-018-2649-0. Disponível em: https://search-ebscohost-com.ez68.periodicos.capes.gov.br/login.aspx?direct=true&db=c8h&AN=135841087&lang=pt-br&site=ehost-live&scope=site. Acesso em: 23 maio. 2022.

[21] MONTERROSA-CASTRO, Álvaro; ROMERO-MARTINEZ, Shairine; MONTERROSA-BLANCO, Angélica. Somnolencia diurna excesiva identificada con la escala de Epworth en gestantes que acuden a consulta prenatal ambulatoria. **Rev. chil. obstet. ginecol.**, Santiago , v. 86, n. 3, p. 265-273, jun. 2021 . Disponible en <http://www.scielo.cl/scielo.php?script=sci_arttext&pid=S0717-75262021000300265&lng=es&nrm=iso>. accedido en 29 abr. 2022. http://dx.doi.org/10.24875/rechog.m21000002.

[22] MORADI, Fatemeh et al. "COVID-19 and self-care strategies for women with gestational diabetes mellitus." ***Diabetes & metabolic syndrom****e* vol. 14,5 (2020): 1535-1539. doi:10.1016/j.dsx.2020.08.004

[23] MV, OLMEDO SOSA et al . Importancia de la reclasificación postparto de la diabetes gestacional para prevención de las complicaciones a mediano y largo plazo. **Rev. argent. endocrinol. metab.**, Ciudad Autónoma de Buenos Aires , v. 57, n. 3, p. 1-10, sept. 2020 . Disponible en http://www.scielo.org.ar/scielo.php?script=sci_arttext&pid=S1851-30342020000300006&lng=es&nrm=iso . accedido en 01 mayo 2022.

[24] OGLAK, Süleyman Cemil; OBUT, Mehmet. Expressão de ADAMTS13 e PCNA nas placentas de mães diabéticas gestacionais. **Int. J. Morphol.** , Temuco, v. 39, n. 1, pág. 38-44, fev. 2021. Disponível em <http://www.scielo.cl/scielo.php?script=sci_arttext&pid=S0717-95022021000100038&lng=es&nrm=iso>. Acedido em 01 de maio de 2022. http://dx.doi.org/10.4067/S0717-95022021000100038.

[25] OLIVEIRA, Claúdia Lourenço; FONSECA, Catarina Morais; SILVA, Cristina Ramos. Uso da metformina na prevenção da diabetes gestacional na grávida obesa não diabética: uma revisão baseada na evidência. **Rev Port Med Geral Fam**, Lisboa , v. 38, n. 1, p. 74-80, fev. 2022 . Disponível em <http://scielo.pt/scielo.php?script=sci_arttext&pid=S2182-51732022000100074&lng=pt&nrm=iso>. acessos em 01 maio 2022. Epub 28-Fev2022. https://doi.org/10.32385/rpmgf.v38i1.13128.

[26] OLIVEIRA, Claúdia Lourenço; FONSECA, Catarina Morais; SILVA, Cristina Ramos. Uso da metformina na prevenção da diabetes gestacional na grávida obesa não diabética: uma revisão baseada na evidência. **Rev Port Med Geral Fam**, Lisboa , v. 38, n. 1, p. 74-80, fev. 2022 . Disponível em http://scielo.pt/scielo.php?script=sci_arttext&pid=S2182-51732022000100074&lng=pt&nrm=iso . acessos em 20 maio 2022. Epub 28-Fev-2022. https://doi.org/10.32385/rpmgf.v38i1.13128.

[27] MORLANDO, Maddalena et al. "Maternal and Fetal Outcomes in Women with Diabetes in Pregnancy Treated before and after the Introduction of a Standardized Multidisciplinary Management Protocol." ***Journal of diabetes research*** vol. 2021 9959606. 12 Nov. 2021, doi:10.1155/2021/9959606

International Journal of Advanced Engineering Research and Science (IJAERS)
Peer-Reviewed Journal
ISSN: 2349-6495(P) | 2456-1908(O)
Vol-10, Issue-4; Apr, 2023
Journal Home Page Available: https://ijaers.com/
Article DOI: https://dx.doi.org/10.22161/ijaers.104.4

Morphometric analysis of the Ekole River as a consequence of climate change: A case study in Yenagoa, Bayelsa State, Nigeria

Jonathan Lisa Erebi[1]*, Digha Opaminola Nicholas[2]

[1]Department of Geology, Niger Delta University, Wilberforce Island, Bayelsa State, Nigeria
ORCID: 0009-0007-4208-5953
[2]Department of Geography, Isaac Jasper Boro College of Education, Sagbama, Bayelsa State
ORCID: 0000-0001-7097-3578
*Corresponding Author

Received: 25 Feb 2023,

Receive in revised form: 27 Mar 2023,

Accepted: 05 Apr 2023,

Available online: 17 Apr 2023

***Keywords*— Morphometric, Climate change, SRTM, Ekole River, Hydrologic: impact**

***Abstract*—** *The effect of climate change on the morphometric features of the Ekole River in Yenagoa, Bayelsa State, Nigeria, is investigated in this study. The study employs morphometric analysis, which includes area, perimeter, mean stream length, drainage density, stream frequency, and basin length, as well as other factors like elongation ratio, form factor, shape factor, relief ratio, and density, with the assistance of the Shuttle radar topography mission (SRTM) and ArcGIS software. The Ekole River has an area of 83.76 km^2 and a perimeter of 100.75 km, according to the findings. The average stream length was 0.41 km, and the average bifurcation ratio was 2.15. The drainage density was 2.28 km/km^2 and the stream frequency was 5.56. The elogation ratio, form factor, shape factor, and relief ratio were also determined to be 0.20, 0.32 km/km, 3.14, and 3.11, respectively. These findings reveal that the Ekole River has a comparatively low discharge density and a dendritic drainage structure. The elongation ratio, form factor, and relief ratio, on the other hand, indicate that the basin of the river is comparatively elongated and narrow, with low relief. The present condition of the Ekole River is thought to be the result of climate change, which has impacted the river's hydrological processes. Finally, this research sheds light on the effects of climate change on the Ekole River and its morphometric features. Climate change has changed the river's hydrological processes and affected its morphometric parameters, according to the results.*

I. INTRODUCTION

Climate change is a global phenomenon that has significant impacts on natural systems and human activities worldwide. One of the major consequences of climate change is its impact on the hydrological cycle, which affects rivers and their morphology (Mahala, 2020). Rivers are vital resources for humans, providing water for irrigation, domestic use, and transportation, and are also important ecosystems that support a wide range of aquatic and terrestrial life (Mangan *et al*., 2019). Morphometric analysis provides a valuable tool to investigate the changes in river morphology and their responses to environmental and anthropogenic factors. Morphometry is the quantitative analysis of the physical characteristics of a river system, including its shape, size, relief, and drainage network (Rajasekhar *et al*., 2020). This approach can provide insights into the hydrological characteristics, sediment transport, and ecological processes of rivers and

help identify changes in river systems due to climate change. As stated by Ebiegberi and Eteh (2023), Morphometric analysis is a useful technique in understanding the hydrological processes, geomorphology, and ecology of rivers" (Eteh et al., 2021). The study of river morphometry can help identify the key drivers of river systems, such as climate, geology, and land use, and how these factors affect the river's characteristics. Therefore, analyzing the morphometry of rivers is crucial for understanding their response to climate change and for developing effective management strategies for fluvial systems. The Ekole River in Nigeria is an example of a river system that has undergone significant changes as a result of shoreline activities (Eteh et al., 2022). The river is located in the Niger Delta region, which is known for its high rainfall and complex river systems. The Ekole River is an important resource for the surrounding communities, providing water for irrigation, fishing, and domestic use. However, changes in precipitation patterns and land use have affected the river's morphology, with potential implications for its hydrology, sediment transport, and ecological processes. The study highlights the importance of considering the effects of climate change on river morphology in the management and planning of fluvial systems. The study underscores the need for effective management strategies that consider the impacts of climate change on river systems and that involve local communities in the planning and management of their natural resources. Therefore, in this study, morphometric analysis is used to investigate the hydrological activities of the Ekole River and their responses to environmental and anthropogenic factors resulting in climate change.

II. STUDY AREA

The region is located in the center of the Niger Delta and is made up of structures created by sedimentation, as shown in Figure 1. It is located between Latitude 4º47'0"N and 4º57'30"N, and Longitude 6º14'0"E and 6 22'30"E. The region's terrain is mostly level, with elevations reaching only 36 meters as seen in Figure 3 with Ekole river link to Nun River and Epie creek. According to Reyment, (2018) when the South American plate split from the African plate, an unsuccessful rift junction formed, culminating in the formation of the Niger Delta Basin. This procedure started in the late Jurassic era and lasted until the mid-Cretaceous period. As a consequence of this rift, various faults developed, leading to the formation of thrust faults. (Reijers, 2011). These formations comprise the Akata Formation and the Agbada Formation, both of which are paralic delta front facies. The Benin Formation is made up of a continental estuary facies. The Akata Formation's base lithostratigraphic age varies from Paleocene to Holocene. (Reyment, 2018; Etu–Efeotor, 1997). The Akata Formation is made up of deep marine sediments under great pressure and low density. The megamarine facies is composed of thick shales, turbidite sands, and trace quantities of silt and clay, indicating that it developed on a shallow marine shelf depositional environment. (Etu-Efeotor, 1997).

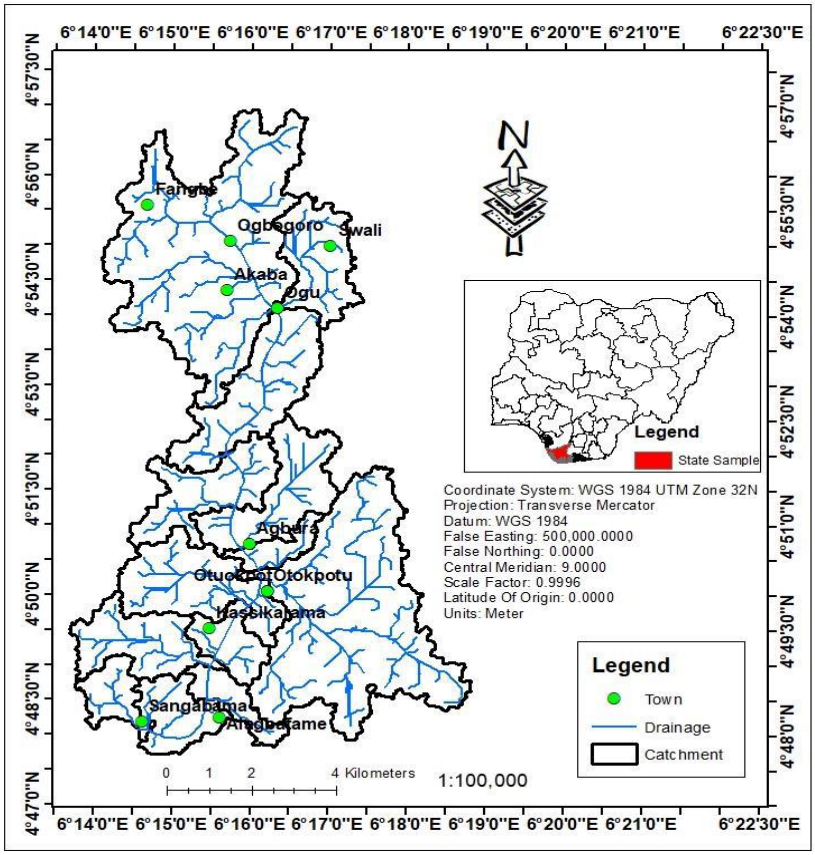


Fig.1: Location map of the study area

III. MATERIALS AND METHOD

Data Collection

This study's data was collected from both primary and secondary sources. GPS coordinates for sample sites were acquired as primary data, while secondary data were obtained from the Shuttle Radar Topographic Mission (SRTM), retrieved from https://dwtkns.com/srtm30m. Using the ArcGIS 10.6 software and the Universal Transverse Mercator (UTM) 32N coordinate system, these data sources were integrated into a shared projection using remote sensing and geographic information system technologies. The Digital Elevation Model created from SRTM data gave a comprehensive picture of the elevation values and distribution in the area.

Data processing

The research approach made use of a Geographical Information Systems and hydrology tools. The data was analyzed using ArcGIS software and Arc Hydro utilities. These tools were used to analyze the SRTM data in order to create the Digital Elevation Model and define the features of the drainage areas based on the elevation data.

IV. RESULTS AND DISCUSSION

In achieving our result, remote sensing techniques was used to obtain data on the river channel's length, width, and sinuosity. Remote sensing techniques have several advantages over traditional field surveys, including the ability to capture data over large areas quickly and efficiently, even in remote or inaccessible regions. The Remote sensing data was integrated into GIS software, allowing for the analysis of multiple parameters and the creation of detailed maps and models. The stream order and total stream length are important morphometric parameters that were deployed in this study to understand the characteristics of the river basin and climate change. The Table 1 below shows the summary of the stream order and total stream length result. The Table 1 and Figure 2 shows that the Ekole River has 5 stream order which amount in total 466 streams, with 237 being first-order streams, 121 second-order streams, 55 third-order streams, 40 fourth-order streams, and 13 fifth-order streams in Figure 2 . The total stream length of the river is 191.4 km, with the majority of the length being contributed by the first-order streams.

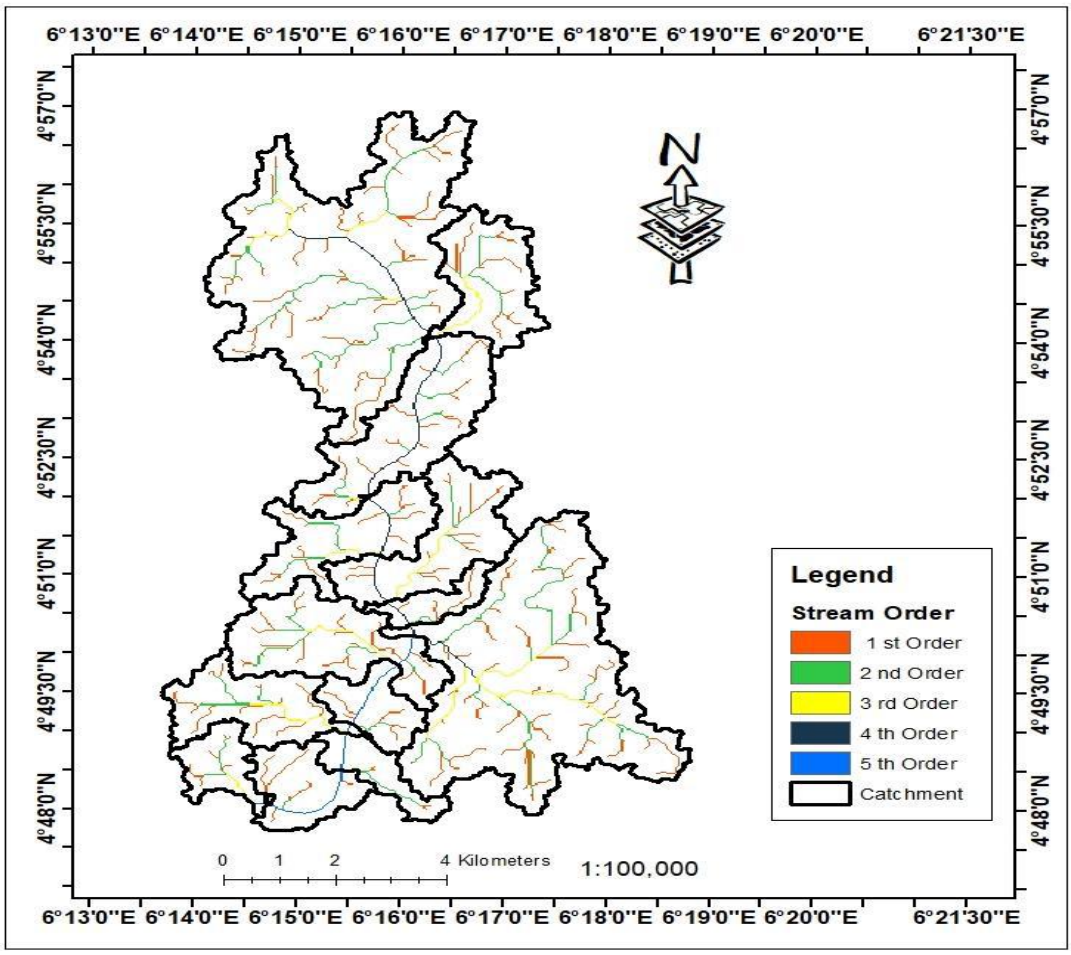
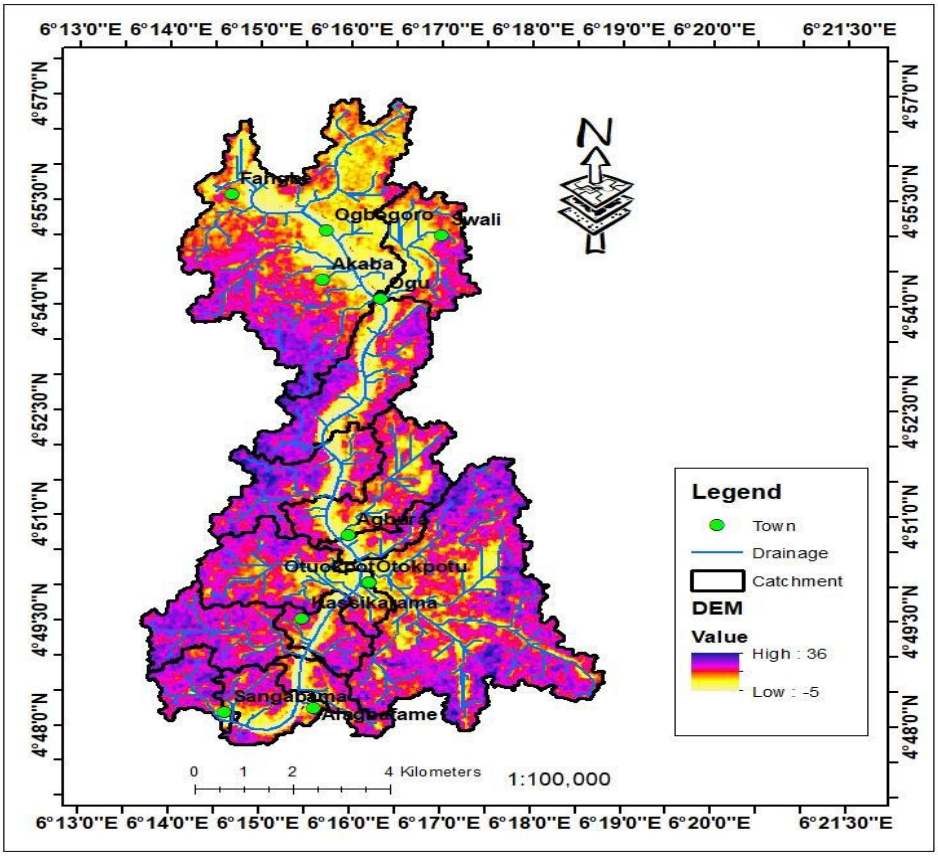


Fig.2: Stream order catchment in Ekole River



Figurer 3: Digital elevation map of the study area

Table 1: Stream characteristic of Ekole River

S/N	Stream order	Stream no (Nu)	Total stream length(Lu)
1	1st Order	237	98
2	2nd Order	121	51.98
3	3rd Order	55	21.75
4	4th Order	40	13.72
5	5th Order	13	5.41
		∑,Nu= 466	∑,LU = 191.4

Table 2: Results of morphometric parameter of river basin in Ekole River and it Formula, definition and reference

S/N	NAME	FORMULA	DEFINITION	REFERENCE	RESULTS
1	Area (A)		The total area of a basin or watershed.		83.76 km^2
2	Perimeter (P)		The total length of the boundary or outline of a basin or watershed.		100.75 km
3	Mean Stream Length (Lsm)	Lsm = A/Dd	The average distance between the outlet and all the points along the main channel in a basin or watershed.	Horton (1945)	0.41 km

4	Mean Bifurcation ratio (Rbm)	Rbm = N/N-1	The average ratio of the number of streams of the next order to the number of streams of the current order in a basin or watershed.	Horton (1945)	2.15
5	Drainage Density (Dd)	Dd = L/ A	The total length of all the streams and channels in a basin or watershed divided by the total area of the basin or watershed.	Horton (1945)	2.28 km/km^2
6	Stream Frequency (Fs)	Fs = N/L	The number of streams and channels per unit length in a basin or watershed.	Strahler (1957)	5.56
7	Drainage Texture (T)	T = Fs/Fd	A measure of the texture of a basin or watershed based on the ratio of drainage density to stream frequency.	Schumm (1956)	12.68 km/km
8	Texture Ratio (Rt)	Rt = Lb/Lsm	The ratio of the basin length to the mean stream length in a basin or watershed.	Schumm (1956)	4.62 km/km
9	Basin Length (Lb)	No formula needed.	The distance from the outlet of a basin or watershed to the farthest point along the main channel of the basin or watershed.		16.23 km
10	Circulatory Ratio (RC)	RC = (P^2/4πA)	A measure of the circularity of a basin or watershed based on the ratio of the area of the basin or watershed to the square of its perimeter.	Miller 1953	0.1
11	Elongation Ratio (Re)	Re = Lmax/Lmin	The ratio of the maximum length to the minimum width of a basin or watershed.	Horton (1945)	0.2
12	Form Factor (Ff)	Ff = 4πA/P^2	A measure of the shape of a basin or watershed based on the ratio of its area to the product of its maximum length and minimum width.	Schumm (1956)	0.32 km/km
13	Length of overland flow (Lg)	Lg = A/T	The distance that water travels overland from the farthest point in a basin or watershed to the outlet.	Strahler (1952)	1.14 km/km
14	Shape factor (Bs)	Bs = 0.25(Pc/P)^(2/3)	A measure of the shape of a basin or watershed based on the ratio of the square of its perimeter to the product of its area and length of overland flow.	Schumm (1956)	3.14
15	Relative relief (R)	R = Hmax/Hmean	The ratio of the difference between the highest and lowest elevations in a basin or watershed to the mean elevation of the basin or watershed.	Strahler (1952)	0.03 km
16	Relief ratio (Rn)	Rn = Hmax/Hmin	The ratio of the highest elevation (Hmax) to the lowest elevation (Hmin) within a specified area.	Melton (1958)	3.11
17	Ruggedness number (Rn)	Rn = ΣH/ L	A measure of the vertical variation in elevation within a drainage basin, calculated as the mean absolute difference in elevation between adjacent grid cells.	Strahler (1957)	0.07

19	Dissertative index (Di)	Di = Σ(d^2) / [Σ(d)]^2	A measure of the degree to which a particular geographic region has been studied or documented in academic literature. It is typically calculated as the ratio of the number of published articles or dissertations about the region to the region's total area.	Strahler (1964) and Schumm (1956)	0.89

The results from Table 2 shows that the area of the basin, which is 83.76 km^2, is the first morphometric measure. The basin's big area makes it susceptible to climate change effects such as increased runoff and inundation from increased precipitation. The basin's length is 100.75 km, which indicates the basin's form and area, which can influence water flow. The Ekole River has a typical stream length of 0.41 km. This parameter is critical in calculating the time it takes for water to move through the waterway. With less precipitation anticipated in the area as a result of climate change, the Ekole River's short stream length may result in a decrease in river flow and, as a result, a decrease in the quantity of water accessible for the towns that depend on the river for their water supply. The mean bifurcation ratio (Rbm) of 2.15 shows that the river basin is in its early stages and that the system of rivers is denser. The Ekole River's drainage density (Dd) is 2.28 km/km^2, which is high and suggests that the basin's channels have limited water holding capacity. This measure is significant in the context of climate change because an increase in precipitation may result in an increase in runoff, which may cause flooding and erosion, resulting in land loss. The Ekole River has a stream frequency (Fs) of 5.56, showing a high number of streams in the watershed. Because variations in precipitation trends can affect the quantity and geographic distribution of streams in the basin, this measure is significant in evaluating the effect of climate change on the basin's hydrology. The basin length (Lb) is 16.23 km, indicating that the basin is modest. The circulatory ratio (RC) of 0.10 shows that the region is elongated and has a low degree of circularity, with a low possibility for flooding. The elongation ratio (Re) of 0.20 suggests that flooding is unlikely in the region. The form factor (Ff) of 0.32 km/km indicates the structure and geometry of the basin, and the length of overland flow (Lg) of 1.14 km/km indicates the terrain of the basin. The shape factor (Bs) of 3.14 shows that the region is elongated in shape. The relief ratio (Rn) of 3.11 indicates that the draining density and relief are both substantial. The ruggedness number (Rn) of 0.07 indicates a comparatively flat terrain that could overflow in the case of heavy rain. Finally, the basin is elongated and has a low degree of bifurcation and the dissertation index (Di) of 0.89.

V. CONCLUSION

Climate change has influenced the topography of the Ekole River watershed by changing the hydrological processes that regulate the basin's creation. Changes in precipitation patterns, temperature, and other climate factors have impacted the basin's water equilibrium. The decrease in precipitation has resulted in a decrease in streamflow, which has impacted the basin's draining network. The reduction in streamflow has also resulted in a reduction in the erosion and deposition processes that form the basin's environment. Furthermore, rising temperatures have increased evapotranspiration, reducing the quantity of water accessible for hydrological processes. The decrease in water availability has also resulted in a decrease in vegetation cover, which has increased surface runoff and soil erosion in the basin, affecting morphometric parameters such as drainage density, stream frequency, and relief ratio. As a result, the morphometric analysis of the Ekole River has revealed that the basin has a dendritic drainage pattern, with a low relief and high drainage density.

VI. RECOMMENDATION

It is recommended that policymakers and stakeholders in the area take measures to create and execute effective climate change mitigation and adaptation strategies. This could include measures such as enhancing land-use practices to reduce erosion and sedimentation, encouraging replanting and conservation efforts to protect river areas, and creating early warning systems to notify communities of imminent flood or drought conditions.

REFERENCES

[1] Ebiegberi Oborie and Eteh Desmond Rowland, (2023). "Flood influence using GIS and remote sensing based morphometric parameters: A case study in Niger delta region," Journal of Asian Scientific Research, Asian Economic and Social Society, vol. 13(1), pages 1-15.

[2] Eteh D. R. ., Lolade, A. A. ., Nicholas, D. O. ., Opukumo, A. W. ., & Omonefe, F. (2022). The Environmental Impact of Shoreline Changes and Land Use/Land Cover Change Detection in the Niger Delta Region using Geospatial Technology. *Journal of Asian Scientific Research*, *12*(4), 237–248. https://doi.org/10.55493/5003.v12i4.4650

[3] Eteh, D., Akpofure, E., & Otobo, S. (2021). GIS & Remote Sensing Based Morphometric Parameters and Topographic Changes of the Lower Orashi River in Niger Delta. *Journal of Atmospheric Science Research*, *5*(1), 1–10. https://doi.org/10.30564/jasr.v5i1.3873

[4] Etu–Efeotor, J. O. (1997). Fundamentals of petroleum geology. Paragraphic publications, Port Harcourt, Nigeria, Press page 135.

[5] Horton RE, (1945). Erosional development of streams and their drainage basins: Hydrophysical approach to quantitative morphology. Bulletin of Geological Society of America. 5:275-370

[6] Mahala, A. (2020). The significance of morphometric analysis to understand the hydrological and morphological characteristics in two different morpho-climatic settings. Applied Water Science, 10(1), 1-16. https://doi.org/10.1007/s13201-019-1118-2

[7] Mangan, P., Haq, M. A., & Baral, P. (2019). Morphometric analysis of watershed using remote sensing and GIS—a case study of Nanganji River Basin in Tamil Nadu, India. Arabian Journal of Geosciences, 12, 1-14.

[8] Melton MA, (1958). Correlation structures of morphometric properties of drainage systems and their controlling agents. Journal of Geology. 66:442-460.

[9] Miller N. A, 1953. Quantitative geomorphic study of drainage basins characteristics in clinish mountain area, Verginia and Tenssesse. Columbia University. 30. (Technical Report No. 3).

[10] Rajasekhar, M., Raju, G. S., & Raju, R. S. (2020). Morphometric analysis of the Jilledubanderu river basin, Anantapur District, Andhra Pradesh, India, using geospatial technologies. Groundwater for Sustainable Development, 11, 100434. doi.org/10.1016/j.gsd.2020.100434

[11] Reijers, T. J. A. (2011). Stratigraphy and Sedimentology of the Niger Delta. Geologic, The Netherlands, 17(3), p.133-162

[12] Reyment RA (2018) Ammonitologist sensu latissimo and founder of Cretaceous Research Bengtson. P Cretaceous Research-1926-2016, 88, 5-35.

[13] Schumm SA. 1956. Evolution of drainage systems and slopes in Badlands at Perth Amboy, New Jersey. Bull. Geol. Soc. Amer.; 67:597-646

[14] Strahler AN. (1957). Quantitative analysis of watershed geomorphology. Trans, Am Geophys Union. 38:913.

[15] Strahler AN. (1964). Quantitative geomorphology of drainage basins and channel networks. In: Chow VT, editor. Handbook of applied hydrology. New York (NY): McGraw Hill; p. 4–76

https://dwtkns.com/srtm30m

International Journal of Advanced Engineering Research and Science (IJAERS)
Peer-Reviewed Jounal
ISSN: 2349-6495(P) | 2456-1908(O)
Vol-10, Issue-4; Apr, 2023
Journal Home Page Available: https://ijaers.com/
Article DOI: https://dx.doi.org/10.22161/ijaers.104.5

The Illusion of a Marshall Plan for Africa

Abdelhamid Nechad[1], Meryem Bahha[2], Mohammed Rhalma[3]

[1]Professor at ESCA, Ecole de Management, Morocco
Professor at Abdelmalek Essaadi University
[2]Phd from Abdelmalek Essaadi University
[3]Professor at Abdelmalek Essaadi University

Received: 01 Mar 2023,

Receive in revised form: 31 Mar 2023,

Accepted: 09 Apr 2023,

Available online: 17 Apr 2023

***Keywords*— Aid, assistance, geo-economics, geopolitics, poverty**

Abstract— *On Tuesday May 28th, 2013, the billionaire and philanthropist Mr. Bill Gates attended a Q&Asession at the University of New South Wales. During the session, a lady asked him: "Mr. Gates,Dead Aid, a book by Dambisa Moyo, illustrates that giving more aid to Africa over the courseof the years did not alleviate poverty, instead it kept the economy crippled with governments asking for more aid. This fluke made a cycle of aid giving which resulted in nothing productiveand it has not been used to solve the immediate problems and the money is not being used to make businesses sustainable in Africa. What's the foundation's view in this regard?" To whichMr. Gates responded "Books like that are promoting evil". Mr. Gates' sound bite sheds light upon aid as a topic of controversy: in his creed, aid is humane, virtuous and will do the global poor a world of good while anti-aid literature is evil. From Tibor Mende and his famous book"From aid to the re-colonization" (bestseller in the 70s) to Dambisa Moyo and her book "DeadAid", the issue of assistance to poor countries has been much talked about. Between the fifteenbillion dollars transferred to Europe under the Marshall Plan and the thousand billion dollarssucked up by the sub-Saharan Africa since independence, we have come to understand that a poorly-designed assistance automatically produces state-aid recipients. In this paper we will endeavor to weigh the geopolitical and geo-economic impacts of aid and demonstrate why aid,presumably an altruistic deed for the benefit of the poor and the needy, has sparked such a hotdebate.*

I. INTRODUCTION

In traditional societies, the poor and the needy all had their place in the community, no questions asked about aid or assistance. The unfortunate needed the less fortunate and vice versa: mutualaid was a natural behavior and nobody never thought of it in terms of assistance. Who wouldhave imagined that the same word would one day often designate enslaving practices againstpersons in distress, or serve as a justification for governments to conduct military or repressiveactions against their own people? The history of debates and practices around the concept ofaid shows that the inconceivable has in fact become a reality. More than a century and a halfago, Henry Thoreau was already worried about possible abuses of some voluntaristic actions: "If I knew for a certainty that a man was coming to my house with the conscious design ofdoing me good, I should run for my life". Today, Joseph E. Stiglitz, a Nobel Laureate inEconomics in 2001, cites in his book "The Price of Inequality" some otherwise edifyingexamples of how aid-specialized organizations such as the International Monetary Fund were able to destabilize the entire populations in Indonesia or Ethiopia for example. Thus, aid as construed by the modern language has nothing in common with aid as experienced in vernacularcommunities. The often spontaneous and direct relationship between two individuals called "neighbors" has turned into a highly

professionalized intervention defined in medium or long terms. An intervention often coupled with an instrument of power exercised against those it claimed to serve. In vernacular societies, sharing and caring were not only moral qualities, but also guarantees of a good social cohesion. Helping your neighbor meant acting at several levels.As an individual, it allowed you to enrich your own inner world and develop your ability to compassion and charity. Socially speaking, it boosts your moral authority over the other members of the community. Collectively, these individual and social fulfillment processes favored the emergence of similar qualities across the entire community that provide each member of the society with a productive balance between the requirements of personal fulfillment and those of social development. By embarking on the path of a large-scale vision of assistance, the religious authorities have greatly contributed to its institutionalization and corruption. For the Church, it was important to offer an institutional translation of the word of Christ. The love of the neighbor had to be encouraged indeed, but it was inconceivable that a deed representing the divine justice be not exercised in the name of the Church of God, the solequalified institution to recognize the true poor from the false. And while aid was institutionalized, it was also specialized: the love of the neighbor shall be practiced preferably for the benefit of a given institution. For those seeking to reconstruct the exact history of the concept of aid, the events that followed this first institutional takeover are particularly instructive. They show that aid and aid promotion have always enabled whatsoever governmentin power to impose its image and protect its own interests. In medieval Europe, the institutionalization of aid by the Church endorsed this belief: anyone who wanted to be absolvedfrom their sins had only to pay the price, the Church would then take care of the rest. The amount paid would prompt God to find them a place in Heaven. Thus, the original charity beganto turn into a curious exchange currency: the aid to the poor taking on the appearances of a tacitinsurance contract in order to increase the chances of the penitent donor to escape the flames ofHell. In short, aid as it was perceived by human societies has nothing in common with that preached by the international institutions and the aficionados of the *pensée unique* –a mainstream ideological conformism-. The concept of assistance was reviewed and examined by Bretton Woods institutions which broke up with the ancestral altruistic practices and traditions whether in Europe, in Africa or the Middle East. Far from this "stone age economics" of Marshall Sahlins, Adam Smith's invisible hand has deflected aid away from its main objective which is helping the destitute to recover from a situation of adversity instead of putting them in a chronic state of dependence on donors. As the late Hassan Zaoual put it: "a poorly devised assistance generates automatically state-aid recipients".

II. THE INVISIBLE HAND OF AID

In the march to the industrial revolution and the triumph of the capitalist economy, three phenomena have more determined the mutations in the discourses and practices: the seizure ofpower by the People acting on behalf of the poor –the universal suffrage ensuring this new power–, the threat of pauperism, and finally the discovery of aid as an instrument of economic promotion. Pauperism was even more threatening as it meant "the state in which individuals have the right to supply their needs by using public funds legally assigned to this purpose". For all these reasons, Eugene Buret (1840) himself did not hesitate to deem it as "the enemy of ourcivilization." The concern of every ruling class was that the growing pauperism, unlike poverty,was not merely a personal destiny marked by misfortune but rather a social problem of unprecedented magnitude. This horde of the "bad poor", inconsistent and dangerous for societyas well as for themselves, did not only embody "a disorganized, spontaneous coalition escapingevery social rationality" but it also sought to monopolize all rights to this legal assistance whilerefusing any constraints. However, these fears and this indignation did not all have the same background: the phenomenon that some refused to interpret as a result of the Industrial Revolution was felt by others as a social threat, a challenge to the mechanisms of capital accumulation. It is in this quite confused context that aid emerged as a possible solution to theproblems created by the industrial evolution. In theory, the new economic discourse on the issue of misery remained ambiguous: on the one hand, it claimed that the new sciences and wealth production techniques would know how to eradicate poverty once for all, on the other hand, it had to recognize that social and economic inequalities were not only an integral part of this production system, but they were in many ways the support and counterpoint thereof as they represent a reservoir of unmet needs essential to this very new productive system. Thus, miseryhad some benefits as long as it was not scandalous .i.e. as long as it was only a natural or socialinequality. Charles Dunoyer (1825), a pioneer of social economy, considered for instance -andhe was not alone- that a "well-behaved and mellowed out" poverty was one of the conditions for economic prosperity and the proper functioning of a production system based on the division of labor. These inequalities had another advantage: By their sole influence and without any resort to violence, they had the power to beget more inequalities and thus produce large discrepancies in the degree of freedom which everyone could enjoy. This poverty had thereforeits place in the logic of the self-regulating forces and the "invisible hand" of the market

which are supposed to restore order and equilibrium at every moment, including during disturbances by factors exogenous to economy. One of the first to express reservations about the magical power of this "hand" is the Reverend Thomas Robert Malthus, described later by Keynes as “the first economist of Cambridge”. This economist, famous for his pessimistic theories on population, is also the one who placed the emblematic figure of "the Irish peasant" at the centerof a hypothesis which went then against the grain of mainstream thinking. If this analysis of Malthus is so particularly relevant to us here, it is because it announced the revolutionary turn that would lead to a utilitarian and modern perception of aid: now that it is commoditized, aid will no longer be but an instrument of governance and subtle control of its target populations. The "Irish peasant" who haunted Malthus throughout his life, a poor quite similar to the poor in vernacular societies, symbolized a human archetype rather ominous for the future of the economy: eating only potatoes and dressed in rags, he seemed not attracted by any means to owning objects. He used to consume only what he produced and never bought a thing, and yethe seemed content with his lot. As a veritable anti-homo economicus, he was a permanent threat to economic growth. It is the persistence of men and women of similar behavior within society that led Malthus to two conclusions:

- That the "invisible hand" of the economy is not sufficient to ensure the smooth running of the productive system “at least as long as the Irish peasant would resist the seduction of manufactured needs”.
- That for the system to sell its products, it should start helping this peasant so that his needsmatch as much as possible those of the economy.

The actual social assistance will no longer signify the supply of lifebuoys thrown here and there to give a chance of survival to useless mouths: it will be transformed into a dynamic and preventive instrument prompting each and every one to meet the production needs.

III. INTERNATIONAL AID & POVERTY: WHAT ALTRUISM IS IT?

Despite the theoretical differences that we have just mentioned, there is a common aspect to human societies: the fight against all sorts of poverty. If the causes and remedies are different,the objective is widely accepted. The idea that some humans could be facing famine, doomed to an early death, illiteracy or a second class citizenship is contrary to what the concept of justicemeans to most of us. We know that all the great religions were concerned about fairness, inciting or even compelling their followers to regard the fight against extreme poverty as a moral duty.In fact, when addressing the fight against poverty by a donation, be it in kind (give a little or alot of one’s time), in cash or material (goods), it is difficult to dissociate the act as such – defined as altruistic – from the mentioned moral duty. "The disadvantage of sociological altruism is that it is perceived with values: right/wrong, good/bad, free/totalitarian, just/unjust) that make it incompatible with economic reasoning This moral altruism should be corrected by returning to the philosophical tradition. In economic philosophy, altruism corresponds to an extended rationality expanding economic calculation to the relationship that individuals have with their social environment." [2] "Essentially by definition, an altruist is willing to reduce his own consumption in order to increase the consumption of others."[3] This is a benevolent altruism. When an individual gives a coin to a beggar on the street or some of their time to an elderly person or shares their home with a poor etc… without turning this act into a media event or even disclosing it, this is generosity, solidarity, altruism. This was the case for example of the ARTC (Association for Research on Treatment against Cancer) in France at the end of the lastcentury. This is also the case of some public corporations for the jobless and rehiring firms. Thepayment of government subsidies for the integration or reintegration of people in difficulty doesnot mean the ability to ensure a social follow-up that would attain reintegration. This is somehow usurping public funds. Similarly, the payment of monetary amounts to charity can sometimes be a matter of a disinterested altruism, and sometimes of an interested altruism. In France, for example, a monetary donation to a recognized public utility association (such as Restaurants du Cœur) is compensated by a (monetary) reduction of the income tax. This mechanism introduced by the public authority raises several questions:

- The "donations" are not managed (managerially speaking) spontaneously by the donor butare organized and institutionalized. The state seeks to influence the behavior of households via tax incentives and it is possible to imagine that this behavior could have been different for some of them should there be no tax reduction in counterpart.
- An objection can be made immediately when all donating households are not all subject toincome tax. Still, they have no financial benefit. The act of donating has then a specific externality for taxable households. This does not mean that they are not altruists but it is more likely that the computation of the tax reduction is one element - among others - that influences the choice and amount of the donation(s).
- In these conditions, can we consider that the donations

from both (different) categories of households refer to the same altruism? Undoubtedly, they seek to mitigate the effects of poverty and / or partake in research breakthroughs that affect us all but it is arguable that in a market society, an act of donation has in counterpart a counter-donation -not symbolic asin other societies- but monetary. Non-taxable households make a social and / or moral "profit" out of their donations. Other households also derive a monetary benefit as the distinction between households by income class is established beyond the sources of their income and their respective expenses.

It is still possible to question the benevolent or malicious nature of altruism based on the advertisement that accompanies certain actions. If, basically, no one can argue that giving to the poor is a selfless act, the fact is that sometimes this act is revealed to the public while sometimes it is carried out with utmost discreetness. Asserting one's generosity with or withouta monetary counterpart such as the reduction of income tax in France, may mean that the donor searches the esteem of their entourage. The initiative makes sense only if it is related to what sociologists call the social interaction. Donating motivation and helping the poor depend then (at least partly) on how they appear in the eyes of the other whose recognition and approval aresolicited by the donor. The individual act is not so disinterested and does not fall out of the societal framework.

---

[2] Jarret M-F. et Mahieu F.-R. (1998) « *Economie publique: théories économiques de l'interaction sociale-Public Economics: economic theories of social interaction* », Paris, Ellipses, p. 82

[3] Becker Gary S. (1997) in Jarret et Mahieu *op. cit*. p. 21

This type of behavior seems even more plausible when advertising donations becomes the norm. In a context of mass dissemination of information and media explosion, does the "Peoplisation" of charitable organizations and foundations that are continuously seeking donations for "just causes" denote altruism? The jury is still out! "And what if the stars were only icons entrusted to do good business for the humanitarian industry." [4] The President of UNICEF France confirmed bluntly: "Yes, we need the "Peoples", they offer us easy access to the media and arouse donors' interest in our cause. Emmanuelle Béart's press conference testifying to what she saw in Sierra Leone has become an event." [5] The actress states in the same article that she "does not believe in altruism… but rather in exchange." This example is not exhaustive, yet is indicative of the "commodification" of aid, of the fight against inequality,of the fight against deprivation, of suffering and it is not for sure that this is done for the benefitof recipients only. Other associations such as Médecins Sans Frontières (MSF) chose to appealto generosity by phone or the Internet, no showcasing on television. Finally, regarding the limitsof "organized altruism", we would like to mention a few conclusions of the Audit office in January 2007, on the management of donations in the wake of the "natural" disaster, the Tsunami. In France, 340 to 350 million euros were collected plus 67 million euros of public aid. The report states that only one third was spent due to the flooding of international aid. Thebudgets were significantly too high for the actual on-site staff to manage. One can also read in this report that part of the donations received by charitable organizations or international agencies was redirected. The UNICEF for example transferred 57.4 million euros to its headquarters in New York. For the Red Cross and Catholic Relief Services, the percentage of amounts used compared to donations is about 40%. The amounts available can be granted to local NGOs, to intermediaries, namely in the building sector and public works. In an article published in "Le Nouvel Observateur", Serge Paugam (2013) underlined the enthusiasm for private solidarity "in the form of an appeal to generosity via the media .... This would be perceived sometimes with higher virtues than public solidarity which is often considered as bureaucratic and impersonal ... Of course, one must not despise this generosity, but must remember that it cannot be considered as an alternative to collective solidarities as conceived at the end of the nineteenth century." A little further on, the author denounces after all the factthat governments often react on the basis of one thing at a time and that more visible solidarityactions are those that take place in an emergency. "The news highlight, periodically, all the visible signs of a solidarity that we think spontaneous, but which is actually entertained by the media." Fighting against poverty via public policies and / or private solidarity, akin to altruism,has limitations and challenges theorists. For Van Parijs (2003), justice should be sought .i.e. allow everyone - not just in theory (location) - to have access to goods and services. «It is moreabout what is given to each and not what they do with it, it helps them achieve their own conception of life and not a particular conception that the society would consider superior to others. » That means to define a method whereby it is possible to offer opportunities to everyone and thus adhere to ethics without preaching morals. This is a major challenge for the theory of"modern" justice. A conception of an acceptable justice according to the author and which should be egalitarian in the sense that "it must express a form of material solidarity between allmembers of the concerned society.... Justice is not a matter of equity in exchange Nor is it a

matter of collective optimality understood as the production of acts globally effective for the common interest. Some inequalities can be righteous, but only if they help improve the lot of the less advantaged. » Fighting inequalities may consist in acting upon the chances and capacities, real chances and concrete capacities. It doesn't mean to express intentions or show compassion.

[4] «Le Nouvel Observateur», Feb 22nd -28th, 2007, p. 94-97

[5] Ibidem

Galbraith considers the latter as "the most truly conservative course. There is no paradox here.Civil discontent and its consequences do not come from contented people--an obvious point to the extent to which we can make contentment as nearly universal as possible, we will preserveand enlarge the social and political tranquility for which conservatives, above all, should yearn."[6] Long before Galbraith, Simmel in his reflection on the sociology of poverty had "a disillusioned look on charity and the private[7] and public philanthropy, these do not represent anend in itself but a means to achieve the cohesion of the society and the guarantee of social ties "(Paugam, 2013, 47). Does assistance aim to primarily satisfy the recipient? The donor? The established order? The example of the British trade unions (quoted by Simmel) which help the unemployed union member allows to understand that, on the one hand, they seek to alleviate income inequality but, on the other hand, they also preempt job seekers who will go now to offer their free work capacity at a lower salary, which would have the effect of lowering wagesin their sector of activity. The author goes even further: helping the poor through assistance means to avoid riots, violence to obtain income through various ways; it's even to guarantee a certain stability to society to the extent that assistance is, in fine, conservative. "The goal of assistance is precisely to mitigate certain extreme manifestations of social differentiation so thatthe social structure can continue to be based on this differentiation" (Paugam, 2013, 49). We find this critique of assistance to the global poor with Thomas Pogge[8]. The international economic interaction is considerable and, contrary to Rawls, the author thinks that poverty andextreme poverty are not due to domestic (or national) causes. While it is true that some Asian and African countries had a comparable level of GDP per capita in the 1960s and that the African countries were largely outstripped 50 years later, this differentiation in the trajectory cannot be explained by domestic factors which, according to Rawls, are likened to the politicalculture, the religious, philosophical and moral traditions, the demographic policy, the governments etc. For Thomas Pogge, we must not ignore or obscure the burden of a history tainted by unspeakable horrors: sordid slavery, unscrupulous colonialism and even atrocious genocides. "Though these crimes are now in the past, they have left a legacy of great inequalities which would be unacceptable even if peoples were now masters of their own development ... By seeing the problem of poverty merely in terms of assistance, we overlook that our enormous economic advantage is deeply tainted by how it accumulated over the course of one historical process that has devastated the societies and cultures of four continents. »[9] Since the end of colonialism the world economic order has been based on rules in favor of the rich countries byprotecting them, for example, from developing countries imports via the World Trade Organization (WTO). The control of information, of expertise, of production and access to Information and Communications Technology (ICT), gives rich countries a greater power of negotiation so that this world economic order reflects more the interests of the businesses and citizens of rich countries and, de facto, less those of the poor countries. In these conditions, assistance as an adjustment variable cannot reduce inequality - as little - but instead allows to maintain a hierarchy of wealth levels.

[6] Van Parijis Ph. (2003) « *Ethique économique et sociale-Social and economic ethics »*, Paris, La découverte,p.5.

[7] Philanthropy is therefore flourishing, especially in the USA where charitable endeavors are legion. The new philanthropists are however increasingly straying away from the traditional methods of foundations management. In fact, they are seeking to make their structures more financially and socially efficient while dreaming of the advent of philanthro-capitalism" The Birth of Philanthrocapitalism, The Economist, translatedinto French by F. Boisivon in «Problèmes économiques», n°2912, December 6th, 2006.

[8] Pogge Th. (2003), Porter assistance aux pauvres du monde-Assisting the global poor-, *Raison publique*, n°1, Octobre, Bayard, pp. 104-108, translated to French by P. Savidan.

[9] Pogge Th. (2003), Porter assistance aux pauvres du monde-Assisting the global poor-, *Raison publique*, n°1, October, Bayard, pp. 104-108, translated to French by P. Savidan.

To support his thesis, the author borrows the story attributed to Peter Singer "of a healthy youngprofessor who, walking by a shallow pond, sees a small child in it about to drown. Surely, Singer says, the professor has a duty to save the child, even at the cost of dirtying his clothes. And similarly, he argues, we have a duty to send money to poverty relief organizations that can,for each few dollars they receive, save

one more child from a painful hunger death." [10] In the eyes of Thomas Pogge this perspective reinforces the common moral judgment that the citizensand the rich countries are as responsible for poverty as the healthy young professor is for the child. Several reasons explain this widespread feeling in developed countries:

- Psychologically speaking, it is a source of comfort for the people living in the developed world.
- Considering that the domestic factors are responsible for poverty means underestimating orignoring the global factors. Since some countries are developing and others are not, it is possible to achieve the eradication of poverty on the basis of the domestic factors.
- Many governments in poor countries are corrupt which is hardly attributable to the world economic order but rather to the behavior of certain elites who do not care about the livingconditions of their compatriots. Only after having established democracy and the rule of law in these countries that reforms at the world level could be initiated.

Pogge prefers to emphasize that there is no corruption with neither the corrupted nor the corrupter! Corruption has the effect of enriching a minority at the expense of a majority maintained in a state of poverty or extreme poverty: lack of transparency in awarding public contracts, import licenses granted in return for the most generous kickbacks, bribes in arms industry, imports of unnecessary and overpriced products, etc… in other words, squandering public money and / or diverting revenues. Worse, "bribed politicians accept the development of sex tourism, the import of toxic products and waste, the location of polluting companies, the forced labor of young children", etc. That is to say so many causes[11] that do not serve the interests of the local population but that hinder their welfare and therefore, development. The solution to poverty and extreme poverty is not public assistance if it maintains the disparity in living standards, nor the private generosity of some and altruism of others (that must not be ignored) whose impact is very limited. Without hushing up the (co) responsibility of certain elites in the poor countries, according to Pogge, we must really:

- reduce the harm caused.
- not take advantage of injustice at the expense of those who endure it.
- compensate the poor .i.e. reduce the impact of unfair global rules that result in positive externalities for rich countries (such as the exploitation of natural resources in poor countries) and negative externalities for poor countries (inveiglement of their resources, environmental pollution, namely greenhouse effects due mainly to rich countries' consumption patterns).

IV. BACK TO THE SOURCES OF FAILURE OF AID TO AFRICA

Between 1948 and 1952, the United States transferred more than 13 billion dollars (100 billiondollars today) to assist in the reconstruction of Europe after World War II. We agree to acknowledge the resounding success of the Marshall Plan to rebuild the European economies devastated by war.

[10] Singer P., (1972), « Famine, Affluence and Morality », Philosophy and Public Affairs, 1, 249-43 in Pogge Th. (2003), Porter assistance aux pauvres du monde-Assisting the global poor-, *Raison publique*, n°1, October, Bayard, pp. 104-108, translated to French by P. Savidan.

[11] The IMF latest estimates are edifying: the amount of money laundered is tenfold or even more since 1990.Other than drugs and forgery, the underground economy covers the trafficking in human organs, endangered species, industrial waste, counterfeit money, handguns and nuclear centrifuges.

The plan did not only ensure the economic success of recipient nations, it also contributed, in the opinion of many analysts, to the restoration of political and social institutions of crucial importance for peace and prosperity today in Western Europe. This is true, but even if the ideaof aid policy to Africa arose from the success of the Marshall Plan in Europe, these are two completely different realities. Presenting the positive results of the Marshall Plan as a promise of similar achievements in tomorrow's Africa is completely wrong. Why?

First, the European nations were not totally dependent on aid. Despite the ravages of war, the economic revival of Western Europe was already underway; the continent had other resources.At their peak, the flows of the Marshall Plan represented only 2.5% of the GDP of the main recipient countries, such as France and Germany, and somehow they never exceeded 3% of theGDP of any country in the five year term of the program. Africa, long submerged by aid, receives today assistance for development equivalent to almost 15% of its GDP, more than fourtimes the Marshall Plan at its peak. According to Dambisa Moyo (2009) "Given Africa's poor economic performance in the past fifty years, while billions of dollars of aid have poured in, itis hard to grasp how another swathe of billions will somehow turn

Africa's aid experience intoone of success." [12] In addition, the Marshall Plan was time limited. The United States had set atarget, the European countries accepted the terms of the contract and signed the document. Money flowed abundantly for five years only. In contrast to the Marshall Plan financial injection, decisive but short, Africa has, generally speaking, received uninterrupted support for at least fifty years. An ongoing aid for an unlimited duration so that no effort would be needed.Thus, in the absence of any explicit threat of aid interruption, and as nothing inspires the feelingthat one day it could end, African governments have had to consider the aid as a permanent andsecure source of income; they have no reason to think that the lakes of lucre will not continue to flow indefinitely. There is no incentive to build long-term financial plans, no rhyme or reasonto look for other ways to finance development when all you have to do is sit and wait quietly for your check to cash. Crucially, the Marshall Plan context was so different from the African context. Before the war, the devastated European nations had already the necessary institutions:they had an experienced public service, well-managed companies, an administration of the courts and effective social organizations. After the war, all it took was an injection of money to restart the machine. The Marshall Plan provided an aid for reconstruction, not for economic development. No matter how wrecked Europe was, it had a structure in place, a political, economic and physical structure, while, despite the infrastructure inherited from colonialism, Africa had not experienced any effective development. Building, and not rebuilding, the political and social institutions requires more than money. The flow of billions of simoleons ofaid, poorly controlled and regulated as little as possible has resulted in undermining the establishment of these institutions as well as of a sustainable growth. In this respect, the recentand successful experience of Ireland (before the subprime crisis), which received substantial sums from the European community, cannot be cited as evidence that aid might work in Africa. For, as the post-war Europe, Ireland had the institutions and infrastructure required to master and control aid and make it produce a significant economic impact. Ultimately, while the aid provided by the Marshall Plan targeted the physical infrastructure mainly, assistance to Africacovers almost every aspect of the economy. In most poor countries today, the aid is channeled to the public service, the political institutions, the military, public health, education, infrastructure The more the scope of aid is extended the more corrosive aid is, and the greater aid dependency culture is. Aid advocates underline the economic success of the countries which today have ceased to be assisted after having received assistance in the past. These are countries such as those of the IDA (International Development Association).

[12] Moyo D., L'aide fatale-Dead Aid-, Editions JC Lattès, 2009.

They are twenty-two countries and they include some of the emerging countries that experienced the greatest economic successes: Chile, China, South Korea, Thailand and Turkey. Three of them only are African: Botswana, Equatorial Guinea (mainly because of the discoveryof oil deposits) and Swaziland. Aid champions suggest that these countries have substantially reduced poverty, increased income and improved the living standards thanks to a large-scale assistance. However, as in the case of the Marshall Plan, it should be noted that the aid flows in question were relatively moderate (i.e. less than 10% of the GNP) and of short duration. Botswana, often cited as the classic example of a good student of the IDA, had actually receivedsubstantial foreign assistance in 1960 (20% of the GNP). Between 1968 and 2001, the averageeconomic growth of Botswana per capita reached 6.8%, one of the highest in the world. But it is not aid that is to be held accountable for this performance. Botswana had vigorously pursued a policy favoring the market economy and that is the key to its success - its trade policy was open to competition, monetary stability was sought and the fiscal discipline observed. Cruciallyenough, in 2000, the aid to Botswana represented only 1.6% of the national income, that is to say, a tiny proportion compared to aid nowadays in so many African countries. The success ofBotswana lies in the fact that it ceased to be aid dependent. Until the middle of the first decadeof the 21st century, many believed that aid was synonymous with poverty reduction. The theseswhich were developed afterwards came to deny this approach. In her book "Dead Aid", Dambisa Moyo cites the fictitious example of an African manufacturer of mosquito nets. He produces about 500 nets per week. He employs ten people who, as usual in Africa, maintain each fifteen relatives. Despite their hard work, these people cannot make enough nets to effectively combat the malaria-carrying mosquitoes. A Hollywood star enters the scene, runs a crowdfunding campaign and bullies Western governments into sending 100,000 mosquito nets to the region. The operation amounts to one million dollars. The nets arrive and are distributed. A good altruistic action is accomplished. But once the market was flooded with these nets, the local manufacturer had to close down. His ten employees can no longer feed the 150 souls whodepend on them (and who are now forced to live on alms), bearing in mind that in maximum five years the majority of the imported nets will eventually be torn and useless. This is the micro-macro paradox. An effective intervention in the short term can have only very few lastingbenefits. Worse, it risks to unintentionally undermine the existing chances, no matter

how fragile they are, of any authentic sustainable development. Thus, at first sight, aid appears to have a positive effect. But with hindsight, we see that not only the overall situation did not improve, but it worsened. In almost all cases, short-term assessments create a false impressionof aid success. But this kind of assessments is not relevant when it comes to tackling Africa's problems over the long term. We should measure the effectiveness of aid by questioning whether it contributes to sustainable long-term growth and lifts up the greatest number of individuals out of poverty. And from this perspective, aid proves to be a failure. That is said, the proposal of a new food aid formula launched at the Food Aid Conference in Kansas City in2005 was an attempt to give a new direction to the policy of assistance which could benefit African farmers. The said proposal would allow a quarter of the US Food for Peace budget to be used for the purchase of food in poor countries, rather than only buy food from American farmers and ship it by sea. Thus, instead of flooding the American food markets and ruining thelocal farmers, this strategy would lead to use aid money to buy the products from the local farmers and distribute them to the locals in need. Going back to the example of mosquito nets,one could imagine that the donors would buy those nets from the local manufacturers and thensell them or give them to the locals. This approach should be applied to all problems. Aid advocates argue that aid works - but that rich countries are not generous enough. They plead that if Africa was given a “big helping hand” i.e. a substantial increase in aid for the decisive investments, Africa could have escaped the persistent poverty trap. In fact, Africa needs increased aid, massively increased aid. Only then things will truly improve.

In 2000, 180 countries subscribed to the Millennium Development Goals (MDG). This eightfold action plan targeted health, education, environment preservation, child mortality, andthe alleviation of poverty and hunger. In 2005, the program cost was revalued: an additional injection of $ 130 billion per year would be needed to achieve the objectives of the MDG in a number of countries. Two years after the collective commitment to this program the United Nations organized an international conference in Monterey, Mexico on the theme: Financing for Development, during which donor countries promised to increase their contributions (an average of 0, 25% of their GNP) and bring them to 0.7% in the belief that the annual additional200 billion dollars would finally settle the persistent problems of Africa. In practice, most of the commitments made by donor countries were not honored, and aid champions, clinging to the failure of donor countries, saw in it the reason for the backwardness of Africa. But the notion of giving "a big helping hand", the decisive thrust, skirts one of the great problems of aid, namely that it is fungible - that the amounts assigned to a certain goal can be easily diverted, and used differently, especially for irrelevant or even harmful projects. It’s noteworthy that theuncontrolled flow of aid always runs the danger of being consumed rather than invested, lining up the pockets of individuals instead of landing in the public treasury. When this happens, andit often does, no sanction is imposed, no punishment is inflicted. More subsidies means more corruption. One of the gloomiest aspects of this aid fiasco is that donors, politicians, governments, academics, economists and specialists all know deep within themselves that aid does not work, that it never has and it never will. In his comment on some assistance action, the Director of Government Economic Services at the UK Ministry for Trade and Investment madethis remark: "They know it is pure hot air but it sells their T-shirts." Welcome to the real world! Countless studies and reports (often carried out by donor countries) showed that, after several decades, and after billions of dollars spent, aid had not had any appreciable impact on development. Examples: Clemens in 2004 recognized that there was no sustainable impact of aid on growth, Hadjmichael (1995) and Reichel (1995) found a negative relationship between aid and savings, Boone (1996) concluded that aid had financed consumption rather than investment. On the other hand it was demonstrated that foreign aid had increased public spending and unproductive consumption, and failed to promote investment. Even a cursory glance at the available data suffices to suggest that, while aid has soared over time, growth in Africa has been declining and has been accompanied by a more accentuated poverty. Over thelast thirty years the most aid-dependent countries can boast an average annual growth rate of less than 0.2%. For the majority of these countries the direct consequence of aid was tailspinning into poverty. While before the 1970s most economic indicators were on the rise, a decade later Zambia was economically ruined. Bill Easterly, professor at New York University and former economist at the World Bank, notes that if Zambia had converted all the aid receivedsince 1960 into investments and had relied on market growth, it would have had in early 1990sa per capita GNP of around 20,000 dollars. Instead, Zambia GNP was lower than in 1960 and was less than 500 dollars per capita! In fact, it should be thirty times higher than it is today. Between 1990 and 1998 aid to Africa skyrocketed from 11 to 66%, a staggering progression, only to see about 600 million Africans controversially trapped in poverty. The case against aidstands on firm ground, it is so persuasive that even the IMF which plays a leading role in this area warned the fervent supporters who pin high hopes on aid and see in it the instrument of a development it cannot eventually stimulate. The IMF also recommended that governments, donors and organizers of various campaigns be

more modest in their statements and not pretend that increased aid would solve the problems of Africa. We would like that this moderation be the prelude to real change. The most mind-boggling aspect of this issue is that there is no otherarea of human activity, be it business or politics, where one would not think to change course and would persevere in error in spite of compelling evidence of utter failure.

Such is the status quo: sixty years, over one trillion dollars spent on aid to Africa and a result that is more than modest. If aid was just harmless, if it just did not do what it had claimed to do, this paper would not have been written. The problem is that it is not harmless, it is evil. It is not part of the potential solution, it is part of the issue. In fact, aid is the issue.

V. CONCLUSION

Whether at a national or international level, aid aims primarily at helping the alleged "donors" to maintain the devices that perpetuate their positions of power and social privileges, while depriving the poor of their own means to fight against poverty. For the poor, this aid embodies the logic of an economy which not only commits all humans to often harmful external donations that are beyond their control, but also which destroys the great human and social balances thatthe vernacular lifestyle of the poor had created to help them confront necessity. The social system this economy seeks to establish in lieu may lead to the perpetual "quarantining" of manypeople and the dislocation or even the implosion of their societies. It institutionalizes a form of secular charity that transforms the beneficiaries into permanent aid-dependents, thus more andmore dependent on a system of needs that corrupts both body and soul alike. We easily understand now why the promoters of major international meetings regularly held in favor of helping the poor - one of them which gathered Heads of States in March 2002 at Monterrey, Mexico, - carefully avoided any debate on the root causes of the production of misery and injustice. In fact, they are well aware that a careful examination of these cases would unveil the fraud perpetrated today worldwide under the brand of aid. Indeed, such a debate risks to disclosethe perverse collusions, often structural, which, always in the name of aid, unify the leaders ofthe North and the South against their own "subjects". And when, for the sake of propaganda, the Northern "generous donors" threaten to reduce their "aid" on the grounds that the recipientgovernments are corrupt, this examination would eventually reveal all the machinery set up by these same donors to "help" these "rogue" governments rule over their own populations. Finally, a serious investigation of the underlying reasons for these maneuvers would demonstrate to the world opinion that the most of the aid destined to eligible poor countries is intended whether to strengthen military and coercive programs or to restructure their economies to be adapted to the requirements of the sole global market. Hence this bitter conclusion: what we insist on calling aid is but an expense to strengthen the structures that generate misery. However, the victims who are stripped of their real properties are never assisted since they seek to stand out from theglobal productive system in order to find alternatives in concert with their own aspirations.

REFERENCES

[1] Ballet J., (1997) *Les entreprises d'insertion –Rehiring firms-*, Paris, PUF, Coll. «Que sais-je?».

[2] Buret E. (1840) *De la Misère des classes laborieuses en Angleterre et en France: de la nature de la misère, de son existence, de ses effets, de ses causes, et de l'insuffisance des remèdes qu'on lui a opposés jusqu'ici, avec les moyens propres à en affranchir les sociétés– On misery of the Working Class in England and France: the nature of misery, its existence, its effects, its causes, and the lack so far of remedies against it, with the relevantmeans to emancipate societies from it-*, Paris, Paulin.

[3] Dunoyer C.(1825) *L'Industrie et la morale considérées dans leurs rapports avec la liberté-Industry & Morality viewed in Their Relationships With Liberty-, Paris, Paulin.*

[4] Farcet G. (1998) *Henry Thoreau: l'Éveillé du nouveau monde- Henry Thoreau:The enlightened from the new world-*, Paris, Sang dans la Terre.

[5] Jarret M-F. & Mahieu F.-R. (1998) *Economie publique, théories économiques de l'interaction sociale- Public Economics: Economic theories of social interaction-*, Paris, Ellipses

[6] Le Nouvel Observateur, Feb 22-28, 2007

[7] Moyo D. (2009), *L'aide fatale -Dead Aid- , Paris, Lattes.*

[8] Paugam S. (2013) *Le lien social –The social link-*, Paris, PUF, Coll. «Que sais-je?».

[9] Pogge Th. (2003), Porter assistance aux pauvres du monde -Assisting the global poor-, *Raison publique*, n°1, October, Bayard, pp. 104-108, translated into French by P. Savidan.

[10] Sahlins M. (1976), *Age de pierre, âge d'abondance -Stone age economics-*, Paris, Gallimard

[11] Stiglitz J (2012) le prix de l'inégalité -The price of inequality-, Paris, Fayard.

[12] Christian ARNSPERGER, Philippe Van Parijs (2000) *Ethique économique et sociale – Social & economic ethics-*, Paris, La découverte.

[13] *"What Makes Democracies* Endure?" Adam Przeworski, Journal of Democracy, 7, no. 1 (1996)

International Journal of Advanced Engineering Research and Science (IJAERS)
Peer-Reviewed Jounal
ISSN: 2349-6495(P) | 2456-1908(O)
Vol-10, Issue-4; Apr, 2023
Journal Home Page Available: https://ijaers.com/
Article DOI: https://dx.doi.org/10.22161/ijaers.104.6

Perceptions of players in the wood-energy market on the effects of their activities on the dynamics of the vegetation cover in the western part of the Plateaux Region in Togo

Perceptions des acteurs du marché du bois-énergie sur les effets de leurs activités sur la dynamique du couvert végétal de la partie Ouest de la Région des Plateaux au Togo

Komla Uwolowudu Amegna

Department of Geography, Center for Research and Expertise on the Dynamics of Spaces and Societies, Kara University, Togo

Received: 27 Feb 2023,

Receive in revised form:26 Mar 2023,

Accepted: 01 Apr 2023,

Available online: 18 Apr 2023

***Keywords*— perception, wood-energy, vegetation, Plateaux Ouest (Togo)**

***Mots clés*— Perception, bois-énergie, végétation, Plateaux Ouest (Togo)**

***Abstract*—** *The efforts made in black Africa in general and in Togo in particular for the preservation of vegetation have had unsatisfactory results. New approaches deserve to be adopted in order to attenuate the anthropic pressures exerted on the vegetation. Taking into account one of the panoply of factors to be examined, this study aims to identify the perceptions of players in the wood- energy market in the western part of the Plateaux Region in Togo in order to better direct their actions towards the protection and preservation of vegetation. The methodological approach of this study is based on the classic methodology of geographical research: field observation, documentary research, interviews and field survey. The results reveal that 16 per cent of the producers recognize that their activities strongly degrade the vegetation. 6 per cent of collectors and 3 per cent of traders have the same perception. In addition, 78 per cent of producers, 82 per cent of collectors and 65 per cent of retailers declared a slight degradation of the plant cover from their activities. The secondary actors, in particular stevedores, shippers and transporters or carriers, unanimously do not recognize the contribution of the wood-energy market to this mechanism.*

***Résumé* —** *Les efforts déployés en Afrique noire en général et au Togo en particulier pour la préservation de la végétation ont connu des résultats non satisfaisants. De nouvelles approches méritent d'être adoptées afin d'atténuer les pressions anthropiques exercées sur la végétation. Prenant en compte un de la panoplie de facteurs à examiner, cette étude vise à identifier les perceptions des acteurs du marché du bois-énergie dans la partie Ouest de la Région des Plateaux au Togo pour mieux orienter leurs actions allant dans le sens de la protection et de la sauvegarde de la végétation. L'approche méthodologique de cette étude*

repose sur la méthodologie classique d'une recherche géographique : l'observation du terrain, la recherche documentaire, les entretiens et l'enquête de terrain. Les résultats révèlent que 16% des producteurs reconnaissent que leurs activités dégradent fortement la végétation. 6% des collecteurs et 3% de commerçants ont la même perception. Par ailleurs, 78% des producteurs, 82% des collecteurs et 65% des revendeurs ont déclaré une légère dégradation du couvert végétal à partir de leurs activités. Les acteurs secondaires notamment les débardeurs, les chargeurs et les transporteurs à l'unanimité ne reconnaissent pas l'apport du marché du bois-énergie dans ce mécanisme.

I. INTRODUCTION

Au Togo comme dans nombre des pays en développement, les énergies d'origine ligneuse utilisée dans les secteurs domestiques et artisanaux sont essentiellement destinées à la cuisson des aliments, au chauffage de l'eau, à la boulangerie, à la forge… Les études réalisées sur les énergies dans ces pays s'accordent à reconnaître le rôle prépondérant joué par les énergies traditionnelles (bois de feu, charbon de bois) dans ces secteurs (K. SESSI, 2001, p. 21). La consommation nationale du bois-énergie va connaître une augmentation significative dans les années à venir. En considérant une constance dans les pratiques énergétiques des ménages jusqu'en 2023 (c'est-à-dire en absence de politique de réduction de la demande), les scénarii indiquent que la consommation nationale domestique s'établirait à 7,944 millions de mètres cubes de bois dont 1,919 million de tonnes de bois de chauffe, soit 2,742 millions de mètres cubes et 364 107 tonnes de charbon de bois équivalant à 5201 millions de mètres cubes (K. KOKOU, 2019, p.42). Au-delà de ces avantages que les populations tirent de cet usage, la biomasse se trouve exposée à la pression de la demande en bois-énergie. La végétation se dégrade suscitant des réflexions axées sur la partie Ouest de la Région des Plateaux non seulement du point de vue de sa dégradation continuelle mais aussi la recherche des approches pour sa protection. La dimension relative à la dégradation a été explorée par une pluralité de travaux dont ceux de T.T.K. TCHAMIE (2000) dans le Kloto, K. KOUAME (2005) dans le Litimé, T. TCHEINTI-NABINE (2006) dans le Danyi, T. SOUSSOU (2009) dans la plaine de Litimé, A. E. KOUYA (2010) dans la région des plateaux, P. W. TAKOU (2012) dans cinq préfectures des plateaux-Ouest, K. AGBEYADZI et al (2020) dans la partie Ouest de la Région des Plateaux au Togo (K. U. AMEGNA et al, 2020, p.) pour ne citer que ces travaux.

S'agissant des approches proposées diversement pour endiguer la dynamique régressive du couvert végétal, les travaux concourent aux mêmes conclusions. Elles visent à atténuer la déforestation et stopper la désertification. C'est dans cette perspective que les actions envisagées ont portées sur l'amélioration de foyers pour la cuisine, la technique de carbonisation, l'utilisation des combustibles de substitution, des plantations forestières la foresterie paysanne et communautaire (G. MADON, 2017, p. 203). Cependant, force est de constater que ces mesures sont loin d'arrêter le phénomène. Les résultats attendus étant non satisfaisants, la poursuite des réflexions sur la thématique en vue de l'adoption d'une approche efficace s'avère nécessaire.

Il se pose le problème du choix de l'approche la mieux indiquée pouvant assurer la réussite des projets visant à la sauvegarde et à la protection durablement et efficacement l'environnement forestier dans cette région du pays. C'est face à cette situation qu'il est important de repenser et de se poser la question suivante : comment peut-on efficacement lutter pour préserver la végétation dans la partie Ouest des Plateaux au Togo. Par hypothèse, l'identification des perceptions des acteurs qui animent le marché du bois d'énergie de la région sur la dégradation de la végétation de ladite zone pourrait guider au mieux la politique à adopter. Cette étude vise donc à identifier les perceptions des acteurs du marché afin de mieux orienter leurs actions. Toute activité faisant entorse à l'environnement forestier en général et en particulier au couvert végétal est identifiée et analysée dans le but d'en apporter la façon la mieux indiquée de son exécution non seulement dans l'intérêt des bénéficiaires mais aussi la protection et la conservation des ressources pour les générations futures. Cette analyse est d'abord axée sur les matériels et méthodes de la recherche. Ensuite, la deuxième partie présente les résultats. Enfin le dernier volet discute les résultats obtenus.

II. MATERIELS ET METHODES

Cette rubrique présente la partie Ouest de la Région des Plateaux au Togo comme zone d'étude et l'approche méthodologique adopté.

2.1 Présentation de la zone d'étude

Les auteurs du marché sur lesquels porte cette étude sont basés au Togo notamment dans la partie Ouest de la Région des Plateaux (figure1).

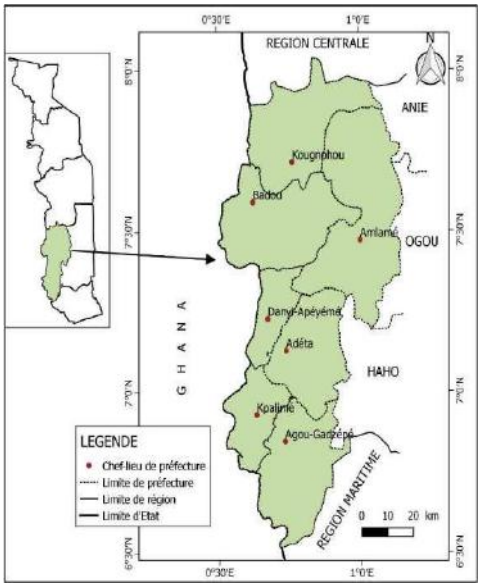


Fig.1: Localisation de la zone d'étude

Source : fonds de carte IGN, 1986, actualisé (AMEGNA et al. 2019, p.249)

D'après les travaux de AMEGNA et al. (2019, p.249), la zone d'étude est située entre 6°50' et 8°50' de latitude Nord et entre 0°30' et 1°10' de longitude Est. Elle est limitée au Nord par le plateau de l'Adélé, au Sud par le bassin sédimentaire côtier, à l'Est par la plaine du Mono avec les préfectures comme Ogou, Haho et Anié, puis à l'Ouest par la République du Ghana.

2.2 Méthodologie

L'approche méthodologique de cette étude repose sur la méthodologie classique d'une recherche géographique : l'observation du terrain, la recherche documentaire, les entretiens et l'enquête de terrain.

L'observation a permis d'identifier les acteurs du marché du bois-énergie dans La partie Ouest de la Région des Plateaux (Togo) considéré comme une source de consommation mais aussi un bassin d'alimentation des grandes agglomérations méridionales du Togo en bois énergie.

La recherche documentaire a, quant à elle, donné accès à la consultation des études antérieures ayant abordé la filière bois- énergie. La consultation de ces études a permis d'avoir une idée sur les acteurs des circuits de commercialisation de l'Ouest des Plateaux en direction des villes méridionales parmi lesquelles, le District Autonome du Grand Lomé (DAGL). Ce qui pourrait orienter les décideurs dans la prise des décisions afférentes à la protection du couvert végétal de la zone d'étude.

L'enquête de terrain a ciblé une population composée de 06 catégories d'acteurs considérés comme les acteurs du marché du bois énergie par qui la collecte des données concerne. Ce sont entre autres les producteurs, les collecteurs, les grossistes, les débardeurs, les chargeurs et les transporteurs.

Pour la détermination de la base de sondage des acteurs, nous avons adopté le sondage par « choix raisonné » pour deux raisons. La première est due au fait que aucun acteur précité ne fait de cette activité, un emploi permanent. La deuxième raison est relative à l'absence d'une base de données. C'est sur cette base et de façon aléatoire que nous avons interrogé 200 producteurs, 50 collecteurs, 50 grossistes, 30 débardeurs 25 chargeurs et 20 transporteurs. La répartition des enquêtés par préfecture est présentée par le tableau ci-après.

Tableau 1 : Effectif et répartition des enquêtés

Acteurs	Préfectures							Total
	Amou	Agou	Akébou	Danyi	Kloto	Kpelé	Wawa	
Producteurs	30	25	30	30	30	25	30	200
Collecteurs	7	5	8	8	8	4	10	50
Grossistes	7	5	8	8	8	4	10	50
Débardeurs	4	3	5	4	5	3	6	30
Chargeurs	3	3	4	4	4	3	4	25
Transporteurs	3	3	3	3	3	3	3	21
Total	54	44	58	57	58	42	63	376

Source : Travaux de terrain, 2022

Au total 376 acteurs ont été touchés par l'enquête de terrain. Les différentes catégories d'acteurs sont reparties sur les sept (07) préfectures de la zone d'étude à savoir 54 dans Amou, 44 dans Agou, 58 dans Akébou, 57 dans Danyi, 58

dans Kloto, 42 dans Kpélé et 63 dans Wawa. Les données de terrain sont traitées avec Excel et ArcView 3.2 et ont servi à élaborer les tableaux, les cartes et les graphiques.

III. RESULTATS

C'est pour répondre à l'objectif de cette étude, celui recenser les perceptions des acteurs impliqués dans le marché du bois énergie sur la thématique de dégradation du couvert végétal que cette étude se planche sur cette catégorie de composantes du marché. Ces acteurs sont ainsi classés en deux groupes notamment les principaux acteurs et les acteurs secondaires.

3.1 Les principaux acteurs

Ce sont des acteurs qui sont en amont du circuit de distribution dont la présence est capitale pour la disponibilité de la marchandise. Sans ces derniers, la liaison entre le bassin de production et celui de consommation ne saurait exister. Ce sont les producteurs, les collecteurs et les grossistes. Cette étude a exclu les consommateurs d'autant puisque les études antérieures menées dans cette zone d'étude ont montré que la partie Ouest des plateaux au Togo est plus un bassin de production du bois-énergie pour l'alimentation du grand Lomé et les villes secondaires du pays (K. U. AMEGNA et al., 2020, p. 236).

3.1.1 Les producteurs

Les producteurs sont une catégorie d'acteurs importants dans le circuit de commercialisation du bois énergie dans la zone d'étude et dans l'approvisionnement des villes méridionales du pays de cette énergie. La perception des 200 producteurs (soit 53,19% de l'ensemble des enquêtés) sur l'action du marché du bois énergie en lien avec la dégradation du couvert végétal n'est pas la même d'un producteur à un autre (figure 2).

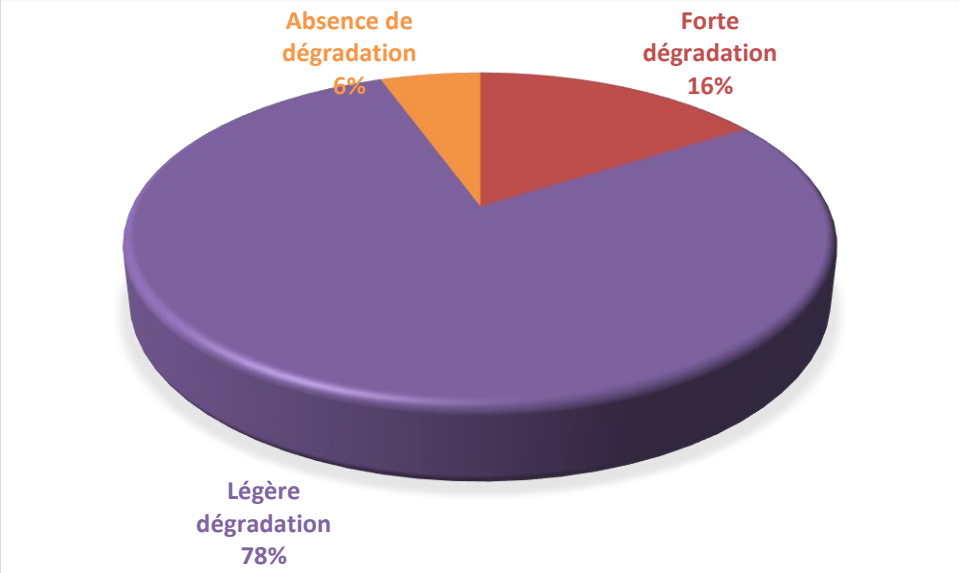


Fig.2: Perception des producteurs enquêtés

Source : Enquête de terrain, 2022

Les données de la figure 2 montrent qu'une proportion de 16% de producteurs perçoivent que le commerce du bois énergie dégrade fortement le couvert végétal de la zone d'étude. Pour 78% des producteurs, l'activité commerciale du bois énergie dégrade légèrement la végétation. Par contre, 6% trouvent que cette activité est sans effet sur la végétation du milieu. De cette description ressort des informations de natures diverses. Seuls 16% des producteurs sont convaincus des effets pervers de ce commerce sur la végétation. 84% des producteurs minimisent l'ampleur du phénomène et les enjeux environnementaux auxquels la population fait face. Ceci révèle que la majorité (soit 84%) n'as pas encore pris conscience du mal. Dans ce cas, il est clair que les efforts de sensibilisation pour la protection de la végétation et qui tiennent compte de cette catégorie de population, sont d'emblée un échec. Elle ne peut donc pas s'engager dans des actions qui ciblent l'activité de la vente du bois énergie comme un facteur de dégradation du couvert végétal. Plus de 93% des producteurs enquêtés ont déclaré qu'ils utilisent le bois vert pour produire du bois de chauffe et du charbon de bois. A peine 7% ont dit qu'ils utilisent uniquement le bois mort pour produire le bois énergie.

Photo 1 : Des tas de bois de chauffe exposés dans les abords de la route Atakpamé-Badou à Evou-Apégamé

Planche 1 : bois de petits calibres

Planche 2 : brindilles

Source : Cliché de l'auteur, 2022

Les planches 1 et 2 présentent des tas de bois de chauffe disposés dans les abords de la route pour la vente. La planche 1 fait voir des bois de petits calibres. La nature de ces bois, par observation, montre que ces bois ont été produits à partir des bois verts provenant des arbres abattus à cet effet. Les bois de la planche 2 sont des brindilles. Ils ne proviennent pas des bois morts des forêts ou des savanes. Sans doute, ils sont aussi des produits des arbres abattus.

Photo 2 : Des sacs de charbon de bois exposés dans les abords de la route Adéta -Danyi Apéyémé

Source : Cliché de l'auteur, 2022

La photo 2 fait voir des sacs de charbon de bois entassés en vue de leur acheminement à Lomé pour leur commercialisation. L'exposition ne permet pas de savoir si les produits émanent du mort ou du bois vert. Mais les résultats des enquêtes sus-présentés (plus de 93%) montrent à suffisance que ces produits émanent du bois vert. Les revendeurs achètent leurs marchandises soit auprès des producteurs-vendeurs, soit auprès des collecteurs basés dans le bassin de production.

3.1.2. Les collecteurs

Ils sont des acteurs qui opèrent dans le bassin de production du bois énergie. Leur mission consiste à collecter auprès des producteurs pour le compte des revendeurs grossistes. En tant que des intermédiaires dans le circuit, ils servent de liaison entre les producteurs ruraux et les grossistes citadins. La prise en compte des points de vue de ces acteurs est importante dans la définition des stratégies pour la lutte contre de la dégradation du couvert végétal dans la mesure où ils connaissent mieux les points ou les zones où se trouvent les marchandises. C'est pourquoi 50 collecteurs furent interrogés sur la thématique, soit une proportion de 13, 30% de l'ensemble des enquêtés. Les informations recueillies sont présentées par la figure ci-après.

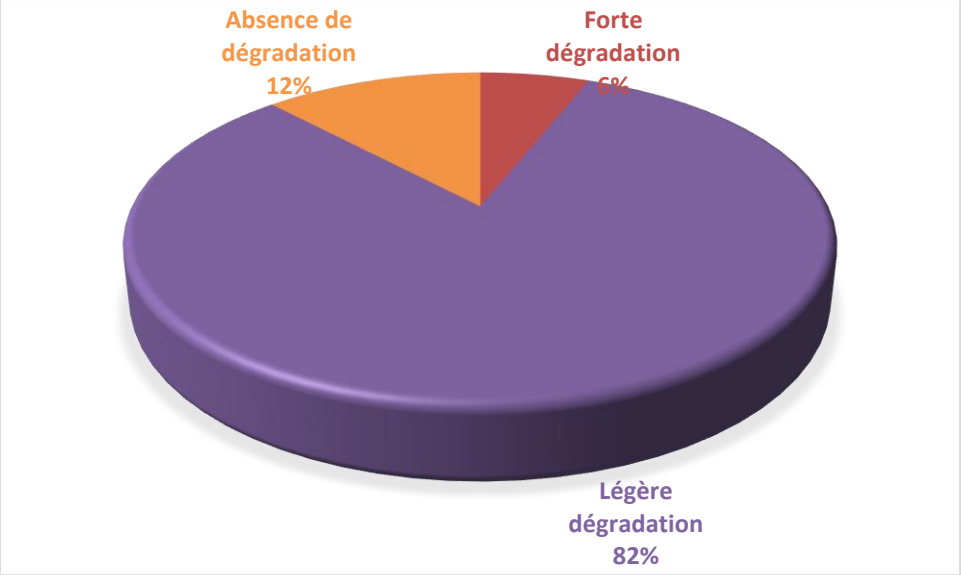


Fig.3 : Perception des collecteurs interrogés

Source : Enquête de terrain, 2022

L'analyse des données de la figure 3 montrent qu'une proportion de 6% des collecteurs perçoivent que le commerce du bois énergie dégrade fortement le couvert végétal de la partie Ouest de la Région des Plateaux. Selon 82% des collecteurs, l'activité commerciale du bois énergie dégrade légèrement la végétation. Par contre 12% trouvent que cette activité n'a aucune action néfaste sur la végétation de la zone étudiée. La perception des collecteurs est similaire à celle des acteurs précédents (producteurs) mais avec une nuance d'autant puisque 94% des collecteurs ne trouvent pas que cette activité impacte dangereusement le couvert végétal. 6% seulement sont conscients du mal même s'ils demeurent encore des acteurs actifs du circuit. Cette similitude est observée et existe entre les collecteurs et les grossistes qui animent le circuit de commercialisation.

3.1.3 Les grossistes

C'est une autre catégorie d'acteurs du circuit de commercialisation qui assure la vente dans le bassin de production mais aussi dans les métropoles méridionales du pays en particulier dans le grand Lomé. Les enquêtes de terrain ont concerné 50 grossistes, soit 13,30% de la population interrogée. La perception des grossistes sur l'action du marché du bois énergie sur le couvert végétal varie d'un grossiste à un autre. Néanmoins, la synthèse des différentes positions est faite dans la figure suivante.

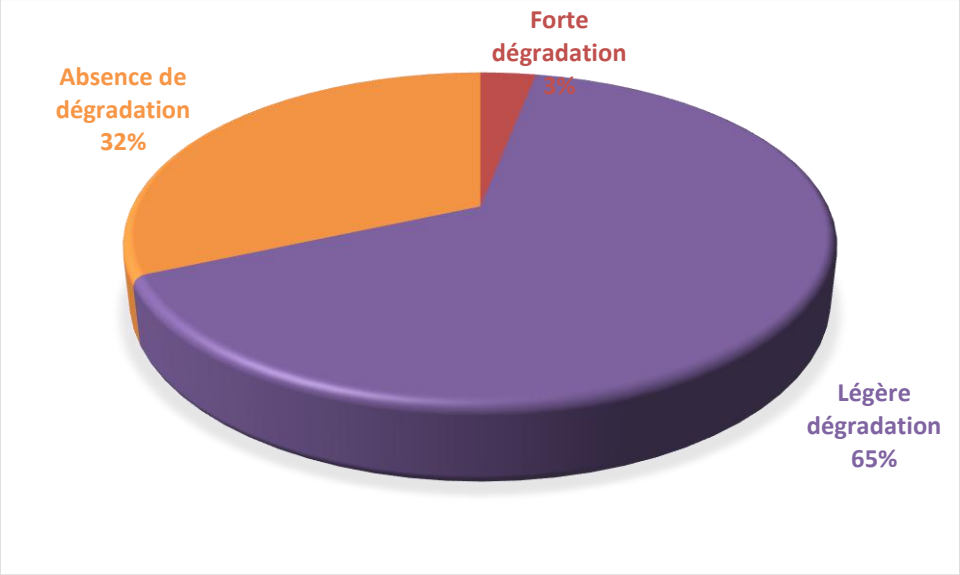


Fig.4: Perception des grossistes

Source : Enquête de terrain, 2022

Les données de la figure 4 montrent que, seuls 3% des grossistes perçoivent que le commerce du bois énergie dégrade fortement le couvert végétal de la zone d'étude. Par contre, 65% des grossistes estiment que l'activité commerciale du bois énergie dégrade légèrement la végétation. 32% trouvent que cette activité est sans effet sur la végétation du milieu. Le tableau 2 ci-après présente une vue globale des perceptions de principaux acteurs mis à part les consommateurs finaux.

Tableau 2 : Le récapitulatif des perceptions des principaux acteurs

Perception / Acteurs	Forte dégradation	Légère dégradation	Absence de dégradation
Producteurs	16%	78%	6%
Collecteurs	6%	82%	12%
Revendeurs	3%	65%	32%

Source : Travaux de terrain, 2022

Des producteurs jusqu'aux grossistes en passant par les collecteurs, la proportion de ceux qui estiment que le commerce du bois énergie n'a aucun effet sur la végétation a évolué en croissance (6 ; 12 et 32%). De ce fait, les sensibilisations pouvaient être plus orienter les grossistes et les collecteurs afin de les amener à prendre conscience de l'existence du mal. Ceci pouvait mieux orienter leur comportement vers une attitude plus responsable.

3.2 Les acteurs secondaires : les débardeurs, les chargeurs et les transporteurs

Les acteurs secondaires prêtent des services spécifiques aux principaux acteurs. Ce sont des services dont l'objectif consiste à aider les principaux acteurs dans leurs tâches. Ces services ne se font pas en plein temps. Ce sont les débardeurs, les chargeurs et les transporteurs.

Les débardeurs

Les débardeurs assurent la fonction de débardage de la marchandise. Il s'agit par le portage, de transporter le bois produit du point de production jusqu'au point d'entreposage pour ainsi faciliter soit la vente, soit le transport par camion pour la vente. Les enquêtes de terrain ont touché 30 débardeurs. Aucun de ces auteurs n'a reconnu les effets pervers du marché du bois-énergie sur la végétation. Qu'en est-il des chargeurs ?

Les chargeurs

Les chargeurs assurent la mission de chargement des camions sollicités pour le transport de la marchandise. 25 chargeurs furent enquêtés afin de recueillir d'eux leurs points de vue sur l'action du marché du bois-énergie en général et leurs activités en particulier sur la végétation.

Les informations recueillies auprès d'eux révèlent que le marché du bois-énergie n'affecte pas dangereusement l'état de la végétation.

Les transporteurs

Ils sont au service des revendeurs (les grossistes) qui ont besoin de leurs services pour l'acheminement de leurs marchandises dans les bassins de consommation. 21 transporteurs c'est-à-dire conducteurs de camion ont été interrogés. Pour ce qui concerne leurs perceptions sur la question de recherche, il et à retenir qu'à 100%, ces acteurs ont déclaré que leurs activités ne font pas entorse à la végétation.

IV. DISCUSSION

Une diversité de travaux existe sur les causes de déforestation et de dégradation des forêts. C'est le cas de cette analyse qualitative portées sur les facteurs directs de déforestation et de dégradation des forêts en Côte d'Ivoire où l'exploitation du bois énergie participe à une proportion de 29% dans ce processus (MEDD, 2016, p. 47). La même étude commanditée en RDC a révélé que la coupe du bois de chauffe intervient à 20% dans la déforestation du pays (MECNT, 2016, p.26). Cependant, les études prenant en considération spécifiquement les perceptions des acteurs du marché du bois-énergie sur la dégradation de la végétation en lien avec leurs activités sont inexistantes. C'est donc un terrain inexploré malgré la pluralité de travaux orientés sur la végétation et qui nécessite d'être travaillé.

La présente étude portée sur l'identification des perceptions des acteurs du circuit de commercialisation du bois énergie de la partie Ouest des Plateaux au Togo révèle que seulement 16% des producteurs ou exploitants reconnaissent que leurs activités dégradent la végétation. 6% des collecteurs et 3% de commerçants ont la même perception. Faute d'études pouvant permettre de confronter ces résultats à ceux d'autres études réalisées dans d'autres espaces géographiques, les chiffres évoquent une certaine ignorance de la part des acteurs malgré les campagnes de sensibilisation et d'information et de formation, les contrôles et les repressions des forestiers dans la zone d'étude. Dans ces conditions, on ne peut qu'assister à un gaspillage des ressources forestières. Une étude commanditée au Togo par le Ministère de l'Environnement et des Ressources Forestières – MERF (2017, p.69) a abouti à la même conclusion. La ressource bois est aujourd'hui gaspillée. Les comportements et les habitudes des utilisateurs dans certaines région où la ressource est abondante (régions des plateaux et centrale) entraînent des pertes importantes de combustibles ligneux. La prise de conscience de la raréfaction de la ressource n'est pas généralisée à l'échelle nationale.

V. CONCLUSION

Au terme de cette étude menée pour recueillir les points de vue des acteurs du marché du bois d'énergie sur les effets de leurs activités en lien avec la dynamique du couvert végétal de la partie Ouest de la Région des Plateaux au Togo, il ressort une divergence de positions de ces acteurs sur la thématique. Certes tous s'accordent sur le fait que de la production jusqu'à la consommation de cette énergie traditionnelle, la végétation reçoit un coup dur. Elle se dégrade continuellement ; sauf que le degré d'implication de ces activités dans ce processus de dégradation est différemment conçu par les acteurs qui animent les activités de la chaîne de commercialisation. Néanmoins par catégorie d'acteurs, les enquêtes diligentées ont accouché les résultats dont le contenu est le suivant : 16% des producteurs, 6% des collecteurs et 3% de commerçants du bois énergie ont reconnu que leurs activités dégradent fortement la végétation. La majorité de ces acteurs soit 78% des producteurs, 82% des collecteurs et 65% des revendeurs (commerçants) a déclaré une légère dégradation du couvert végétal à partir de leurs activités. La dernière dimension du travail a concerné la catégorie des acteurs qui perçoivent que la production et la commercialisation n'ont aucun effet néfaste sur la végétation. Par rapport à ce point de vue, la présente étude a identifié 6% de producteurs, 12% de collecteurs et 32% de revendeurs. Tous les autres acteurs à savoir les débardeurs, les chargeurs et les transporteurs à l'unanimité dans leurs déclarations, ont minimisé l'apport du marché du bois énergie dans ce mécanisme. En somme, il est donc à retenir que 84% des exploitants, 94% des collecteurs et 97% des revendeurs de même que les acteurs secondaires ne se sentent pas véritablement concerner par les actions engagées (sensibilisation, l'application de règlements en vigueur, …) pour la préservation de la biodiversité en général et de la végétation de cette zone en particulier. A partir de ces données, il est aisé de comprendre la raison pour laquelle, malgré les appels à la protection et à la sauvegarde de la végétation, force est de constater la dynamique régressive de cette dernière.

Au regard des données sus-présentées et vu la nécessité de poursuivre la lutte pour préserver le patrimoine forestier dans la partie Ouest des Plateaux, des actions ciblées méritent d'être menées au niveau de chaque catégorie d'acteurs. La première consisterait à aider chaque catégorie à prendre conscience des effets pervers de leurs activités sur la végétation et à collaborer sérieusement et efficacement à toute action allant dans le sens de la réduction de ces effets et du coup à préserver le patrimoine végétatif.

REFERENCES

[1] AGBEYADZI, Kossi, TAKOU Paroussiè Wiyao, OLANLO Tini Kodzo, 2020 : L'écotourisme, alternative à la vulnérabilité des ressources naturelles et des sociétés dans un contexte de changement climatique dans les Plateaux Ouest du Togo ? In : Revue Ivoirienne de Sociologie et des Sciences Sociales, volume 1, n° 3, Université Alassane Ouattara, Bouaké, p. 49 – 62.

[2] AMEGNA Komla Uwolowudu, 2012 : Approvisionnement et distribution des combustibles ligneux dans la ville de Lomé. Thèse de doctorat en géographie. Université de Lomé, Lomé, 337 p.

[3] AMEGNA Komla Uwolowudu, AGBEYADZI Kossi, SOUSSOU Tatongueba 2020 : Consommation du bois-énergie et dégradation du couvert végétal de l'Ouest de la Région des Plateaux au Togo. In : Géo Vision, Revue du Laboratoire Africain de Démographie et des Dynamiques Spatiales, Vol.1 N°003, Université Alassane OUATARA, Bouaké 01, Côte d'Ivoire, pp- 228-243.

[4] KOKOU Kouami, 2019, Etude de faisabilité pour le développement des énergies renouvelables au Togo. Rapport final, Lomé, Togo, 127 p.

[5] KOUYA, Ama - Edi, 2010, Les changements environnementaux et l'appauvrissement de la biodiversité en milieu montagnard Akposso (Sud-ouest du Togo). Thèse de doctorat, Université de Lomé, 246 p.

[6] KOUWAME Koami, 2005 : Evolution récente des reliques forestières à sous-bois cultivé et ses conséquences environnementales dans la plaine du Litimé (Sud-Ouest Togo). Mémoire de maîtrise en Géographie physique, Université de Lomé, Lomé, 89 p.

[7] MADON Gérard, 2017 : Le bois, énergie de première nécessité en Afrique : une ressource trop souvent négligée, De Boeck Supérieur, Louvain-la-Neuve, Belgique, pp- 201-222.

[8] MECNT, 2016 : Etude qualitative des facteurs de déforestation et de dégradation des forêts en République Démocratique du Congo. Version finale de UN-REDD programme, 165 p.

[9] MEDD, 2016 : Analyse qualitative des facteurs de déforestation et de dégradation des forêts en Côte d'Ivoire. Rapport final du programme ONU-REDD, 114 p.

[10] MERF, 2017 : Etude approfondie sur la dynamique de l'utilisation du bois-énergie au Togo, 112 p.

[11] SESSI Koffi : 2001 : Rapport d'étude sur les données du bois énergie au Togo. Programme de partenariat CE-FAO (1998-2002) – GCP/INT679/EC, 31 p.

[12] SOUSSOU Tatongueba, 2009 : Dynamique forestière dans la plaine du Litimé sous pression anthropique au Togo, Thèse de doctorat, Université Paul Cézanne Aix-Marseille III et Université de Lomé, Marseille,176 p.

[13] TAKOU Paroussiè Wiyao, BOUKPESSI Tchaa, DJANGBEDJA Minkilabe, MAMA Adi, 2012 : Apports de la télédétection et des systèmes d'informations géographiques dans l'étude de la dynamique des paysages végétaux de l'Ouest de la Région des Plateaux au Togo. In : Revue du Laboratoire de Recherche Biogéographique et d'Etudes Environnementales, n°9, Université de Lomé, Lomé, pp.30-48.

[14] TCHAMIE Thiou Tanzidani Komlan, 2000 : Les problèmes environnementaux liés à la caféiculture sur les plateaux du Sud-Ouest du Togo. In : Revue CAMES - Série B, vol.02, 2000 Sciences sociales et humaines, pp. 153-166.

[15] THIAM Alioune Tamchir, 1999 : Etude des marchés des produits forestiers ligneux au Togo, projet PNUD/FAO, Lomé, 225 p +Annexe.

International Journal of Advanced Engineering Research and Science (IJAERS)
Peer-Reviewed Journal
ISSN: 2349-6495(P) | 2456-1908(O)
Vol-10, Issue-4; Apr, 2023
Journal Home Page Available: https://ijaers.com/
Article DOI: https://dx.doi.org/10.22161/ijaers.104.7

VCO Rancidity Analysis refers to Fermentation Time that Produced by Gradual Heating Method

Toar Daniel Malingkas[1], Nelly Selvia Tongkeles[1•], Damianus Manesi[2], Resti Fadillah[3], Onesimus Ke Lele[1], Desak Ketut Tri Martini[1], Elesta Banamtuan[3]

[1]Dry Land Agriculture Cultivation Study Program, Faculty of Military Logistic, Republic of Indonesia Defense University, Belu, Indonesia
[2]Ship Engineering Study Program, Faculty of Military Logistic, Republic of Indonesia Defense University, Belu, Indonesia
[2]Plantation Cultivation Study Program, Faculty of Military Logistic, Republic of Indonesia Defense University, Belu, Indonesia
•Corresponding Author

Received: 04 Mar 2023,

Receive in revised form:02 Apr 2023,

Accepted: 10 Apr 2023,

Available online: 23 Apr 2023

Keywords*— *VCO, fermentation time, moisture content, free fatty acid, peroxide value

***Abstract*—** *One of the final processed products from coconut that is popular in Indonesia, even in several other countries, for the last 3 years is Virgin Coconut Oil (VCO), which is processed directly from coconut meat. Processing of these products is part of the application of Applied Technology in the development of Coconut commodity products, and is very affordable in terms of production costs for the people in Belu district, NTT province, which has a land border between the Republic of Indonesia and Timor Leste, where the people does not well know about VCO processing technology accordance with quality standards. This study aims to analyze rancidity of VCO produced by gradual heating method on the effect of fermentation time by determining parameters of water content, peroxide value, and free fatty acid content based on the applicable Indonesian National Standard (SNI). Each parameter has been fermented for 2 hours, 6 hours and 10 hours as a treatment in this observation and analyzed in a descriptive way through the results chart. The results showed that the treatment for 2 hours, 6 hours and 10 hours had a moisture content of 0,15%; 0,12%; 0,1% then free fatty acid content is 0,09%; 0,10%; 0,11% and also peroxide value 0,52 mg ek/kg respectively. Based on the results of this study, it can be concluded that each test result is still below the threshold value according to the provisions of the Indonesian National Standard (SNI) 7381:2008.*

I. INTRODUCTION

Belu regency is one of the regencies that are part of NTT province at Indonesia. It is located in the easternmost region of the province and is directly bordered by land with the Republic Democratic of Timor Leste (RDTL) with an area of 1284,94 km^2 (BPS, 2021a). Dewi et al (2022) mentioned that the dry season at NTT, including the Belu regency, is very different from other regions in Indonesia. This regency also has a longer dry season than the rainy season, wherein the dry season can last for 8 months compared to the rainy season.

Coconut is the most extensively cultivated plant, grown and used for human life, especially for the people of Belu. This is because these plants greatly influence the social, cultural, and economic roles of society wherein almost all parts of these plants can be used by humans, so that they become the most potential multi-purpose plants.

Based on the conditions of the season, several superior potential plantation crops can grow well as a source of wealth of natural resources in Belu Regency. One of them that is Coconut (*Cocos Nucifera* L.) with plantation area about 1303 hectares, which is spread over several sub-districts on this regency (BPS, 2021b). The availability of existing natural resource potential become momentum for the Belu government to establish the agricultural sector as one of the mainstay sectors (Boboy, 2022), in community-based economic development in this regency.

There are various benefits derived from coconut plants. One of the most widely used is the ripe kernel (Coconut meat) to be processed into coconut oil, desiccated coconut, also coconut milk, and what is really needed during the Covid-19 pandemic era until now to help sufferers to recover that is Virgin Coconut Oil (VCO). According to Snowdon et al (2003) the amount of nutrients contained in coconut meat depends on the type/variety, age, and other ecological factors. The most significant nutrient in fresh coconut water is sugar and ripe coconut it is fat. Specifically, the ripe kernel contains protein 4.08 g, fat 39 g, energy 389 kcal, sugar 4 g, dietary fiber 7.5 g, moisture 46.30%, crude fiber 3.39%, and carbohydrates 11.29% (Snowdon et al., 2003; Woodroof, J. 1979).

The process of making VCO is one part of the application of post-harvest handling technology to processed food products. The application of this technology, among other things, can play a role in producing derivative products that have a longer shelf life and have a higher economic value when farmers face problems with very abundant crop commodities. The results of its implementation will be very beneficial for the community, especially those in areas with limited sources of information based on the results of studies that have been conducted (Malingkas et al, 2021; Tongkeles et al, 2022)

Processing to produce VCO is often done in a traditional way. The resulting product often has a fairly high water content which can be seen with the naked eye in the presence of white lumps. The existence of these white lumps can accelerate the process of damage to VCO which can cause a decrease in quality due to rancidity. This could be caused by the presence of a protein component in the form of blondo which was not properly filtered during the oil separation process.

Various research on VCO as a coconut derivative product have been carried out by experts, especially on how it is made by traditional method or even with processing technology. Pontoh et al (2008) have tested several methods for processing VCO in terms of the water content and rancidity (peroxide value and free fatty acid content) of the VCO. According to him, the best VCO processing technology is using gradual heating method. Furthermore, refers to the quality standards of VCO from APCC (2004) that is limits of free fatty acid content maximum of 5%, water content ranges from 0.1% to 0.5%, and a maximum VCO peroxide value is 3 meq/kg oil. The limit values for each criteria in that standard are adjusted to the needs of VCO standards in Indonesia through the Indonesian National Standard (SNI) 7381:2008 (BSN, 2008), where the maximum free fatty acid content is 0.2%, water content maximum of 0.2%, and a maximum VCO peroxide value is 2 meq/kg

This study aims to determine the quality of VCO through rancidity analysis produced by gradual heating method on the effect of natural fermentation time by determining parameters of water content, free fatty acid content, and peroxide value based on Indonesian National Standard (SNI) 7381:2008. Each parameter has been natural fermented for 2 hours, 6 hours and 10 hours as a treatment in this observation and descriptive analyzed by chart.

II. MATERIALS AND METHODS

Materials and Tools

This study used materials such as Coconuts, with a harvest age of between 10 and 12 months were collected from the vicinity of Kaluk Mesak District at Belu Regency East Nusa Tenggara province, water, and other materials used for samples analysis in the laboratory. Then the tools used are 2 in 1 coconut milk producing tools (designed from the Faculty of Military Logistics, Republic of Indonesia Defense University), gas stoves, gas cylinders, pots, pans, plastic containers, filter cloth, VCO container bottles, filter papers, and other tools used when analyzing samples in the laboratory.

Coconut Processing into Virgin Coconut Oil

Coconut milk was obtained using a 2 in 1 coconut milk production tool, then left for natural fermentation with 2 hours, 6 hours and 10 hours as a treatment in this study until 2 layers were formed, namely cream, and skim (water). Then the cream is carefully separated to extract the oil which will be filtered using a filter cloth.

The filtered oil still has a mixture of cream on it, so it is heated at $<90^{O}C$ until formed oil and blondo (heated cream) with white in color. Furthermore, the oil is separated from the blondo and heated again for 10 hours at a temperature of $60^{O}C$, then cooled in containers. The final stage is the oil filtered again using filter papers (for more clear oil) and stored in a bottle container.

Sample Analysis Procedure

The VCO samples examination were held at the Food and Drug Control Agency in Kupang city, according to SNI Virgin Coconut Oil number 7381:2008 standard quality. The choice of this place was due to the limitations of the laboratory test which was close to the place where the research was carried out. Determination of these quality standards on this research is limited to the parameters for determining moisture content, free fatty acids (FFA), and peroxide value of VCO.

Moisture Content

Moisture content for VCO was determined by gravimetry method, where the weight loss during heating at 105°C is considered as the moisture content present in the sample. According to Dalmadi (2019) principle of this method is to find out the amount of water in the sample by weighing the initial weight of the sample before heating and after heating. Samples were heated in an oven at 105 °C for 3 hours by weighing the sample weight every 1 hour. Moisture content was determined using equation:

Moisture Content (%wb) (BSN, 2008) :

$$\frac{[m_1 - m_2]}{m_1} x100\% \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Note:

m_1 = weight of material before drying (gram)

m_2 = weight of material after drying (gram)

Free Fatty Acid (FFA)

Free fatty acids are fatty acids that exist as unbound free acids as triglycerides. Free fatty acids are produced from hydrolysis and oxidation processes which usually combine with neutral fats (Dalmadi, 2019). The principle in determining free fatty acids is to dissolve the fat/oil sample in a certain organic solvent (96% alcohol is neutral) then proceed with the titration process using NaOH or KOH solution (BSN, 2008).

This method was determined by adding 10 g of sample to a 200 mL Erlenmeyer and adding 50 ml of 95% ethanol. Into the mixture added 3-5 drops of Phenolphthalein indicator. Then it was titrated with 0.0991 N NaOH standard solution until it turned pink. The final step is to record the amount of KOH solution used during the titration to determine the free fatty acid content (expressed as a percent of fatty acids) based on the following equation.

Free Fatty Acid (FFA) (%) ((BSN, 2008) :

$$\frac{V \times N \times 200}{m \times 10} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

Note :

V = volume of NaOH solution used during the titration (ml)

N = NaOH Normality

Peroxide Value (PV)

The principle in determining the peroxide number is that the sample solution in glacial acetic acid and chloroform is reacted with KI solution. The liberated iodine is titrated with a standard sodium thiosulphate solution (BSN, 2008).

The steps taken in determining the value of the peroxide number were by inserting 5 grams of sample into an Erlenmeyer with a volume of 300 ml then while shaking 25 ml of a solvent mixture consisting of 60% glacial acetic acid and 40% chloroform was added to it. After the oil has dissolved, 1 ml of saturated potassium iodide solution is added while shaking. Furthermore, allowed to stand for thirty minutes in a dark room, then 30 ml of distilled water was added. The excess iodine is titrated with 0.1012 N sodium thiosulfate solution until the yellow color almost disappears. Then 0.5 ml of 1% starch solution was added, and the titration process was continued until the blue color disappeared.

The final step is to calculate the peroxide number expressed in milligrams equivalent of peroxide in every 1000 g of sample. The equation used in this calculation is:

Peroxide Value (Pontoh et al., 2008) :

$$\frac{ml\ Na_2S_2O_3 \times N \times 1000}{G} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

Note:

G = Weight of sample (gram)

N = $Na_2S_2O_3$ Normality

III. RESULTS AND DISCUSSION

The quality of VCO obtained through a comparison of the natural fermentation time of coconut milk to produce VCO using the gradual heating method has gone through testing parameters in the form of water content, peroxide value and free fatty acid levels which were carried out in the laboratory of the food and drug control agency, Kupang city, NTT province. The test results data from the laboratory were then analyzed descriptively through a graphical display of each parameter.

Moisture Content of VCO

The percentage of water content in a material that plays an important role in the process of damage, spoilage and rancidity in food ingredients. According to Rindawati et al (2020), one of them is the high water content in the oil can cause a hydrolysis reaction which converts the oil into free

fatty acids and glycerol and will cause rancidity in the oil. The results of determining the VCO water content from three lengths of fermentation using the gradual heating method can be seen in Figure 1 below.

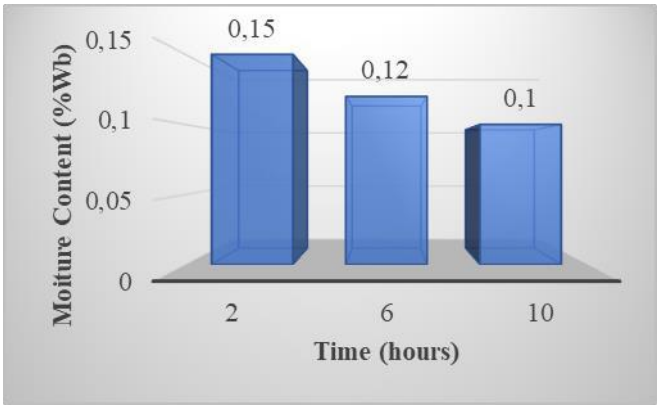


Fig 1. VCO Moisture Content

Based on the results of Figure 1, the water content values for all VCO samples still meet the requirements of SNI 7381:2008 with a maximum moisture content value of 0.2%. The data showed that for the length time of natural fermentation for 2 hours, 6 hours and 10 hours the water content was 0.15% wb; 0.12%wb; 0.1%wb.

That is shows that the longer the natural fermentation of coconut milk, the lower the water content of the VCO produced. This is because when the coconut milk was fermented there is a separation process into two layers, where the part that has a lot of oil content called cream is at the top, and the part that has a lot of water content called skim is located at the bottom. To produce VCO, part that will be processed next is the cream part, more longer the natural fermentation is carried out lead to water content more less in the cream part will be.

In addition, results of this study also in accordance with the research conducted by Pontoh et al (2008), where the gradual heating method can produce VCO with the lowest water content because it has gone through 2 stages of heating the VCO. The results of the water content according to the SNI standard were obtained in the second stage of the heating process, because on this stage the VCO was heated to a temperature < 65 ^{O}C for 10 hours with aim to reducing the high water content from previous stage.

Free Fatty Acid (FFA) of the VCO

Parameters for determining the content of free fatty acids in oil, especially in VCO, are very important to do. This is because these free fatty acids are present in oil or fat, so they are an early indicator of rancidity and as a determinant of oil quality. Figure 2 shows the amount of free fatty acid content in VCO based on the treatment carried out.

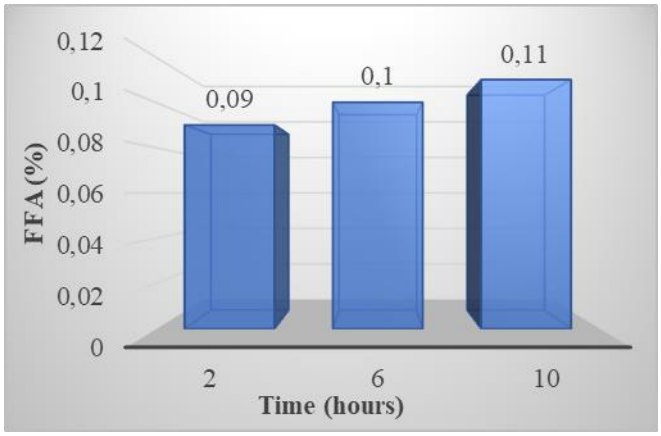


Fig 2. Free Fatty Acid (FFA) Content in VCO

The test results show that the free fatty acid values for all VCO samples still meet the requirements of SNI 7381:2008 with a maximum free fatty acid content value of 0.2%. The treatment of natural fermentation time for 2 hours, 6 hours and 10 hours and the application of the gradual heating method for each treatment respectively contained free fatty acids, namely 0.09%; 0.10%; 0.11%.

Based on the test results, it can be seen that the longer the natural fermentation process is carried out, the more free fatty acid content in the VCO produced. This is because when natural fermentation takes place, the oil molecules that are formed react with the water in the coconut milk so that an enzymatic hydrolysis process occurs against triglycerides resulting in free fatty acids for the VCO. these results are also as stated by Ngatemin et al (2013), namely the longer the fermentation time the impact on the free fatty acid content in VCO will increase.

In addition, the gradual heating method is also one of the determining factors for the formation of free fatty acids in oil/fat. Heating also affects the performance of the enzyme, in this case the Lipase enzyme which breaks down fat to produce free fatty acids. The acquisition of the value of the fatty acid content of the results of this test is supported by a statement from Ayu and Juliadi (2019), where the effect of heating on natural fermentation can increase the content of free fatty acids in the resulting VCO.

Peroxide Value (PV)

The peroxide value is an index of the amount of fat or oil that has undergone oxidation caused by unsaturated fatty acids. Peroxide is formed at the oxidation initiation stage, at this stage hydrogen is taken from oleofine compounds to produce free radicals. The presence of light and metal plays a role in the process of taking the hydrogen. Free

radicals that are formed react with oxygen to form peroxy radicals, which can take hydrogen from other unsaturated molecules to produce peroxides and new free radicals.

Dalmadi (2019) wrote that value of peroxide can speed up the process of causing rancid and unwanted odors in food, in this case including VCO. The process of oxygen oxidation that occurs as a result of several factors such as light, exposure to oxygen and temperature due to heating also determines the amount of peroxide value in the VCO produced.

Therefore the peroxide value is included as one of the important things in determining the damage to the oil. Figure 3 below shows the amount of peroxide value in VCO based on the treatment carried out.

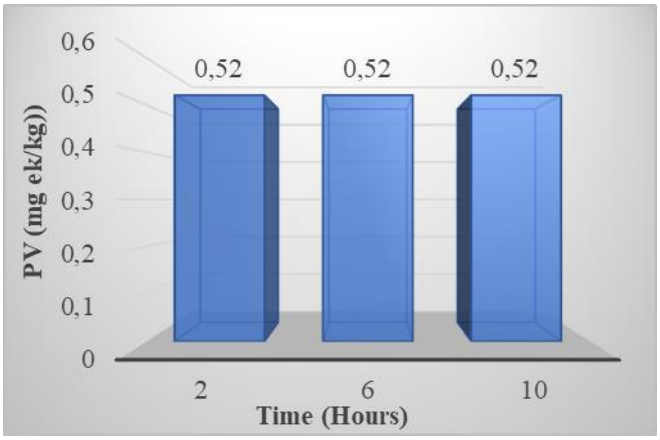


Fig 3. Peroxide Value in VCO

The results of testing the peroxide value for the VCO produced with natural fermentation time at 2 hours, 6 hours and 10 hours were the same at 0.52 mg oak/kg. The test results obtained still meet the requirements of SNI 7381:2008 with a maximum peroxide value of 2 mg.ek/kg. The test results indicate that the natural fermentation duration does not affect the formation of peroxide values.

In addition, the gradual heating method for VCO obtained from natural heating produces peroxide values that are far below the safe limits of the provisions of SNI 7381:2008. In terms of the gradual heating method the scorching can be caused by the absence of heating at high temperatures, that is <95 ^{O}C, and the second stage of heating which is carried out for 10 hours but at temperatures <60 ^{O}C and the presence of contact with oxygen from ambient air.

IV. CONCLUSION

Research results showed that the treatment for 2 hours, 6 hours and 10 hours had a moisture content of 0,15%; 0,12%; 0,1% then free fatty acid content is 0,09%; 0,10%; 0,11% and also peroxide value 0,52 mg ek/kg respectively. Based on the results of this study, it can be concluded that each test result is still below the threshold value according to the provisions of the Indonesian National Standard (SNI) 7381:2008

ACKNOWLEDGEMENTS

This research was supported and funded by LPPM (Lembaga Penelitian dan Pengabdian Masyarakat) of Republic of Indonesia Defence University through Research Lecturer Program Number: 57/IV/2022/LPPM Unhan RI. The authors also want to thank the Rector of Republic of Indonesia Defence University, which has provided the opportunity for us in conducting this research

REFERENCES

[1] APCC. (2004). VCO Standards As Approved By The 41st APCC Session In Kiribati In 2004. *Cocoinfo International*. Retrieved January 23, 2023, from https://library.coconutcommunity.org/media.php?page=read&id=1165

[2] Ayu, D. A. I., & Juliadi, D. (2019). Pengaruh Suhu Terhadap Bilangan Perosida dan Asam Lemak Bebas pada VCO (Virgin Coconut Oil) Hasil Fermentasi Alami. *Cakra Kimia (Indonesian E-Journal of Applied Chemistry)*, *7*(2), 149–154.

[3] Boboy, M. I. (2022, July). Penentuan Komoditi Pertanian Unggulan Di Kabupaten Belu Provinsi Nusa Tenggara Timur. *UPT Perpustakaan Undana*. Kupang: UPT Perpustakaan Undana. Retrieved October 2, 2022, from //skripsi.undana.ac.id/?p=show_detail&id=8442

[4] BPS. (2021a). *Kabupaten Belu Dalam Angka 2021*. Badan Pusat Statistik Kabupaten Belu. Retrieved September 23, 2022, from https://belukab.bps.go.id/publication.html?Publikasi%5BtahunJudul%5D=&Publikasi%5BkataKunci%5D=kabupaten+belu+dalam+angka&Publikasi%5BcekJudul%5D=0&yt0=Tampilkan

[5] BPS. (2021b). Luas Areal Tanaman Perkebunan Menurut Kabupaten/Kota (Hektar), 2021. *BPS Provinsi NTT*. Retrieved January 21, 2023, from https://ntt.bps.go.id/indicator/54/58/1/luas-areal-tanaman-perkebunan-menurut-kabupaten-kota.html

[6] BSN. (2008). Standar Nasional Indonesia Minyak Kelapa Virgin (VCO). *Badan Standarisasi Nasional*.

[7] Dalmadi. (2019). Development of "Immersion and Plated Filtering" as an Alternative of VCO Making. *Jurnal Biologi Tropis*, *19*(1), 116–122. Universitas Mataram.

[8] Dewi, Y. L., Ismail, A., Akramullah, M., Bouk, G., Kamlasi, Y., Sinabang, M. K., & Soares, D. C. D. C. (2022). Effect of Corn Waste Fermentation as Livestock Feed on Fiber Fraction Content | International Journal of Environment, Agriculture and Biotechnology. *International Journal of Environment, Agriculture and Biotechnology*, 108–112. Retrieved January 20, 2023, from http://journal-repository.com/index.php/ijeab/article/view/5822

[9] Malingkas, T. D., & Tongkeles, N. S. (2021). Karakteristik Pengeringan Pisang Goroho Menggunakan Alat Pengering Energi Matahari Metode Hibrid. *Jurnal Penelitian Teknologi Industri*, *12*(2), 13–22. Retrieved January 23, 2023, from http://litbang.kemenperin.go.id/jpti/article/view/6685

[10] Ngatemin, Nurrahman, & Isworo, J. T. (2013). Pengaruh Lama Fermentasi Pada Produksi Minyak Kelapa Murni (Virgin Coconut Oil) Terhadap Sifat Fisik, Kimia, dan Organoleptik. *Jurnal Pangan dan Gizi*, *04*(08), 9–18.

[11] Pontoh, J., Surbakti, M. B., & Papilaya, M. (2008). KUALITAS VIRGIN COCONUT OIL DARI BEBERAPA METODE PEMBUATAN. *CHEMISTRY PROGRESS*, *1*(1), 60–65. Retrieved January 22, 2023, from https://ejournal.unsrat.ac.id/index.php/chemprog/article/view/28

[12] Rindawati, Peralsumi, & Kurniawan, E. W. (2020). Studi Perbandingan Pembuatan VCO (Virgin Coconut Oil) Sistem Enzimatis dan Pancingan Terhadap Karakteristik Minyak Kelapa Murni yang Dihasilkan. *Indonesian Journal of Laboratory*, *2*(2), 25–32. Online.

[13] Snowdon, W., Osborn, T., Aarlbersberg, B., & Schultz, J. (2003). *COCONUT Its role in health*. *Secretariat of the Pacific Community*. Secretariat of the Pacific Community. Retrieved October 25, 2022, from https://core.ac.uk/download/pdf/11533392.pdf

[14] Tongkeles, N. S., Ludong, D. P., & Malingkas, T. D. (2022, March 2). Pemanfaatan Alat Pengering Metode Hibrid Pada Pengolahan Cabai Rawit. *Politeknik Pertanian Kupang*. Retrieved January 22, 2023, from https://ejurnal.politanikoe.ac.id/index.php/psnp/article/view/63/44

[15] Woodroof, J. G. (1979). *Coconuts : Production, Processing, Products*. *The AVI Publishing Company, Inc* (Second Edition.). Westport, Connecticut.

International Journal of Advanced Engineering Research and Science (IJAERS)
Peer-Reviewed Jounal
ISSN: 2349-6495(P) | 2456-1908(O)
Vol-10, Issue-4; Apr, 2023
Journal Home Page Available: https://ijaers.com/
Article DOI: https://dx.doi.org/10.22161/ijaers.104.8

Design and Building of Servo Motor Portable Coconut Peller Machine

Damianus Manesi*, Imanuel A. Tnunay, Elkana B Lopo, Jemssy R. Rohi, Boy Bistolen

Department of Military Logistics, Indonesian Defense University, Indonesia
*Corresponding Author

Received: 01 Mar 2023,

Receive in revised form: 02 Apr 2023,

Accepted: 09 Apr 2023,

Available online: 23 Apr 2023

***Keywords*—Post Harvest Technology, Coconut, Coconut Peeler Machine**

Abstract*—*Threats to food security for the Indonesian nation as an agricultural country are still occurring where the government is still opening import faucets, especially for food products. For this reason, Indonesia needs to build food self-sufficiency by optimizing its potential and resources, one of which is through the use of post-harvest technology. Utilization of post-harvest technology can be carried out on all types of commodities, one of which is coconut. Coconut as a leading commodity in the agricultural sector is a multifunctional plant and can grow in all regions of Indonesia. Even though there are a lot of coconut products in all regions of Indonesia, especially in the regions, the availability of technology to improve the quality of post-harvest production is still low. Therefore this study aims to design a coconut peeler machine. The results of the research are in the form of a portable coconut peeler with a servo motor that can be applied in rural areas to be used by farmers to increase the productivity of post-harvest coconut management. The development of this research has several updates, namely a type of portable tool that is easy to carry anywhere

I. INTRODUCTION

Indonesia is located on the equator so it has a tropical climate and is a place to grow a variety of plants including coconut. Coconut is easy to find in all regions of Indonesia, from from the coast to the highlands. The coconut plant is a multipurpose plant where all parts of the plant, starting from the roots, stems, leaves and fruit, can be used to meet human needs and have high economic value.

One part of the coconut, namely Coir, has recently become a trend and is being exported on a large scale to various parts of the world because it has durability whose quality is not inferior to raw materials. commercial material when it is produced into an item.

Products made from coconut coir are not inferior in quality to synthetic materials [3]. Indonesian production of coconuts averages 2.8 million tonnes in 2021 [1],[2]. This amount has a higher percentage value of 1.47% of the total coconut production in 2020 of 2.81 million tonnes.

Meanwhile, coconut derivative products also experienced an increase such as national copra by 3.02 million tons, 0.75 million tons of shell charcoal, 1.8 million tons of coir fiber, and 3.3 million tons of coir dust.

The coconut processing industry is generally still focused on processing fruit flesh as the main product [8], while industries that process coconut by-products (by-products) such as: coconut water, coconut coir, and coconut shells are still traditional and the raw materials for building a processing industry are still very large. Not only in terms of quantity, in terms of downstream product types, the processing of coconut products also still has quite a big opportunity [5].

East Nusa Tenggara Province is one of the regions in Indonesia, has a large area and abundant natural resources. With regard to coconut products, Belu as one districts in East Nusa Tenggara which are on the border have a land area for coconut plantations of 1303 Ha [2]. Existence of plantations coconuts that were scattered in various areas of Belu district, then attracted many partners, so that the process of buying coconuts from the plantations of the surrounding community was carried out, both in peeled and unpeeled conditions. countries such as China, Thailand and Singapore.

In general, coconut-based industries consist of 3 (three) types of industries, namely: upstream industry, intermediate industry, and downstream industry [6]. The coconut-based upstream industry produces products in the form of fresh coconuts and copra. The intermediate industry produces products such as copra flour, while the downstream industry produces carbon, coconut oil, nata de coco, and coconut syrup. Distribution of coconut coir as a result farmers to consumers are as follows, coconut coir from farmers is collected by collectors, then distributed to industries to be processed into derivative products or even directly exported[4].

Business potential that can be developed is inversely proportional to resources that can be managed. The demand for coconut coir for high export needs is not supported by the existence of technology which can streamline the production process. So far, coconut coir orders tend to be late and result in difficult order quotas being met, this is due to the large part of the process Coconut coir processing still uses the old method or what is commonly called the manual (traditional) method, namely by peeling the coconut coir from the coconut shell using traditional tools and semi-mechanical equipment.

Peeling coconuts with traditional tools has several drawbacks, namely the small work capacity where peeling one coconut takes ± 1–5 minutes. Wages for a stripping coconut around Rp. 300, - up to Rp. 400,-. When coconut production is high enough, the costs, time and effort for stripping it are also high.

Stripping of coir is also done using a tool made of iron in the shape of a crowbar about 80 cm high with the sharp part facing upwards. At the bottom of this tool is given a seat so that iron does not enter the soil. Trained workers are able to peel an average of 500-1000 coconuts every day [7].

A semi-mechanical coconut peeler development of traditional tools. Even though this tool is semi-mechanical, most of it is still operational using human power. Thus this tool cannot be said to be effective because human power has limits and cannot be used for continuous work. Coir peeling machine coconut can help the job of stripping coir faster with a large work capacity when compared to stripping coconut coir traditionally and semi-mechanically.

Currently there are many coco peeling tools that are sold and can assist in the process of stripping coco [4], both conventionally, semi-conventionally, and automatically which can help production process, but the operation of the tool is quite difficult and expensive, so a coco peeler is designed to use an electric-powered engine with a rotation source obtained from the motor servo to be more effective and efficient in overcoming delays in exports for coconut.

II. METHOD

The method used in this study is a design method that clearly describes activities and allows the designer to use and combine the process as a whole, although some of the designs are still conventional.

2.1 FlowChar Methodology

The process and stages in the design of a portable coconut coir peeler are described as follows:

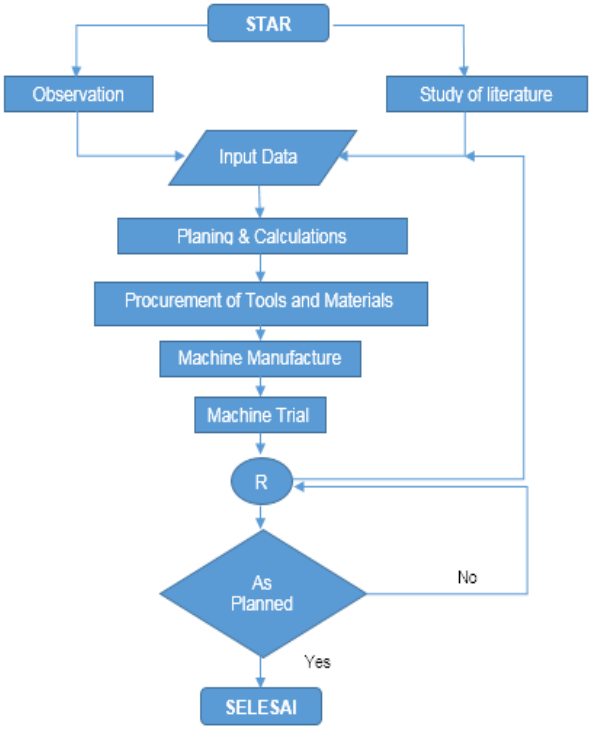


Fig 1. Machine Manufacturing Flowchart

1. Observation

   Observations or field studies were carried out by direct surveys at several locations of small and medium farming communities in Belu district, East Nusa Tenggara. This is done in the context of finding data that can later be used to plan, design and produce coconut coir peelers.

   Study of literature

   The literature study includes searching for and studying library materials relating to all problems regarding the planning of a coco peeling machine obtained from various sources including books, scientific publications and other electronic sources.

2. Data Input

   Data input is the process of collecting data obtained during observation and literature study. From the observation results obtained data on the characteristics of the coconut, the motor power for the stripping process and the operating system and model of the tool applied to the existing coco peeling machine.

3. Planning and Calculations

   This planning and calculation aims to obtain an optimal design and mechanism by taking into account the data that has been obtained from literature studies and direct observation. The machine plan that will be designed is a coconut coir peeler machine

4. Procurement of tools and materials

   From the results of planning and calculations, it can be seen the specifications of the materials and dimensions of the components that will be required for the manufacture of this machine

5. Machine manufacture

   From the components obtained, the assembly is then carried out to make a machine that is in accordance with the design that has been made

6. Equipment Test

   After the tool has been made, testing is carried out by operating the tool. In later testing, the time required will be recorded and the results of the process will be observed

7. Recommendation

   Based on the results of testing the equipment, it is then recommended whether the tool can be made or needs to be modified again.

2.2 Concept Design

Before the design process was carried out, based on the results of observations and literature studies, a scale of importance was drawn up in the design of this servo motor driven portable coco peeler as follows:

1. Producing a machine that can peel coconut coir to the fullest.
2. Only 1 person as operator.
3. Materials and spare parts are widely available and easy to obtain.
4. Simple design and easy to assemble (can be disassembled)
5. Relatively inexpensive manufacturing costs.
6. Easy fabrication process.
7. The fabrication process is sufficient with a conventional machine, no need for a special machine.
8. Safe and easy to operate.
9. No need for special skills in operation.
10. Easy to move (portable)
11. Safe and comfortable.
12. Easy to maintain and can be disassembled.
13. Environmentally friendly.
14. Does not require a large area
15. Tool dimensions 800 x 185 x 1250 mm
16. The stripping capacity reaches 3-4 grains per minute

Based on this concept of importance, a machine concept was designed to be used as a coco peeler for the needs of farmers with the following model:

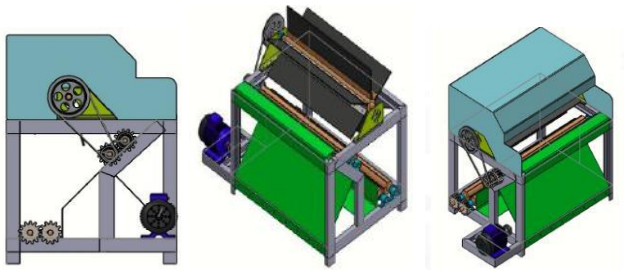


Fig 2. The design concept of a coconut peeler machine

III. RESULTS AND DISCUSSION

3.1 Manufacture and Operation of Portable coconut peeler machine

The production process of the coconut coir peeling machine is carried out by the welding method to build the frame, while for the connection it uses a bolt and nut connection type. The placement of the electric motor, servo and reduced is placed in a position that is safe from

the operator's reach and the ergonomic factor has been calculated. All instruments are operated using a panel and the operator's position when inserting coconut for the stripping process is placed in a safe position.

Fig 3. Coconut coir peeler machine

3.2 Operate the Machine

The workings of this designed machine are as follows:

1. Preparation of Machines and Coconuts to be peeled (Coir)
2. Prepare old or dry coconut husk and coconut fruit peeler machine
3. Stripping Process
4. Turn on the AC Servo motor and let the machine adapt for at least 1 minute.
5. When the AC servo motor receives power from the PLN electricity or through a DC power source which is converted to AC, the main shaft will rotate and then the rotation of the servo motor will be reduced using a speed reduction ratio of 1:40. The rotation reduced by the Speed reduction will then be forwarded to the cylinder shaft where the blade is attached using a v belt and pulley.
6. Place the dried coconuts on the rotating shaft and you can press them using the pressure cover on the lip of the tool.
7. Coconuts are peeled with a knife located on the shaft of the coconut husk peeler
8. Clean coconuts can be taken manually, and
9. After the coconuts have been peeled, the coconut coir peeler is turned off with the ON/OFF switch

3.3 Engine Work Indicator

1. The power of a knife to peel coconuts

Electric motor RPM = 3000 rpm

Speed Reducer ratio 1 : 1 : 40

Speed Reducer ratio 2 : 1 : 30

Ratio of pullyspeed reducer 1 rotation with pullyspeed reducer 2 = 7 : 4

$$Rpm\ Output\ Sped\ Reducer\ 1 = \frac{Rpm\ Motor\ Servo}{Rasio\ Sped\ Rasio\ 1} = \frac{3000}{40} = 75\ RPm$$

$$In\ RPm\ Sped\ reducer\ 2 = \frac{Rpm\ Sped\ Red\ 1}{Ratio\ Pulley} = \frac{75}{7/4} = 42{,}86\ rpm$$

Based on the design and calculation results, it is known that the output speed of the Speed reducer received by the cylinder where the coconut coir knife is attached has been reduced to 42.86 Rpm, causing slower blade rotation and a better feeding effect on coconut coir.

2. Machine capacity

The working capacity of the tool is calculated by continuously inserting a sample of 1 coconut fruit continuously into the peeler and recording the time required. Testing the performance of the coconut fiber peeler machine can be seen in Table 4.1

Table 4.1 The results of testing the performance of the coconut fiber peeler machine

No	Test	Time (Second)
1	Coconut 1	27,02
2	Coconut 2	25,08
3	Coconut 3	27,11
4	Coconut 4	26,24
5	Coconut 5	26,35
Average		26,36

From the table above it is known that testing the old coconut sample which was carried out continuously as many as 5 coconuts into the bolt peeler obtained an average stripping time of 26.36 seconds. Furthermore, indicators can be determined to calculate engine capacity, among others

The number of results peeled = 5 pieces

Total time= 131.8 seconds = 0.0366 hours ≈ 0.04 hours

Then the capacity of the tool/machine is

$$Machine\ Capasity = \frac{Peeled\ Amount\ (grains)}{Total\ time\ (hours)}\ \frac{3}{0{,}04} = 125\ grains/hours$$

Based on the results of testing the capacity of the tool, it is known that the production capacity of coconut coir that can be done using this tool is 125 grains/hour.

3. Tool Efficiency

a. Coconut Belt Peeler Machine Efficiency

The coco peeling tool that has been made has the ability to peel 125 coconut husks/hour. Whereas the manual method is 60 coconuts/hour (Silabam,2021). Based on this comparison, it is known that the efficiency of the peeler is 2.08%.

b. Time efficiency

If you reach on an industrial scale with a working duration of 7 hours a day (already outside of breaks), then during these normal working hours workers who work with a coconut belt peeler are able to produce 875 coconuts a day. Meanwhile, if theoretically working normal hours with a production capacity of 1 egg per minute, workers are only able to produce 420 eggs/day.

c. Power Efficiency

Coconut belt peeler machine has a power of 750 watts and lives for 8 hours per day. With the basic PLN electricity tariff for small industrial scale with an installed power capacity of 2200 VA of IDR 1444.70/Kwh. Then the electricity requirement for the coconut belt peeler per day is 750 watts x 8 hours = 6000 Watts (6Kwh). If multiplied by tdl, the electricity used by the coconut belt peeler machine per day is IDR.8,686.- or if multiplied for a month, the cost is IDR.260,586.-

IV. CONCLUSION

Servo Motor Driven Portable Coconut Peeler Machine is operated mechanically with a servo motor drive. This tool does not eliminate the role of humans but only increases the capacity of the tool. The operationalization of the tool is carried out in 3 ways, namely 1. Preparing the machine (ensuring that the machine is ready to work and all components and the power supply are in a ready-to-use condition), 2. Carrying out the stripping process by ensuring the operator uses PPE, and following all the steps according to the SOP listed on the tools and 3. Perform post-use maintenance of tools. The design of a Servo Motor-Powered Portable Coconut Peeler machine is able to provide an efficiency increase in engine capacity of 2.08%, increasing the production capacity of stripping from 420 grains per day to 875 grains/day. As well as in the case of the use of electric power there is cost efficiency where the tool only costs electricity IDR. 260,586 per month

ACKNOWLEDGEMENTS

Sincere thanks to the Chancellor of the Republic of Indonesia Defense University and Chair of the Indonesian Defense University LPPM for funding this activity from the LPPM Funds for the 2022 Fiscal Year.

REFERENCES

[1] Allorerung, D., and A. Lay. "The possibility of developing coconut fruit processing in an integrated manner on a rural scale" Proceedings of the IV National Coconut Conference. Bandar Lampung 21 – 23 April 1998 Pp.327 – 340

[2] Indonesian Central Bureau of Statistics, 2021.

[3] Ecowati, M. Build Farmers Foundation". Tubus Jakarta (1992)

[4] Perdana Putera "Design of Coconut Fiber Separator Machine". Agrotechnics 2 (1): 31-40 (2019). https://doi.org/10.32530/agtk.v2i1.31.PP 31-40

[5] Rumokoi, M.M.M, and R.H. Akuba. "21st century coconut oil: Food or oleochemicals". Proceedings of the Coconut National Conference IV. Bandar Lampung 21 – 23 April 1998. Research and Development Center. Pp.302 – 341.

[6] Stefanus Tri Rezki Perkasa, et.al. "Design of an Environmentally Friendly Young Coconut Peeler for Young Coconut Distribution Micro Businesses. Final Project Report, Akprind Jogjakarta.PP

[7] Suhardiyono, L. "Coconut Plants, Cultivation and Utilization". Yogyakarta : Publisher Canisius. (1988)

[8] Zainal Mahmud, Yulius Ferry. Prospects for Processing Coconut Fruit By-Products, Indonesian Center for Estate Crops and Development for Estate Crops and Development.PP 55-63.

International Journal of Advanced Engineering Research and Science (IJAERS)
Peer-Reviewed Journal
ISSN: 2349-6495(P) | 2456-1908(O)
Vol-10, Issue-4; Apr, 2023
Journal Home Page Available: https://ijaers.com/
Article DOI: https://dx.doi.org/10.22161/ijaers.104.9

Water Quality Assessment using GIS based Multi-criteria evaluation (MCE) and Analytical Hierarchy Process (AHP) Methods in Yenagoa Bayelsa State, Nigeria

Eteh Desmond Rowland[1]*, Samuel Oseji[2], Erazua Iziegbe[3], Osi Nnamdi Claude[4] Abaye Ebinyo Oreikio[5]

[1, 5] Department of Geology, Niger Delta University, Wilberforce Island, Bayelsa State, Nigeria
[2]University of Texas at San Antonio, 1 UTSA circle, 78249
[3]Department of Biology, Federal University Otuoke , Bayelsa State
[4]Department of Petroleum Engineering, Rivers State University, Port Harcourt.
*Corresponding Author

Received: 01 Mar 2023,
Receive in revised form: 02 Apr 2023,
Accepted: 09 Apr 2023,
Available online: 23 Apr 2023

***Keywords*— Groundwater quality; GIS; Inverse distance weighted; MCE; Yenagoa, APH, Water Quality**

Abstract— *The study examined the quality of groundwater in Yenagoa, a metropolitan area, using Geographic Information System (GIS)-based methods such as Multi-criteria evaluation (MCE) and Analytical Hierarchy Process (AHP). The research emphasizes the crucial nature of protecting and managing groundwater quality in this region, as it is vulnerable to contamination. The spatial distribution patterns of groundwater quality in the area are depicted in this article. The physicochemical properties of fifty (50) water samples are directly related to residents' environmental and health status. The physicochemical parameters measured using the American Public Health Association procedure (APHA)—including pH, conductivity, total dissolved solids, sulphate, nitrate, sodium, chloride, and total hardness—were below the limit established by WHO (2011). Iron in most boreholes is found to be above the WHO standard for drinking water. With the help of ArcGIS software, these results were modeled using the inverse distance-weighted method to provide the spatial pattern of groundwater. The spatial distribution map delineates groundwater suitability zones of 55% and unsuitability zones of 45% for groundwater extraction of water points in yenagoa affected by high iron content. As a result, GIS is a powerful tool for making critical decisions in waste management-related issues, such as identifying areas where waste management practices may be deficient and allowing for targeted initiatives to improve waste management practices and reduce waste's negative impact on the ecosystem and public health.*

I. INTRODUCTION

Groundwater is characterized by biological and chemical characteristics. However, these characteristics are inadequate for understanding the geospatial relation between groundwater quality and its occurrence. As a result, this relationship requires the use of geographical information systems and statistical techniques (Arulbalaji et al., 2019). With the use of these techniques, groundwater data is critically examined, managed, and spatially displayed. The use of GIS in groundwater resource

management is anchored on the inverse overlay method using an inverse weighted technique (Tsihrintzis et al., 1996; Veysel and Recep, 2021). These attributes are critical in the management of design tools (Stafford, 1991). GIS tools are effective in the critical analyses of water suitability, groundwater vulnerability, groundwater leaching, modeling of solute transport, groundwater flow mapping, and groundwater quality index (Oki and Eteh, 2018; Mukate et al., 2019). Statistically, two techniques are critical in the assessment of groundwater quality. These parameters are anchored on the physico-chemical characteristics of the groundwater. In this region, the chemical characteristic of interest remains the iron content of the groundwater (Nwankwoala et al., 2014; Wan et al., 2019). Besides, a high or low pH outside the limits of the World Health Organization is critical to human health (WHO, 2011). Water quality evaluation is an essential task for sustainable water resource management. The analytical hierarchy process (AHP) and GIS-based multi-criteria evaluation (MCE) are two commonly used techniques for assessing water quality. MCE based on GIS is a method for evaluating and comparing numerous factors based on spatial data. This method entails giving weights to each criterion based on their respective significance, then combining the criteria to create a total evaluation of water quality. Physical, chemical, and biological factors such as pH, temperature, dissolved oxygen, turbidity, and nutrient concentrations may be used to evaluate water quality. Hence, multi-criteria evaluation (MCE), the analytical hierarchy process (AHP), and GIS are relevant to the understanding of the water quality in this region. In this study, GIS techniques were used in assessing the distribution pattern of groundwater quality. The results provided by these techniques delineate potable water and non-potable water in Yenagoa, Bayelsa State.

II. GEOLOGY OF THE STUDY AREA

The area is in the middle section of the Niger Delta region and consists of sedimentary basin structures (Figure1). The area covers Latitude 5º3'30"N to 4º68'30"N and Longitude 6º15'0"E to 6 21'0"E. and possesses low-lying topography elevating up to 40m elevation (Reyment, 2018). The Niger Delta Basin constitutes a failed rift junction developed by the pulling apart of the South American plate from the African plate. The rifting began during the late Jurassic period and was truncated during the mid-Cretaceous. Several faults' lines are associated with this rifting resulting in the formation of thrust faults (Reijers, 2011). These structures constitute the facies of the pro-delta Akata Formation and the Agbada Formation which constitute a paralic delta front. The Benin Formation comprises a delta facies that is continental in nature. The basal lithostratigraphic comprises the Akata Formation and ranges from Paleocene to Holocene age (Reyment, 2018; Etu–Efeotor, 1997). The Akata formation comprises deep marine deposits under high pressure and low density. Thick shales, turbidite sands, and small amounts of silt and clay constitute the mega marine facies. (Chukwu, 1991). These characteristics are evidence of a shallow marine shelf depositional environment (Etu-Efeotor, 1997).

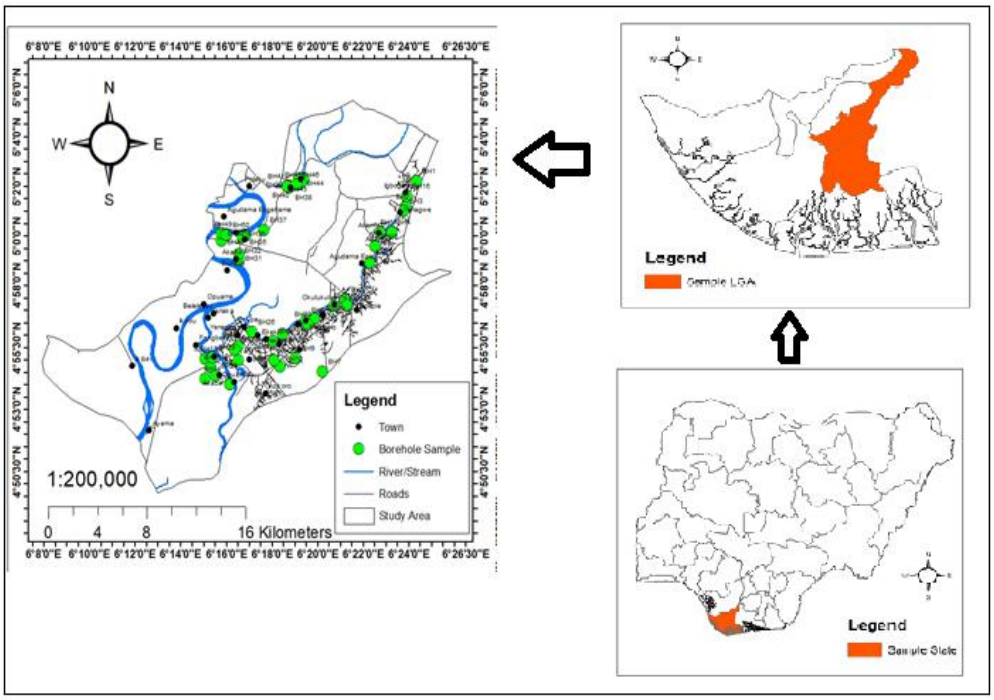


Fig.1: Study Area map showing Borehole location

III. MATERIALS AND METHODS

Data Collection

The locations of the boreholes in the study area were determined using a handheld global positioning system (GPS) instrument GARMIN GPS-60 receiver. Field sampling generated the primary data for the physical and chemical characteristics of the groundwater obtained from several boreholes located in Yenagoa. Polypropylene plastic bottles were used to collect Fifty (50) samples of the groundwater (Figure 1). These samples were collected during pumping to ensure that fresh samples were collected. Besides, there was a need to homogenize the water samples and minimize the impacts of rusty pipes.

Data Analysis

The physical and related characteristics such as pH, Electrical Conductivity (EC) and Total Dissolved Solids (TDS) were determined on-site using portable pH, Electrical Conductivity, Total Dissolved Solid meter (HANNA) the United Kingdom respectively. Metal analyses of water samples were conducted since nitric acid (50 % v/w) was used for acidification to Magnesium (Mg2+), Calcium (Ca2+) and Sodium (Na+) contents in the water samples were determined using an Atomic Absorption Spectrometer (AAS) Chloride (Cl-), Sulphate (SO4), Nitrate (NO3-) contents in the water samples were using ion chromatography. The bicarbonate (HCO3-) content in the water samples was determined using the American Public Health Association titrimetric method (APHA, 2017). The results from the chemical analysis were processed in an excel format and imported into a GIS environment to produce some spatial distribution maps.

Data Processing

The non-spatial database was arranged in excel format and aligned with the spatial data format in ArcMap. These data set were import to generate the geospatial distribution thematic maps of the groundwater using spatial interpolation with inverse distance weighted method. The method was used to delineate the natural and subsurface groundwater contaminants.

The index overlay method was used to analyze the data layers. This spatial technique comprises the superposition of multiple layers using a thematic scheme, thus providing a new layer. The map classes were designated to different value scores with different weightages as supported by Mageshkumar et al., 2019. The weighted overlay method delineated groundwater suitability and selection. The input layers for the analysis of groundwater suitability were the pH, Total Hardness (TH), Total Dissolved Solids (TDS), Sodium (Na+), Nitrate (NO3-), Chloride (Cl-), electrical conductivity (EC), Sulphate (SO42-), Magnesium (Mg2+), and Iron (Fe2+) contents.

The score reading for these parameters was classed for each map and assigned along with the map weightages.

The following lists the general steps to perform overlay analysis:

1. Describe the problem.
2. Break the problem into sub-models.
3. Determine weighty or important layers.
4. Reclassify or change the information inside a layer.
5. Weight the input layers.
6. Add or combine the layers.
7. Inspect Result.

Inverse distance weighted (IDW) technique

To map water quality assessment, we performed an inverse distance weighting (IDW) interpolation on each parameter before classifying it into 3 classes using WHO standard (2011) limit and reclassify them base on highly suitable, suitable, and unsuitable (Figure 2). In an examination of a few distinctive deterministic interpolation methodology, Burrough and McDonnell (2015) found that utilizing IDW with a squared distance term yielded results generally reliable with unique information. Since Inverse Distance Weighted is not a probabilistic way of spatial interpolation approach to estimate an unknown value at a location using some known values with equated weighted values and the Inverse Distance formula is given in equation 1

$$x^* = \frac{w_1 x_1 + w_2 x_2 + w_3 x_3 + \ldots + w_n x_n}{w_1 + w_2 + w_3 + \ldots + w_n} \quad (1)$$

Where x* is the unknown value at a location to be resolved, w is the weight, and x is the known point value.

The weight is the inverse distance of a point to each known point value that is used in the calculation and the weight formula is given in equation 2.

$$w_i = \frac{1}{d_{ix^*}^P} \quad (2)$$

.

Table 1: Physico-Chemical Parameters of Groundwater in Yenagoa

Borehole	Lat	long	pH	EC (us/cm)	TDS(mg/l)	NO3 (mg/l)	Cl(mg/l)	SO4(mg/l)	TH(mg/l)	Iron(mg/l)	Na(mg/l)
BH1	5.036889	6.405972	6.12	406	203	0.36	39	1.4	25	0.6	10.86
BH2	5.01975	6.398167	6.3	715	356	0.165	15	0.8	45	0.14	4
BH3	5.016722	6.396528	6.38	857	430	0.335	21	1.67	18	0.4	6.5
BH4	5.002366	6.387691	6.1	782	391	0.175	14	0.86	37	0.37	4.85
BH5	4.957417	6.35375	5.99	164	82	0.165	14	0.82	35	0.38	4.54
BH6	4.94325	6.324806	5.93	175	84	0.094	16	0.48	32	0.3	5.2
BH7	4.908472	6.337083	5.6	763	383	0.085	14	0.45	30	0.15	4.74
BH8	4.929167	6.300806	6.69	1156	578	0.096	22	0.5	46	0.35	5.8
BH9	4.917722	6.317583	6.14	269	135	0.348	34	1.75	101	0.14	9.95
BH10	4.91175	6.305972	6.74	1652	826	0.42	47	2.1	45	0.36	13.58
BH11	4.925861	6.275583	6.05	422	211	0.204	37	0.96	91	0.16	9.84
BH12	4.916	6.2755	6.87	722	361	0.49	23	2.45	33	0.36	7.6
BH13	4.917028	6.251222	6.43	928	464	0.078	16	0.39	27	0.26	5.4
BH14	4.903722	6.251222	6.2	160	80	0.162	24	0.8	56	0.12	6
BH15	4.91125	6.255611	6.91	530	265	0.17	8	0.86	15	0.18	3.85
BH16	5.026869	6.398981	6.33	496	248	0.137	13	1.28	65	0.39	5.82
BH17	5.002678	6.379307	6.13	164	82	0.341	55	5.6	93	0.4	15.9
BH18	4.992793	6.375336	5.88	334	167	0.23	58	5.5	200	0.7	17.4
BH19	4.98176	6.37166	6.01	173	87	0.22	46	4.38	128	0.68	13.54
BH20	4.953314	6.355015	5.99	164	82	0.165	14	0.82	35	0.8	4.54
BH21	4.952838	6.34541	5.85	91	46	0.132	14	1.42	56	0.32	4.62
BH22	4.94409	6.331098	5.93	84	42	0.374	43	3.4	90	0.65	12.43
BH23	4.940728	6.326492	6.38	94	48	0.41	65	5.6	115	0.4	14.9
BH24	4.933825	6.307698	5.86	348	174	0.127	14	1.38	26	0.11	4.86
BH25	4.916093	6.301615	6.4	422	211	0.318	90	10.8	148	0.44	28.64
BH26	4.935199	6.285502	6.74	194	97	0.187	22	0.28	47	0.11	6.38
BH27	4.923142	6.272686	6.46	486	243	0.172	19	1.64	116	0.35	5.38
BH28	4.905837	6.258554	5.99	77	38	0.213	40	4	111	0.4	12.58
BH29	4.918221	6.25624	6.2	160	80	0.162	24	0.8	56	0.12	6
BH30	4.899849	6.269169	6.28	172	86	0.348	52	5.25	41	0.43	16.7
BH31	4.983667	6.276111	6.14	285	142	0.218	14	2.48	17	0.31	5.48
BH32	4.987861	6.275722	6.59	355	178	0.231	20	3.5	34	0.36	7.6
BH33	5.000389	6.279556	6.01	420	210	0.31	20	4	52	0.136	6.5
BH34	4.999861	6.280667	5.97	583	292	0.318	34	4.8	48	0.32	9.45
BH35	4.999656	6.279361	5.96	363	182	0.22	20	3.85	36	0.36	6.84
BH36	4.999222	6.2785	5.92	364	182	0.23	30	3.64	30	0.13	8.35
BH37	5.004056	6.294028	6.15	310	155	0.197	12	3	26	0.38	5.42
BH38	5.032306	6.312556	6.49	379	189	0.271	13	4.3	43	0.35	5.46
BH39	5.033528	6.311917	6.35	304	152	0.176	14	2.34	27	0.19	4.96
BH40	5.034	6.311778	6.52	279	140	0.185	11	2.97	30	0.36	3.75
BH41	5.033361	6.311056	6.08	285	143	0.121	12	2.58	21	0.37	4.34
BH42	5.038194	6.323444	6.15	382	191	0.278	62	4.84	43	0.39	18.68
BH43	5.038	6.319889	5.99	457	274	0.328	16	4.75	44	0.37	7.48
BH44	5.035417	6.321361	6.6	348	174	0.281	12	3.84	41	0.33	4.72
BH45	5.034306	6.318833	6.83	298	199	0.217	12	3.76	35	0.15	5.46
BH46	5.03425	6.31789	6.62	306	153	0.227	13	4	35	0.35	4.8
BH47	4.996806	6.262944	6.24	436	218	0.29	14	3.46	45	0.33	5.75
BH48	5.001417	6.263	6.08	307	154	0.214	21	3.2	22	0.39	6.58
BH49	5.000861	6.265528	6.1	376	188	0.245	32	4	19	0.14	9.36
BH50	5.000639	6.266833	5.67	357	178	0.235	33	3.85	10	0.38	9.65
WHO(2011)			6.5-8.5	1000	500	50	250	150	100	0.3	200

In the Weighted formula, there is a *P* variable which stands for Power. There is no particular rule in defining the *P* value, but from the equation, we can see that the higher *P* value will give lower weight. d_i is the total number for verifications and x* is the determine value at a location.

IV. RESULTS AND DISCUSSIONS

Characteristics of Groundwater

According to the findings in Table 1, the groundwater in the study region appears to satisfy the WHO standards for pH, electrical conductivity (EC), total dissolved solids (TDS), sulphate (SO4), nitrate (NO3), sodium (Na), chlorine (Cl), and total hardness. (TH). However, the iron content of groundwater exceeds the WHO recommendation for potable water, with most boreholes having iron levels varying from 0.13 mg/L to 0.60 mg/L. The spatial interpolation map also shows that the findings for pH, electrical conductivity, total dissolved solids, sulphate, nitrate, sodium, chlorine, and total hardness are lower than the WHO guideline for drinkable water. This information, along with the information in Tables 1 and 4 and Figure 2, indicates that the water quality in the research region is usually suitable for drinking, with the exception of the iron content. It's essential to remember that excessive amounts of iron in drinking water can cause stomach cramps, vertigo, vomiting, and diarrhea. As a result, measures should be taken to address the higher levels of iron in the affected boreholes in order to guarantee the safety of the drinking water supply. With the exception of the high iron levels in some boreholes, the results indicate that the groundwater in the study region is usually safe for drinking

Table 2: Descriptive Statistics of Physiochemical in groundwater

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
Parameter	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
NO3	50	0.08	0.49	0.23	0.09	0.57	0.34	-0.05	0.66
Fe	50	0.11	0.80	0.33	0.16	0.76	0.34	1.00	0.66
SO4	50	0.28	10.80	2.83	1.99	1.27	0.34	3.62	0.66
pH	50	5.60	6.91	6.23	0.31	0.45	0.34	-0.39	0.66
Na	50	3.75	28.64	8.26	4.90	2.02	0.34	5.10	0.66
Cl	50	8.00	90.00	26.56	17.55	1.57	0.34	2.45	0.66
TH	50	10.00	200.00	52.42	38.43	1.88	0.34	3.81	0.66
TDS	50	38.00	826.00	205.48	146.04	2.08	0.34	6.07	0.66
EC	50	77.00	1652.00	407.08	291.76	2.12	0.34	6.23	0.66

Table 2 summarizes statistics for various surface water physiochemical parameters such as nitrate, iron, sulfate, pH, sodium, chloride, total hardness, TDS, and electrical conductivity. For each measure, the data includes the lowest, maximum, mean, standard deviation, skewness, and kurtosis. The minimum number for Nitrate (NO3) is 0.08, the highest is 0.49, and the mean is 0.23. The data is closely grouped around the mean, as indicated by the standard deviation of 0.09. The skewness is 0.57, showing a small positive skew, and the kurtosis is -0.05, indicating that the distribution is slightly flatter than a normal distribution. The minimum number for Iron (Fe) is 0.11, the highest is 0.80, and the mean is 0.33. The standard deviation is 0.16, showing that the data is more dispersed than in the case of Nitrate. The skewness is 0.76, suggesting a positive skew, and the kurtosis is 1.00, showing that the distribution is more peaked than a normal distribution. The minimum number for Sulphate (SO4) is 0.28, the highest is 10.80, and the mean is 2.83. The standard deviation is 1.99, showing that the data is more dispersed than in the cases of Nitrate and Iron. The skewness is 1.27, showing a positive skew, and the kurtosis is 3.62, suggesting a distribution that is more strongly peaked than a normal distribution. The minimum pH number is 5.60, the highest is 6.91, and the average is 6.23. The data is closely grouped around the mean, as indicated by the standard deviation of 0.31.

Table 3: Pearson correlation coefficient in groundwater

		pH	EC	TDS	NO3	Cl	SO4	TH	Fe	Na
pH	Pearson Correlation	1	.343*	.351*	0.197	-0.113	-0.036	-0.113	-0.160	-0.091
	Sig. (2-tailed)		0.015	0.012	0.170	0.434	0.802	0.433	0.267	0.530
EC	Pearson Correlation		1	.998**	0.076	-0.070	-0.235	-0.206	-0.118	-0.068
	Sig. (2-tailed)			0.000	0.600	0.627	0.100	0.151	0.415	0.641
TDS	Pearson Correlation			1	0.082	-0.080	-0.225	-0.210	-0.124	-0.072
	Sig. (2-tailed)				0.571	0.583	0.116	0.143	0.391	0.619
NO3	Pearson Correlation				1	.528**	.527**	0.202	0.259	.527**
	Sig. (2-tailed)					0.000	0.000	0.159	0.069	0.000
Cl	Pearson Correlation					1	.673**	.655**	.347*	.977**
	Sig. (2-tailed)						0.000	0.000	0.014	0.000
SO4	Pearson Correlation						1	.445**	.309*	.748**
	Sig. (2-tailed)							0.001	0.029	0.000
TH	Pearson Correlation							1	.358*	.637**
	Sig. (2-tailed)								0.011	0.000
Fe	Pearson Correlation								1	.376**
	Sig. (2-tailed)									0.007
Na	Pearson Correlation									1

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

The skewness is -0.39, which indicates a slightly negative skew, and the kurtosis is 0.66, which indicates a slightly flatter than usual distribution. The minimum number for Sodium (Na) is 3.75, the highest is 28.64, and the mean is 8.26. The standard deviation is 4.90, showing that the data is more dispersed than in the Nitrate and pH cases. The skewness is 2.02, showing an extremely positive skew, and the kurtosis is 5.10, suggesting a distribution with a high peak. The minimum number for Chloride (Cl) is 8.00, the highest is 90.00, and the mean is 26.56. The standard deviation is 17.55, which indicates that the data is widely dispersed. The skewness is 1.57, indicating that there is a positive skew, and the kurtosis is 2.45, showing that the distribution is more elevated than a normal distribution. Total Hardness (TH) has a minimum of 10.00, a maximum of 200.00, and a mean of 52.42. The data is widely dispersed, as indicated by the standard deviation of 38.43. The skewness is 1.88, showing a positive skew, and the kurtosis is 3.81, indicating a distribution with a high apex. The minimum number for Total Dissolved Solids (TDS) is 38.00, the highest is 826.00, and the mean is 205.48. The standard deviation is 146.04, which indicates that the data is widely dispersed. The skewness is 2.08, showing a skew that is extremely positive, and the kurtosis is 6.

The result from Table 3 shows that the Pearson correlation coefficients between various factors in a dataset are shown in this chart. pH, EC, TDS, NO3, Cl, SO4, TH, Fe, and Na are the factors. The chart displays the correlation coefficient between each set of variables, as well as the correlation's importance at the 0.05 and 0.01 levels.

A correlation coefficient quantifies the magnitude and direction of a linear connection between two factors. The number runs from -1 to 1, with -1 representing perfect negative correlation, 1 representing perfect positive correlation, and 0 representing no correlation.

We can see that there are substantial correlations between some of the factors in this dataset. pH and EC, have a significant positive association (r=0.343, p=0.015), as do pH and TDS (r=0.351, p=0.012), and TDS and EC (r=0.998, p0.01). NO3 and Cl (r=0.528, p0.01), NO3 and SO4 (r=0.527, p0.01), and Cl and SO4 (r=0.673, p0.01) all have a significant positive association.

Furthermore, some factors are strongly correlated with one another. There is, for example, a very strong positive association between Na and Cl (r=0.977, p0.01), as well as a strong positive connection between Cl and SO4 (r=0.673, p0.01). These correlations imply that there may be some underlying forces affecting these variables in the same direction.

Table 4: Guideline for potable water as recommended by WHO 2011

Parameter	Limit	Suitability Class
PH	6.5	Highly Suitable
	7.5	Suitable
	>8.5	Unsuitable
EC (us/cm)	500	Highly Suitable
	1000	suitable
	>1000	Unsuitable
TDS (mg/l)	250	Highly Suitable
	500	suitable
	>500	Unsuitable
N03 (mg/l)	25	Highly Suitable
	50	suitable
	>50	Unsuitable
Cl (mg/l)	100	Highly Suitable
	250	suitable
	>250	Unsuitable
SO3 (mg/l)	50	Highly Suitable

	150	suitable
	>150	Unsuitable
TH (mg/l)	50	Highly Suitable
	100	suitable
	>100	Unsuitable
Na (mg/l)	100	Highly Suitable
	200	suitable
	>200	Unsuitable
Fe (mg/l)	0.15	Highly Suitable
	0.3	suitable
	>0.3	Unsuitable

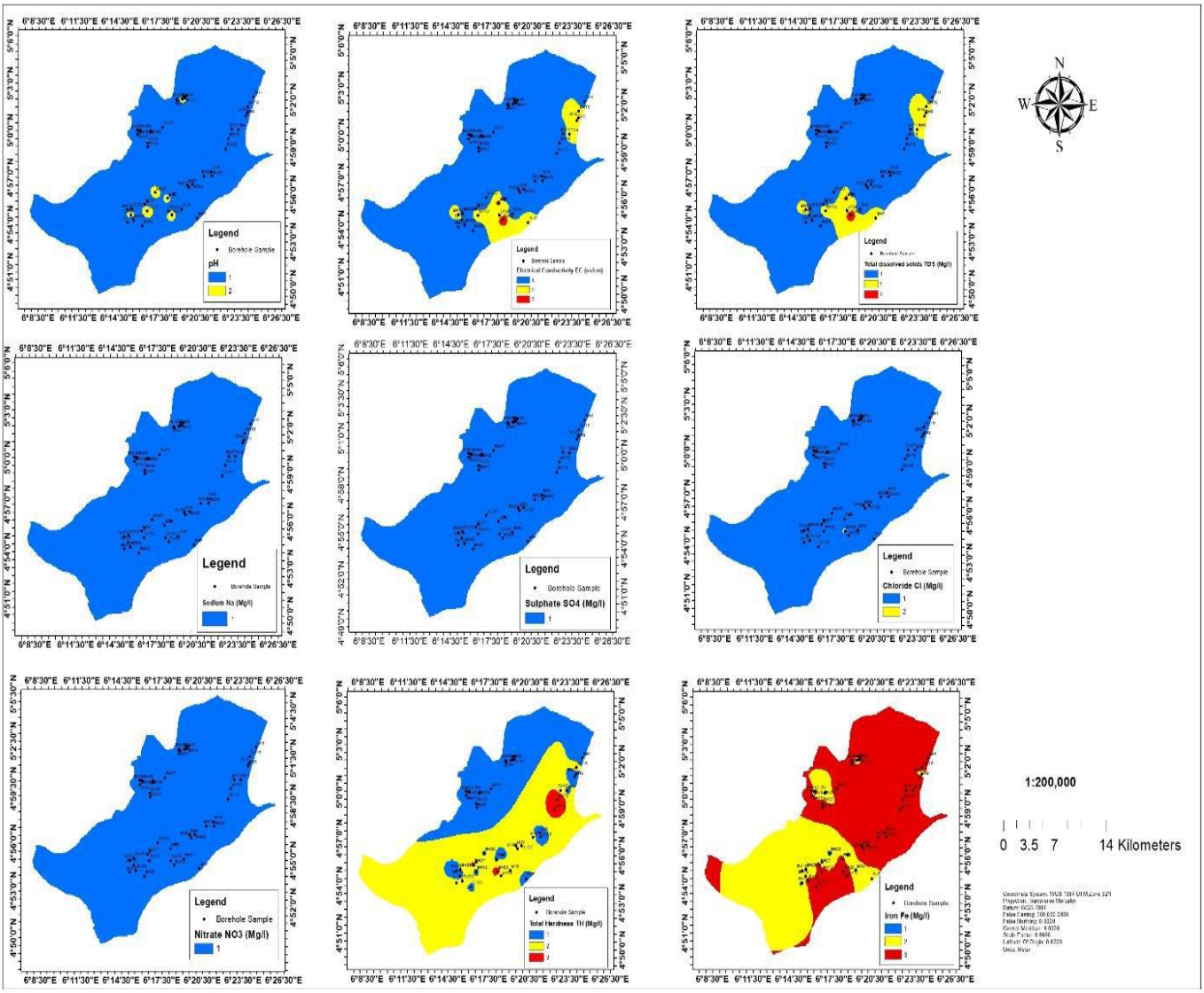


Fig.2: Water quality assessment map performed on the study area using WHO standard 2011.

Multi-criteria evaluation (MCE) and Analytical Hierarchy Process (AHP) Methods

The bigger the weight, the more significant the model in the general utility. The weights were created by giving a sequence of pairwise comparisons of the general significance of variables to the suitability of pixels for the activity being estimated. The methodology by which the weights were delivered follows the rationale created under the Analytical Hierarchy Process (AHP). Weight rates were given based on a pairwise comparison 9-point continuous scale (Table 5). This pair-wise comparison was then analyzed to produce weights that sum to 1. The consistency ratio of this study indicated that 0.03 was acceptable (Table 6). If the consistency ratio is less than or equal to 0.1, it signifies an acceptable reciprocal matrix (Panepinto and Zanetti., 2018; Eteh et al., 2021). The factors and their resulting weights were used as input for the multi-criteria evaluation (MCE) module for the weighted linear combination of overlay analysis.

Table 5: Pairwise comparison 9-point continuous scale.

	Fe	Cl	TH	TDS	NO3	Na	SO4	pH	EC
Fe	1								
Cl	1/2	1							
TH	1/3	1/2	1						
TDS	1/4	1/3	1/2	1					
NO3	1/5	1/4	1/3	1/2	1				
Na	1/6	1/5	1/4	1/3	1/2	1			
SO4	1/7	1/6	1/5	1/4	1/3	1/2	1		
pH	1/8	1/7	1/6	1/5	1/4	1/3	1/2		
EC	1/9	1/8	1/7	1/6	1/5	1/4	1/3	1/2	1
	2.8	4.7	7.5	11.3	16.3	22.1	28.8	36.5	45.0

1/9, Extremely; 1/7, very strongly; 1/5, strongly; 1/3, moderately; 1, equally; 3, moderately; 5, strongly; 7, very strongly 9, extremely.

Table 6: Standard matrix and Eigenvector weight

	Fe	Cl	TH	TDS	NO3	Na	SO4	pH	EC	sum	Eigenvector weight	Percentage (%)
Fe	0.35	0.43	0.40	0.35	0.31	0.27	0.24	0.22	0.20	2.78	0.31	30.85
Cl	0.18	0.21	0.27	0.27	0.25	0.23	0.21	0.19	0.18	1.97	0.22	21.92
TH	0.12	0.11	0.13	0.18	0.18	0.18	0.17	0.16	0.16	1.39	0.15	15.49
TDS	0.09	0.07	0.07	0.09	0.12	0.14	0.14	0.14	0.13	0.98	0.11	10.92
NO3	0.07	0.04	0.03	0.03	0.06	0.09	0.10	0.11	0.11	0.65	0.07	7.26
Na	0.06	0.04	0.03	0.03	0.03	0.05	0.07	0.08	0.09	0.48	0.05	5.34
SO4	0.05	0.04	0.03	0.02	0.02	0.02	0.03	0.05	0.07	0.33	0.04	3.71
Ph	0.04	0.03	0.02	0.02	0.02	0.02	0.02	0.03	0.04	0.23	0.03	2.60
EC	0.04	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.17	0.02	1.90
Total											1	100

Consistency ratio = 0.03, consistency is acceptable

Weighted Overlay Method

Oboshenure et al. (2019) used the Index Overlay technique in a GIS application to create a collection of maps with various value scores and weights in order to answer multi-criteria problems. These maps were used to identify suitable groundwater mapping locations in the research region. (Figure 3). The spatial maps were made using weightage and class, with M1 indicating pH times the class and M2 signifying Conductivity times the class. M3 represents the weightage times the class for TDS, M4 represents the weightage times the class for TH, M5 represents the weightage times the class for Na+, M6 represents the weightage times the class for Mg2+, M7 represents the weightage times the class for NO3-, M8 represents the weightage times the class for Cl-, and M9 represents the weightage times the class for Cl- and M10 representing Weightage times the class for Fe2+.

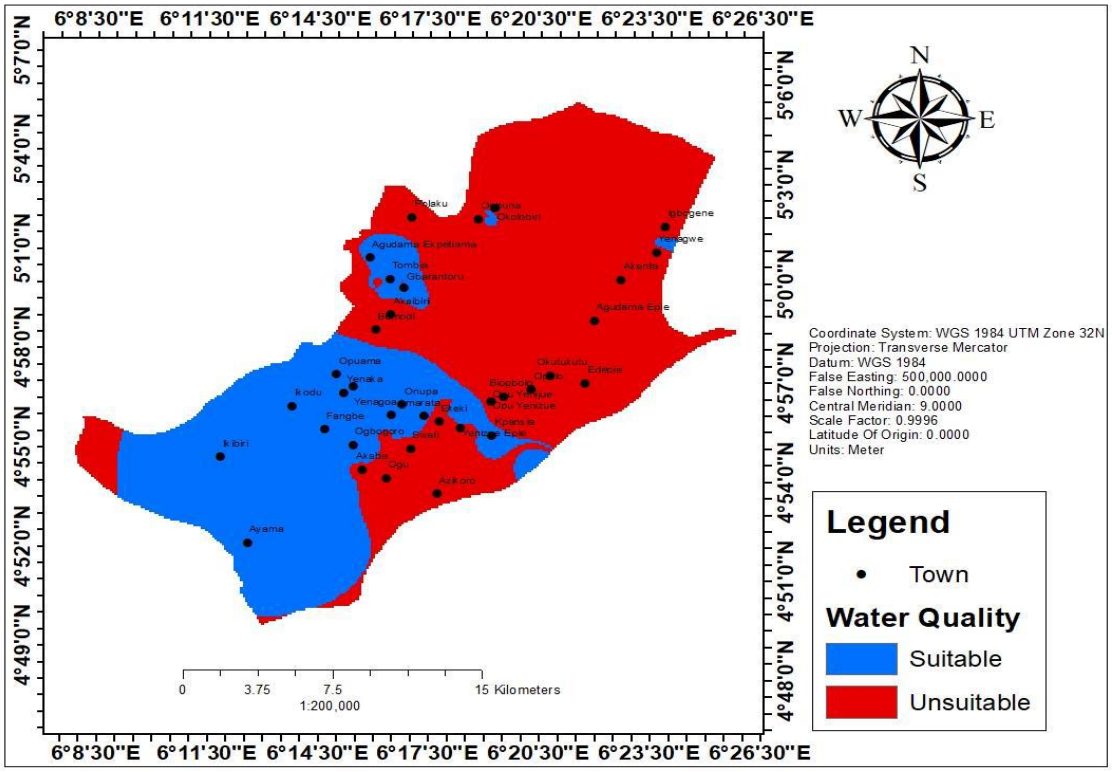


Fig.3: Suitability map for water in the study area.

Figure 3 shows that GIS analysis was able to evaluate and make critical waste management decisions by identifying suitable drinking water areas based on various determining factors such as pH, electrical conductivity, total dissolved solids, sulphate, nitrate, iron, total hardness, and sodium.

The analysis findings were color-coded, with blue showing acceptable regions for drinking water and red signaling unsuitable areas. According to the data given, the GIS analysis determined that 55% of the study region was safe to drink, while the remaining 45% was not.

As previously stated, the findings of the analysis may be subject to various assumptions and constraints, and ongoing monitoring and evaluation of water quality is still required to ensure that the water stays safe for consumption. Nonetheless, the use of GIS in solving waste management-related problems can be a useful tool for decision-making and improving the general standard of living for people in the study region.

V. CONCLUSION

As a result, the research in this study concentrated on identifying suitable drinking water locations using various deciding variables such as pH, electrical conductivity, total dissolved solids, sulphate, nitrate, and sodium. The research showed that 55% of the study region was appropriate for drinking water, while the remaining 45% was not. It should also be mentioned that the iron concentration in most boreholes exceeded the WHO drinking water guideline. In this research, the use of GIS in waste management-related problems was shown to be an efficient decision-making tool. It is essential to note, however, that the government is

responsible for supplying secure and pure drinkable water. As a result, the results of this research should be communicated to the appropriate government authorities, who should take the required steps to provide portable water, particularly given the rise in population. In summary, the analysis in this study emphasizes the significance of using GIS in waste management-related problems, as well as the need for the government to provide portable water to guarantee the safety and well-being of people in the study region.

REFERENCES

[1] American Public Health Association (APHA). (2017). Standard methods for the examination of water and waste water. 23rd Edition, 1504pp

[2] Arulbalaji P, Padmalal D, Sreelash K. (2019). GIS and AHP techniques-based delineation of groundwater potential zones: A case study from Southern Western Ghats, India. Scientific Reports. 9(1):2082.

[3] Burrough PA, McDonnell RA, Lloyd CD. (2015) Principles of Geographical information systems oxford: Oxford University Press. 2015;352.

[4] Chukwu GA. (1991) The Niger delta complex basin: Stratigraphy, structure and hydrocarbon potential. Journal of Petroleum Geology.14211-220.

[5] Oki Austin Oyinkuro and Eteh Desmond Rowland (2018): Spatial Groundwater Quality Assessment by WQI and GIS in Ogbia LGA of Bayelsa State, Nigeria. Asian Journal of Physical and Chemical Sciences 4(4):1-12: DOI: 10.9734/AJOPACS/2017/39055

[6] Eteh Desmond R., Francis Omonefe, Jonathan Lisa E. (2021) "Site Suitability Study for Solid Waste Dumpsite Selection Using Geospatial-Based Multi-Criteria Analysis in Yenagoa, Bayelsa State Nigeria", Annals of Geographical Studies, 4(1), pp 1-12. DOI: https://doi.org/10.22259/2642-9136.0401001

[7] Etu–Efeotor, J. O. (1997). Fundamentals of petroleum geology. Paragraphic publications, Port Harcourt, Nigeria, Press page 135.

[8] Mageshkumar P, Subbaiyan A, Lakshmanan E, Thirumoorthy P. (2019). Application of geospatial techniques in delineating groundwater potential zones: A case study from South India, Arabian Journal of Geosciences.12(5):151.

[9] Mukate S, Wagh V, Panaskar D, Jacobs JA, Sawant A. (2019). Development of new integrated water quality index (IWQI) model to evaluate the drinking suitability of water, Ecological Indicators.101:348-354.

[10] Nwankwoala HO, Amadi AN, Oborie E, Ushie FA. (2014). Hydrochemical factors and correlation analysisof groundwater quality in Yenagoa, Bayelsa State, Nigeria. Applied Ecology and Environmental Services. 2014;2(4):100–105.

[11] Oboshenure K. K, Francis E E. and Davidson E. E. (2019) Application of GIS in the Assessment of Groundwater Quality in the Yenagoa Watershed of the Niger Delta Region of Nigeria Asian Journal of Physical and Chemical Sciences 7(2): 1-15, Article no.AJOPACS.49000 ISSN: 2456-7779.

[12] Oki Austin Oyinkuro and **Eteh Desmond Rowland** (2018): Spatial Groundwater Quality Assessment by WQI and GIS in Ogbia LGA of Bayelsa State, Nigeria. *Asian Journal of Physical and Chemical Sciences* 4(4):1-12: DOI: 10.9734/AJOPACS/2017/39055

[13] Panepinto, D.& Zanetti, M.C. (2018). Municipal solid waste incineration plant: a multistep approach to the evaluation of an energy-recovery configuration.Waste Management, 73, 332−341. doi:10.1016/j.

[14] Panepinto, D.& Zanetti, M.C. (2018). Municipal solid waste incineration plant: a multi-step approach to the evaluation of an energy-recovery configuration. Waste Management, 73, 332−341. doi:10.1016/j.2018.07.036

[15] Reijers, T. J. A. (2011). Stratigraphy and Sedimentology of the Niger Delta. Geologic, The Netherlands, 17(3), p.133-162.

[16] Reyment RA (2018.) Ammonitologist sensu latissimo and founder of Cretaceous Research Bengtson. P Cretaceous Research-1926-2016,88, 5-35.

[17] Stafford, D.B. (1991). Civil Engineering Applications of Remote Sensing and Geographic Information Systems. ASCE, New York.

[18] Tsihrintzis VA, Hamid R, Fuentes HR. (1996). Use of geographic information systems (Gis) in water resources: A review. Water Resources Management.10:251-277.

[19] Veysel Aslan and Recep Çelik.(2021) Integrated GIS-Based Multi-Criteria Analysis for Groundwater Potential Mapping in the Euphrates's Sub-Basin, Harran Basin, Turkey. *Sustainability , 13*, 7375 .

[20] Wan Mohtar, W.H.M., Abdul Maulud, K.N., Muhammad, N.S., Sharil, S., Yaseen, Z.M. (2019) Spatial and temporal risk quotient-based river assessment for water resources management, Environmental Pollution 248, pp. 133-144

[21] World Health Organization (WHO) (2011)."Guidelines for Drinking Water Quality", 4th edition. Geneva, Switzerland.

International Journal of Advanced Engineering Research and Science (IJAERS)
Peer-Reviewed Journal
ISSN: 2349-6495(P) | 2456-1908(O)
Vol-10, Issue-4; Apr, 2023
Journal Home Page Available: https://ijaers.com/
Article DOI: https://dx.doi.org/10.22161/ijaers.104.10

Childhood/ Pediatric Cancer: Nursing care in oncopediatrics with a central focus on humanization

Câncer Infantil/ Pediátrico: Os cuidados da enfermagem em oncopediatria com foco central na humanização

Joelma Erculano Bragança Montovanelli[1], Adgeane Batista de Araújo[1], Erika Ferreira Silva Bittencourt[1], Hentony Clayton Lima Pinto[1] , Vanessa Soares dos Reis de Marins[1], Luciana Teixeira Chaves Rodrigues[1], Luciana Santos de Santana[1], Gleisimar Lima Silva[1], Elizamar de Souza Silva[1], Josiane Alves dos Santos[1], Welesmar Barros dos Santos[1], Cleitineia da Silva Souza[1], Renata Perfetti de Souza[1], Hedelson José da Silva[1], Amanda Soares de Souza[1], Dulcilene Custódio da Cruz[1], Patricia Santos De Souza[1], Gleison Faria[2], Flaviane Cristina da Silva[2], Edson Alan Mora Cavalheiro[2], Aline de Souza Gude[2], Francisco Leandro Soares de Souza[2], Tais Loutarte Oliveira[2], Renata Gatto de Morais[3], Rhamayana Maria da Conceição[3], Vitória de Oliveira Peres[3], Daniele Silva de Almeida[3], Aline Fontes Alves[3], Cleidiane Barbosa Malaquias[4], Solange da Silva Boni[4], Letícia Ferreira Gomes[4], Michele Alves Primo[4], Marco Rogério da Silva[5], Andriele Vancini Sanches[6], Rayanne Cavalcante do Nascimento[7]

[1]Nursing student at Universidade Paulista- UNIP- Jí - Paraná, Rondônia, Brazil Email: abcdef@gmail.com
[2]Graduated/Undergraduate student at Unifacimed-Faculty of Biomedical Sciences of Cacoal – FACIMED – RO, Brazil.
[3]São Lucas University Center, Ji-Paraná, Rondônia, Brazil
[4]Graduated from Higher Education in Cacoal, FANORTE, Rondônia, Brazil
[5]Nurse at the University of Vale do Rio dos Sinos – UNISINOS - São Leopoldo, Rio Grande do Sul, Brazil
[6]Graduated from the Interamerican Faculty of Porto Velho – UNIRON, Porto Velho – RO, Brazil
[7]Graduated fron the Universidade Federal de Rondônia – UNIR, Porto – Velho -Rondônia, Brazil

Received: 03 Mar 2023,
Receive in revised form: 05 Apr 2023,
Accepted: 12 Apr 2023,
Available online: 27 Apr 2023

Keyword— Oncology, Humanization, Patient, Nursing

Palavras chaves— Oncologia, Humanização, Paciente, Enfermagem.

Abstract— *Care for cancer patients, in addition to its complexity, involves physical, psychological, social, spiritual and economic aspects, since the term, cancer is still much stigmatized and brings with it the idea of death, prejudice and taboos. An important component in cancer patient care that is essential to life is communication, which allows for the transmission and understanding of messages and influences interpersonal relationships and the behavior of the people involved. In this context, the present study aimed to: Analyze the role of nurses in welcoming children with cancer and the return of these patients to the respective treatment. The methodological framework: This is a bibliographic review, conducted through original and complex studies, published in the following databases: SCIELO, LILACS, BSV and Google Academico, between 2010 and 2022. The results indicate that the exercise of humanized care provided to the patient/child is a favorable practice, as it establishes the team-patient bond. Understanding*

the fragility of the patient at this stage, the nurse assumes a commitment to pre-establish nursing care in partnership, together with the other professionals of the multiprofessional team, in order to meet the patient's needs, and with a view, mainly, to to quality and effective treatment. Thus, this study concludes that humanized care becomes fundamental to go beyond a traditional service, verbal and non-verbal communication in a therapeutic way in which expressions and gestures can mean a lot to the patient, providing greater patient adherence to the proposed treatment.

Resumo— *A assistência ao paciente oncológico, além de sua complexidade, envolve os aspectos físicos, psicológicos, sociais, espirituais e econômicos, pois o termo câncer, ainda é muito estigmatizado e traz consigo a idéia de morte, preconceitos e tabus. Um componente importante na assistência ao paciente oncológico e que é essencial à vida é a comunicação, que permite uma transmissão e compreensão de mensagens e influência nas relações interpessoais e no comportamento das pessoas envolvidas. Neste contexto o presente estudo teve por objetivo: Analisar o papel do enfermeiro no acolhimento da criança com câncer e o retorno desses pacientes ao respectivo tratamento. O referencial metodológico:Trata se de uma revisão bibliográfica, conduzida por meio de estudos originais e complexos, publicados nas bases: SCIELO, LILACS, BSV e Google Acadêmico, entre os anos de 2010 e 2022. Os resultados apontam que o exercício do cuidado humanizado prestado ao paciente/infantil configura-se uma prática favorável, porquanto estabelece o vínculo equipe-paciente. Compreendendo a fragilidade do paciente nesta fase, o (a) enfermeiro (a) assume compromisso de preestabelecer os cuidados de enfermagem em parceria, junto aos demais profissionais da equipe multiprofissional, de forma a atender às necessidades da paciente, e com vistas, principalmente, a um tratamento de qualidade e eficaz. Assim este estudo conclui que torna-se fundamental cuidado humanizado ir além de uma prestação de serviço tradicional, comunicação verbal e não verbal de forma terapêutica em que as expressões e gestos podem significar muito para o paciente propiciando maior adesão do paciente ao tratamento proposto.*

I. INTRODUCTION

According to data reported by INCA (2021), childhood cancer corresponds to a group of diseases (solid tumors and systemic diseases) that have in common the disorderly and uncontrolled proliferation of abnormal cells, compromising tissues and organs. The most common tumors in childhood and adolescence are leukemias (which affect white blood cells), those that affect the central nervous system and lymphomas (lymphatic system). Neuroblastoma (a tumor of cells of the peripheral nervous system, frequently located in the abdomen) also affects children and adolescents, Wilms' tumor (a type of renal tumor), retinoblastoma (affects the retina, back of the eyes), germinal tumor (of the cells that originate the ovaries and testes), osteosarcoma (osseous tumor) and sarcomas (soft tissue tumors) (INCA, 2021).

It is important for nurses to pay attention to complaints and observe changes such as: unexplained and continuous weight loss, pain in the bones or joints that impair games and activities, headaches accompanied by vomiting, usually in the morning, lumps that do not give in and usually appear on the neck, armpits, groin and abdomen, increased volume in the belly, petechiae, small reddish spots that indicate bleeding from blood vessels, usually capillaries, purple spots on the skin (bruises), without there being any in the place, whitish glow on one of the eyes when the retina is exposed to light, such as flashes, constant tiredness and pallor, anemia, persistent fever and with undetermined or unknown origin, frequent infections and low immunity (LORENZONI, 2018).

Thanks to advances in the treatment of childhood cancer in recent decades, more than 84% of children currently survive 5 years or more. Globally this is a

considerable advance since the mid-1970s, when the 5-year survival rate was only 58%. Still, survival rates vary with type of cancer and other factors. According to the World Health Organization (WHO), there were 474,519 new cases of leukemia in the world in 2020, and the disease occupies the 13th position among the most frequent types of cancer (MUTTI, 2018).

The treatment of childhood cancer is determined based on the evaluation and confirmation of diagnostic tests. Then we continue with the possibility of surgery, radiotherapy and/or chemotherapy. Some childhood cancers can be treated with high-dose chemotherapy followed by a stem cell transplant. New options such as targeted therapy and immunotherapy have also shown promise in treating some types of childhood cancers. Children undergoing cancer treatment need a humanized treatment that takes care not only of their biological body, but also of their subjectivity, the nurse must know how to correctly assess the feelings, perspectives, doubts and perceptions that are related to the patient. It is also essential to offer the child a different treatment, focused on their childhood needs (SILVA, 2016).

Thus, this study aims to describe the situation of children diagnosed with cancer, aiming to identify areas for intervention and planning of nursing care, with the aim of contributing to the early diagnosis of childhood cancer, since for therapeutic success, it is essential to reduce the time between the appearance of signs and symptoms and the definition of the diagnosis, thus increasing the expectation of cure. Assistance in oncology is developed through preventive, curative and palliative care. The nursing member of the multidisciplinary team in pediatric oncology, performs the most diverse functions on a daily basis (CAPRINI, 2017).

In this scenario, the family must be involved in the entire care process, and it is their right to receive relevant information about the disease and chosen treatment. In addition, the team needs to maintain a relationship of trust with the child, in order to prepare them for procedures, exams, among others, thus alleviating their fears, anxieties and discomforts (INCA, 2019).

The objective of this study is to identify the main factors of excellence for integrated nursing care in oncopediatrics.

II. MATERIALS AND METHODS

This is a qualitative study carried out through a thorough literature review. This type of scrutiny makes it possible to analyze scientific research in a systematic and broad way, facilitating the characterization and dissemination of the resulting knowledge.

The bibliographical research raises the question: What is the importance of the humanized assistance of nurses in the treatment of children with cancer?

The following inclusion criteria were used: Complete articles on research objectives published in scientific journals and online libraries in Portuguese, English and Spanish between 2010 and 2022. Exclusion criteria were studies published in congresses, blogs, forums or studies that did not meet the to the objectives or deadlines of the research. For that, 28 scientific articles related to the theme, published between 2010 and 2022 in the following databases were analyzed: National Library of Medicine (PUBMED), Literature, Health Sciences of Latin America and the Caribbean (LILACS), Virtual Libraries of the Ministry of Health (BVS), Scientific Electronic Library Online (SciELO), Brazilian Journal of Nursing (REBEN) and Google Scholar.

This review, organized from December 2021 to January 2022, provides researchers with guidance on relevant topics so that they can formulate hypotheses for children seeking solutions to common care-related problems.

III. RESULT AND DISCUSSION

Cancer – Your childhood/youth development

Cancer arises from a genetic mutation, that is, from an alteration in the cell's DNA, which starts to receive wrong instructions for its activities. Changes can occur in special genes, called proto-oncogenes, which are initially inactive in normal cells. When activated, proto-oncogenes become oncogenes, responsible for transforming normal cells into cancer cells (OLIVEIRA et al, 2021).

This process consists of three stages:

- Initiation stage: the genes suffer the action of carcinogenic agents, which cause modifications in some of their genes. In this phase, the cells are genetically altered, but it is still not possible to detect a tumor clinically. They are prepared, that is, initiated for the action of a second group of agents that will act in the next stage (INCA, 2021).
- Promotion stage: genetically altered cells, that is, initiated, suffer the effect of carcinogenic agents classified as oncopromoters. The initiated cell is transformed into a malignant cell, slowly and gradually. For this transformation to occur, a long and continuous contact with the promoting

carcinogenic agent is necessary. Suspension of contact with promoting agents often interrupts the process at this stage. Some food components and excessive and prolonged exposure to hormones are examples of factors that promote the transformation of cells initiated into malignant ones (INCA, 2021).

• Progression stage: In the last stage, that is, in the progression stage, the cell begins to multiply in an uncontrolled way. In this last stage, the cancer is installed.

Cancer is an abnormal growth of cells that forms tumors, in a healthy body, cells grow, divide, die and are replaced in a controlled way, in a natural process called cell division. When cells suffer some kind of alteration in the DNA and begin to divide and reproduce in an uncontrolled way, problems arise. This unbridled growth results in a grouping of cells, which can cause the origin of a mass, popularly known as a tumor, but not every tumor is cancer, there are benign tumors (INCA, 2021).

Soon it is a differentiated disease because it does not have a single and easily identifiable cause, internal and external factors can contribute to the appearance of cancer. However, if the organism, for some reason (aging is one of them), is in a condition conducive to cell mutation, it facilitates the action of these factors. Cancer is born from this imbalance (BRASIL, 2013).

Cancer is one of the most complex public health problems facing the Brazilian health system, given its epidemiological, social and economic magnitude. It is noteworthy that at least one third of new cases of cancer that occur annually in the world could be prevented (INCA, 2016).

Childhood cancer has its own and very different characteristics compared to cancer in adults. Cells that undergo mutation in the genetic material cannot mature as they should and remain with characteristics similar to the embryonic cell, multiplying quickly and disorderly. Therefore, tumor proliferation is faster in children. On the other hand, it responds better to chemotherapy, with an 80% chance of cure, according to INCA.

Childhood cancer corresponds to a group that have in common the uncontrolled proliferation of abnormal cells and that can occur anywhere in the body. Unlike adult cancer, childhood cancer usually affects cells in the blood system and supporting tissues. Because they are predominantly embryonic in nature, tumors in children and adolescents are made up of indifferent cells, which generally provide a better response to current treatments (INCA 2021).

Cancer is a term that encompasses more than 100 different types of malignant diseases that have in common the disorderly growth of cells, which can invade adjacent tissues or distant organs. Dividing rapidly, these cells tend to be very aggressive and uncontrollable, leading to the formation of tumors that can spread to other regions of the body.

The different types of cancer correspond to the various types of cells in the body. When they start in epithelial tissues, such as the skin or mucous membranes, they are called carcinomas. If the starting point is the connective tissues, such as bone, muscle or cartilage, they are called sarcomas (INCA 2021). And in the midst of all these adversities, children experience profound and significant losses, such as changes in life and in the family, where the new and unknown universe is represented not only by the absence of health, but also by distancing and social isolation. (loss of school) and family, due to the loss of autonomy, as the child is resigned to the schedules and interventions of the health team, restrictions on visits, clothing, living with strangers, among many other situations (SCHLIEMANN, 2014).

Cancer is considered a Public Health problem, known as a chronic degenerative disease marked by disorderly and invasive cell growth. In general, it affects the population with an estimate of 80% and more than 20 million new cases for the year 2025 (BRASIL, 2020).

According to INCA (2018), “Cancer is the name given to a set of more than 100 diseases that have in common the disordered (malignant) growth of cells that invade tissues and organs, and can spread (metastasis) to other regions of the body”. Cancer does not have a predetermined age to develop, children also develop the disease. “Childhood cancer” is a generic term that refers to a heterogeneous group of diseases that present morbidity and mortality rates, which depend on the type and extent of the disease, the age of the child and the effectiveness of the initial response to treatment.

According to Instituto Oncoguia (2017), childhood cancer is not related to the lifestyle of the child in question and commonly develops through changes in the DNA of cells, early in life or even before birth. With regard to their treatment, “With some exceptions, childhood cancers tend to respond better to treatments such as chemotherapy, as it is believed that the child's body tends to receive the treatment better when compared to the adult.

According to the National Cancer Institute (INCA) the number of cancers in the country grows significantly in children, becoming a constant health concern. Cancer is considered the first cause of death in this public in the age group between 1 and 19 years. According to the records in the Population-Based Cancer Registry System (RCBP),

3% were registered, which corresponds to 9,890 cases of pediatric tumors in the country (BRASIL, 2009; SANTOS et al., 2017).

How the disease is divided

The most common tumors in childhood and adolescence are leukemias (which affect white blood cells), those that affect the central nervous system, lymphomas (lymphatic system). Also affecting children and adolescents are neuroblastoma (tumor of cells of the peripheral nervous system, frequently located in the abdomen), Wilms tumor (type of renal tumor), retinoblastoma (affects the retina, back of the eyes) germ tumor (of the cells that originate the ovaries and testes), osteosarcoma (bone tumour) and sarcoma (soft tissue tumours). Because they are predominantly embryonic in nature, tumors in children and adolescents are made up of undifferentiated cells, which generally provide a better response to current treatments (INCA, 2021).

White blood cells develop from stem cells in the bone marrow. Sometimes, errors occur in their maturation, and some fragments of the chromosomes are rearranged. The resulting abnormal chromosomes interfere with the normal control of cell division and cause the affected cells to multiply out of control or become resistant to natural cell death, which results in leukemia.

Types are defined according to how quickly they progress and the type and characteristics of white blood cells that become cancerous.

Acute leukemias progress rapidly and consist of immature cells.

Chronic leukemias progress slowly and consist of more mature cells.

Lymphocytic leukemias develop from cancerous changes in lymphocytes or in cells that normally produce lymphocytes.

Myeloid leukemias (myelocytic or myelogenous) develop from cancerous changes in cells that normally produce neutrophils, basophils, eosinophils and monocytes (INCA, 2021).

Leukemias are the most common childhood cancers and affect the bone marrow and blood. The most common types in children are acute lymphocytic leukemia (ALL) and acute myeloid leukemia (AML). Leukemia can cause bone and joint pain, fatigue, weakness, bleeding, fever, weight loss, and other symptoms. Acute leukemias can progress rapidly, so they need to be treated (usually with chemotherapy) as soon as the diagnosis is made.

Leukemia is cancer of the white blood cells (leukocytes) that begins in the bone marrow. In most cases, leukemia invades the blood very quickly and can spread to other organs, such as lymph nodes, spleen, liver and central nervous system (INCA, 2020).

Some childhood cancers, such as neuroblastoma or rhabdomyosarcoma, start in other organs and can spread to the bone marrow, but these cancers are not leukemias. It is important to diagnose leukemia in children as early as possible, determining the type so that treatment can provide the best chance of success.

Brain and central nervous system tumors are the second most common type in children, accounting for 26% of childhood cancers. There are many types of brain tumors and the treatment and prognosis for each one is different. Most brain tumors in children start in the lower part of the CNS, such as the cerebellum and brainstem. These tumors can cause headaches, nausea, vomiting, blurred or double vision, dizziness, and difficulty walking or manipulating objects.

Spinal cord tumors are less common than brain tumors in both children and adults (INCA, 2021).

Brain Tumors are the result of out-of-control growth of abnormal cells. In most other organs of the body, it is very important to distinguish between benign and malignant tumors. Benign tumors in other regions do not invade neighboring tissues or spread to other organs. One of the main reasons cancer is dangerous is because it can spread throughout the body (INCA, 2021).

Although brain tumors rarely spread to other organs, most can spread through the brain tissue itself. Even so-called benign tumors can, as they grow, destroy and compress normal brain tissue, causing damage that is often disabling and sometimes fatal. For this reason, doctors often speak of brain tumors rather than brain cancer. The main concern with brain tumors is the ease with which they can spread to the spinal cord or the brain itself (INCA, 2020).

Spinal cord and brain tumors are different in adults and children. They usually form in different places, develop from different types of cells and may have different prognoses and types of treatment (SILVA, 2016).

The main types of treatment used for CNS tumors in children include: surgery, radiotherapy, chemotherapy, targeted therapy and the use of other medications. Depending on the treatment options defined for each child, the medical team should be made up of specialists, such as a neurosurgeon, neurologist, oncologist, pediatric oncologist, radiotherapist and endocrinologist. But, many others may be involved during the treatment, such as

nurses, nutritionists, physiotherapists, psychologists and social workers (LORENZONI, 2018).

It is important that all treatment options are discussed with the doctor, as well as their possible side effects, to help make the decision that best suits the needs of each patient (LANZA, 2014).

Neuroblastoma is a form of cancer that starts early in nerve cells found in a developing embryo or fetus and accounts for about 6% of childhood cancers. This type of cancer occurs in infants and babies. It is rarely diagnosed in children older than 10 years. This tumor can start anywhere, but is usually diagnosed in the abdomen, being noticed by the appearance of swelling in the region. It can also cause bone pain and fever (MICHALOWSK, 2018).

Neuroblastoma is a common childhood cancer that grows in parts of the nervous system or in the adrenal glands (INCA, 2022). The cause of neuroblastoma is often not known (INCA, 2022).

Symptoms depend on where neuroblastomas develop, such as in the abdomen, chest, skin, or spinal cord.

Diagnosis usually involves imaging and biopsy (INCA, 2022).

Treatment depends on the child's age and the specific characteristics of the cancer and may include surgery, chemotherapy and radiation (INCA, 2022).

A neuroblastoma develops in a certain type of nerve tissue located in many areas of the body. It usually originates from nerves in the abdomen or chest, most often from the adrenal glands (located above each kidney). Neuroblastomas very rarely develop in the brain. In more than half of children the cancer has already spread to other parts of the body by the time a doctor is consulted.

Neuroblastoma is the most common cancer in babies and is one of the most common tumors in children of any age. About 90% of all neuroblastomas occur in children under five years of age. The cause of neuroblastoma is often unknown. Most of these tumors occur spontaneously. Neuroblastomas are rarely a family problem.

The treatment of neuroblastoma is complex and often requires a multidisciplinary team made up of specialists, such as a surgeon, pediatric oncologist and radiotherapist. But many others may be involved during the treatment, such as nurses, nutritionists, social workers, physiotherapists and psychologists (SILVA, 2010).

The approach to treating neuroblastoma depends on the stage of the disease, the child's age, and other factors such as prognostic markers. Types of treatment used may include surgery, chemotherapy, retinoid therapy, radiotherapy, stem cell transplantation, and immunotherapy. In many cases, more than one type of treatment is required (INCA, 2022).

Depending on the treatment options defined for each child, the medical team should be made up of specialists, such as a pediatric surgeon, pediatric oncologist, clinical oncologist and radiotherapist. But many others may be involved during the treatment, such as nurses, nutritionists, psychologists, social workers and physiotherapists (SILVA, 2010).

Wilms tumor is a tumor that starts in one or, rarely, both kidneys. It is most often diagnosed in children aged 3 to 4 years and is uncommon in older children and adults. It can appear as a swelling or lump in the abdomen. Sometimes, the child may have other symptoms, such as fever, pain, nausea, or lack of appetite. Wilms' tumor accounts for 5% of childhood cancers.

Wilms Tumor (also known as Nephroblastoma) is a malignant tumor originating in the kidney. It is the most common type of kidney tumor in childhood and can affect one or both kidneys (INCA, 2021).

This type of tumor can only be evidenced as a palpable mass in the abdomen (it can be observed by parents while bathing or dressing the child). The mass is firm and often large enough to be felt on both sides of the belly. It is usually not painful, but in some cases it can cause stomach pain (LOURENÇATTO, 2010).

Other associated symptoms may be presented, such as urinary tract infection, blood in the urine, high blood pressure and/or abdominal pain, fever, loss of appetite, nausea, shortness of breath and constipation. Most of the time, the general condition of the child with Wilms Tumor is good. In more severe cases, metastases may occur mainly to the lung (LOURENÇATTO, 2010).

Lymphomas start in lymphocytes, which are cells that are part of the immune system. Lymphomas often affect lymph nodes and lymphatic tissues such as tonsils or thymus. They can also affect the bone marrow and other organs, causing different symptoms depending on where they are developing (INCA, 2021).

Lymphoma arises in the lymphatic system, a network of small vessels and lymph nodes that is part of both the circulatory system and the immune system. The system collects and redirects to the circulatory system a clear liquid called lymph, which contains defense cells (white blood cells) called lymphocytes (INCA, 2021).

Lymph nodes (lymph nodes or lymph nodes) and organs such as the thymus, spleen and tonsils are also part

of this system, structures that are also involved in the production of lymphocytes (INCA, 2021).

Lymphomas can cause weight loss, fever, sweating, weakness, and enlarged lymph nodes in the neck, armpits, or groin. There are two main types of lymphoma: Hodgkin's lymphoma and non-Hodgkin's lymphoma. Both types can occur in both children and adults (LOURENÇATTO ,2016).

Like leukemia, lymphoma is also classified into subgroups: Hodgkin's Lymphoma, which spreads in an orderly fashion from one group of lymph nodes to another group, and Non-Hodgkin's Lymphoma, which spreads in an unordered manner and can start in anywhere on the body (BRASIL, 2022).

Symptoms

As in developed countries, in Brazil, cancer is already the leading cause of death from disease among children and adolescents aged 1 to 19 years. Parents should be alert to the fact that the child does not invent symptoms and that at the sign of some abnormality, the children need to be taken to medical care to report the evolution of the condition that, in most cases, the symptoms are related to common diseases that occur in childhood, but this should not rule out a visit to a specialist (LORENZONI et al, 2018).

The National Cancer Institute (INCA) warns of warning signs of recent appearance. They are: Vomiting accompanied by headaches; imbalance when walking; irritability; difficulty moving; bone or joint (joint) pain; sudden change in skin color (usually pale); frequent or persistent fever; weight loss; weakness; bleeding in general; frequent pains in the belly; rapidly growing, painless lumps or nodules, particularly in the neck, armpits, or groin; excessive night sweat; toothaches without having cavities; purple spots on the body or eyelids; nodules or patches on the skin that grow or change color; high pressure; frequent discharge from the ear; early adult sexual characteristics; difficulty seeing or double vision; in the eyes: white pupil or cat's eye reflex.

The diagnosis made in the early stages allows for a less aggressive treatment, with greater possibilities of cure and less sequelae from the disease or treatments (MICHALOWSKI, 2018).

In order to obtain high cure rates, medical care, correct diagnosis, referral to a treatment center and access to all prescribed therapy are also necessary (BRASIL, 2022).

Commonly used lab tests to diagnose leukemia in children are:

Complete Blood Count and Peripheral Blood Study: These tests evaluate the different types of blood cells. Changes in the number and appearance of these cells help in the diagnosis of leukemia.

Coagulation and Blood Chemistry Tests: Blood chemistry tests measure the amounts of certain chemicals that circulate in the blood but are not used to diagnose leukemia. In women already diagnosed with the disease, these tests can help detect liver or kidney problems caused by leukemic cells or side effects of certain chemotherapy drugs (INCA, 2022).

Cytochemistry: is the application of biochemical dyes to blood and bone marrow cells, in order to show their composition without appreciably modifying their morphology. Cytochemical stains help in the diagnosis of leukemias and other hematological diseases (INCA, 2022).

Flow cytometry is performed with a device that can make individual measurements of thousands of cells, in an exact count that is essential for the efficiency of the treatment of the disease. This technique is often used to examine bone marrow cells, lymph nodes and blood samples for the diagnosis of leukemias (INCA, 2022).

In the immunohistochemical examination, blood cells or bone marrow samples are analyzed using monoclonal antibodies marked with fluorescent substances. Different types of lymphocytes have different antigens, which change as each cell matures. The cells of each leukemia patient have the same antigens because they are all derived from the same cell.

In addition to characterizing the antigens expressed by the cells involved, flow cytometry provides information regarding cell size and granularity. In acute leukemias, the test is indicated to determine the cell lineage, analysis of clonality and the state of maturation of leukemic cells, expression of aberrant antigen patterns typical of certain groups of leukemias and follow-up of treatment and detection of minimal residual disease (INCA , 2022).

Cytogenetics In this test, the chromosomes of the leukemia cells are analyzed to detect any abnormalities. In some cases of leukemia, the cells have chromosomal changes visible under a microscope.

Fluorescent In Situ Hybridization (FISH) FISH detects most chromosomal changes visible under the microscope in cytogenetic tests, as well as small changes not seen in cytogenetic tests. It can be used in blood tests or bone marrow samples (INCA, 2022).

Polymerase Chain Reaction This is a very sensitive DNA test, which allows the detection of small chromosomes, not visible under the microscope, even when few leukemic cells are present in the sample (INCA, 2022).

Treatment

Treatment against childhood cancer, in most cases, takes a long time, exposing the child to a considerable period of hospitalization and to invasive and unpleasant procedures, both physically and emotionally. To adapt to this new situation, the child uses coping strategies, which will be articulated according to the child's personal characteristics, their beliefs and values as a result of the factors to which they are exposed (MOTTA et al, 2018).

Communication between the health team, the child and the family is very important, and the child needs to be informed about their own treatment, after confirming their diagnosis, in a way that is appropriate to their level of understanding, and the team and family need to be attentive to the meanings attributed by the child to the various aspects that involve this treatment, such as hospitalization, chemotherapy, surgery, possibility of cure, among others (LOURENÇALTO et al, 2010).

Some reasons given in the literature for refusal, non-cooperation and abandonment of treatment include physical discomfort of the patient, the parents' fear of losing their role as parents, misunderstanding and uncertainty about the merits of the medication, failure or inadequacy in communicating about the diagnosis and treatment and its side effects. The insufficiency and inappropriateness of communication between the doctor, the patient and the family correspond to one of the most important causes of non-cooperation (LANZA, 2014).

Chemotherapy is the treatment that uses chemical agents in the treatment of malignant tumors and it is usually part of the planning of the treatment of people who are unable to undergo a surgical approach or radiotherapy. It is one of the most common procedures in oncology and is used to reach every cell in the body. The first objective is to destroy malignant cells and maintain normal cells, but almost always the difference between these cells is small, due to this and the high degree of toxicity, undesirable side effects arise that are intense and leave their patients fragile (INCA, 2021).

To resort to chemotherapy, it is necessary to know how the tumor is in addition to its extension, in addition to the physical conditions of the patient. Some tumors are completely excluded with chemotherapy, for example: lymphomas, leukemias, childhood tumors and testicles. When chemotherapy is used as a palliative method, it reduces the tumor, stabilizes the clinical picture and ensures a better quality of life (INCA, 2021).

The nurse's role in assisting a child diagnosed with cancer

Caring for a child with cancer is challenging, as it proposes, in addition to specific material and therapeutic resources, a health team that is attentive to what happens in the child's universe. It is imperative that professionals have responsibility, commitment, adequate preparation and sensitivity to care for the child.

Faced with this situation, we find the professional nurse, whose production of qualified care is influenced by the confrontation with the reality of childhood cancer, which includes practical and emotional aspects (SILVEIRA et al., 2021).

Assistance in pediatric oncology requires certain practice on the part of health professionals, requiring nurses to articulate knowledge and practices, and be able to respond consciously, regardless of the disease that the child experiences and how it develops in the family's daily life (THEOBAID et al, 2016).

The Code of Ethics for Nursing Professionals (COFEN, 2015) ensures that it is the nurse's responsibility and duty to provide assistance to the person, family and community free from damage resulting from malpractice, negligence or recklessness and that nursing must guarantee assistance safely and provide adequate information to the person and the family about the rights, risks, intercurrences and benefits regarding nursing care.

The Ministry of Health (2013) established the National Patient Safety Program with the objective of implementing assistance, educational and programmatic measures and initiatives aimed at patient safety in different areas of care, organization and management of health services through the implementation of risk management and Patient Safety Centers in health establishments.

Since professionals are responsible for planning and appropriate intervention in order to keep the environment safe, the development of nursing research on patient safety is vital (SILVA et al, 2016).

Nursing professionals in the care of children with cancer experience feelings such as suffering, sadness and exhaustion. Still, it is necessary to separate professional performance and emotion, so that there is no involvement and burnout of the professional, highlighting the need to develop multiprofessional action strategies among the team that cares, considering that they also need to be cared for (DUCCA et al. ,2020).

Nursing professionals are responsible for a large part of care actions and, therefore, are in a privileged position to reduce the possibility of incidents that affect the patient, in addition to detecting complications early and carrying out the necessary actions to minimize damage (MORAIS et al, 2016).

Nurses, when caring for children with oncological diseases beyond the possibility of a current cure, provide

assistance aimed at the human child, whose actions are centered on their needs, demanding attention, time, sensitivity and availability, in order to make them comfortable even when not healthy. Also noteworthy is the care for the family member, seeing it holistically and providing support in the face of the situation (SILVEIRA et al, 2021).

Cancer in children is seen as a loss of childhood pleasures, the freedom of a normal and healthy life. Feelings emerged, either negative (fear, sadness and revolt) or positive (hope, happiness and optimism). Thus, the act of playing in the context of the child's hospitalization constituted a viable communication resource used by nursing, providing moments of relaxation and the possibility for the child to express their anxieties, difficulties, desires and emotions (INCA, 2021).

Childhood cancer is a pathology that imposes great limitations, thus interrupting children's daily activities, moving them from their world of fantasies to a reality that is often harsh and cruel.

Thus, this study demonstrates the relevance of nursing care in pediatric oncology and emphasizes that in approaching this care it is necessary to ensure the quality of life of children. To adapt to the disease present in the child, the nurse must create strategies such as therapeutic toy and the construction of affective bonds, which constitute tools that allow the child to better express their feelings, easing the suffering, in addition to facilitating communication. and greater child/professional interaction (SILVEIRA et al, 2021).

The nurse facing the ludic treatment

It is evident that the nurse has an indispensable role in the act of caring for the child with cancer, since he/she is involved in a humane way with the patient and his/her family, who are often sensitized by the whole situation that cancer imposes. It is necessary for the professional nurse to understand the pain of the other, in order to alleviate it, seeking recovery and a good standard of quality of life for the pediatric patient. Finally, the need for further studies on this topic is highlighted, in order to provide nurses with greater support for providing assistance in pediatric oncology, promoting health and preventing situations that increase the suffering generated by cancer, with a view to humanization of care (NEVES et al, 2017).

Ludic art or ludotherapy is considered a humanization strategy, which applies playing in different ways, this activity should be used daily by the health team, as it allows the individual both a continuity of child development and the reintegration of well-being physical and emotional, thus resulting in a less traumatizing hospitalization, because in addition to establishing an interaction between the child and the nursing team, it makes the environment in which it is inserted more pleasant. In this context, its practice allows the subject to expose negative feelings towards hospitalization, as well as the transformation of the subject's behavior (BOSCHETTI et al, 2019).

According to (OLIVEIRA, 2021), playing is used by the nursing team in three moments: during the daily routine; in the preparation of invasive procedures and during the performance of painful and unpleasant procedures.

The professional nurse who has greater contact with pediatric patients, in addition to empathy, must have creative capacity and sensitivity when approaching this client, thus being able to prove the importance that nurses have in alleviating the suffering resulting from hospitalization (PINHEIRO et al, 2021).

As a consequence of all these factors, there is a physiological change favoring an increase in the child's immunity and this fact implies a global improvement (BOSCHETTI et al, 2019).

The technical-scientific knowledge and the affectivity of the professional nurse in the daily life of oncology nursing are constitutive elements of care, which will be influencing the development of assistance provided to the sick person. Emotional support and creativity in the art of caring should be valued, requiring technical and empathic skills. When caring for the child, one must understand their particular world and the stages of childhood, holistically in terms of the child-family dyad, seeking to satisfy their needs, regardless of their current condition. The nursing team, along with the interdisciplinary team, must develop activities with the child and his family, seeking to maintain well-being(NEVES et al, 2017).

The involvement of the nursing team with the cancer patient has its good and bad sides. For example, for professionals who provide palliative care (to improve the patient's quality of life and have a dignified death) it is almost always painful, no matter how much he knows the patient's real situation, he hopes, creates hope that the situation can be reversed and this is not always what happens. In a way, the employee misses the patient, which causes him to mourn for a few days, even if only internally. Reading some research, we can see that professionals who avoid patients, do the procedure and leave soon, with the purpose of not getting involved. Maybe it's good for him, but it's no longer good for the patient, as there may be the impression that his cancer takes over and his emotional state is worse than it already was (ARRUDA et al, 2016).

Humanized Care

The good side of getting emotionally involved with the patient is that the professional gives his entirety to the patient and tries in every way to take care of him in the best possible way, because somehow he managed to absorb the pain and suffering of the client (SILVA et al. 2016).

Some get so involved that they are afraid to perform invasive procedures and this somehow interferes with the patient's treatment, as the procedure may hurt, but it is part of the process and it cannot be delayed (LANZA et al, 2014).

The reaction of health professionals shows how divisive it is to care for cancer patients, balance is essential for the health team or otherwise, the professional can relate the patient's death to their emotions, in addition to ending up taking the patient's problems to the next level. your home and thus causing problems in your life (BRASIL, 2022).

Some get so involved that they are afraid to perform invasive procedures and this somehow interferes with the patient's treatment, as the procedure may hurt, but it is part of the process and it cannot be delayed (LANZA et al, 2014).

The reaction of health professionals shows how divisive it is to care for cancer patients, balance is essential for the health team or otherwise, the professional can relate the patient's death to their emotions, in addition to ending up taking the patient's problems to the next level. your home and thus causing problems in your life (BRASIL, 2022).

Reinforcing what was mentioned Santos (2013), stresses that creative problem solving must combine knowledge and intuition as part of the care process. The scientific and creative method for formulating strategies in nursing practice is of a fundamental nature (caring for the other), which involves a humanistic approach. Considering the child's peculiar universe in order to understand it reflects the concern to practice care aimed at the child's needs, considering particular aspects of development, to improve the understanding and interaction of this child in the hospital environment.

Childhood cancer is not a preventable disease, there is no scientific evidence that makes clear the association between the disease and environmental factors. Thus, the approach to pediatric cancer should be given to its early diagnosis and with timely referral for timely and quality treatment, which allows greater chances of cure. From the perception of symptoms to the diagnosis of childhood cancer, several factors are involved, characterizing a complex process, and many are the variables that seem to influence it (INCA, 2021).

The precarious socioeconomic context of families and the lack of effective support from social policies are factors that impact oncological treatment. In this sense, we seek to reflect on the implications of the diagnosis on the socioeconomic conditions of families of children and adolescents with solid tumors, identifying the social policies that are accessed during cancer treatment and their respective return.

The role of the oncology nurse is to assist the patient in all stages of treatment from the diagnosis of the disease, to chemotherapy, radiotherapy or surgery. Emphasizing the prevention of complications, detecting side effects early and adopting measures to control them, providing differentiated, specialized care that incorporates the psychosocial aspects of the person and his family, thus obtaining a holistic care that responds to all the needs of the individual (INCA 2021).

Also pertinent to the oncologist nurse are the attributions of administrative activities to verify releases and schedule treatment procedures, in addition to having an educational role guiding both the patient and the family members during the treatment. This happens right after the diagnosis and the decision on the treatment made by the oncologist, the nurse evaluates the patient regarding aspects of venous access, checks the treatment protocol to be carried out, verifies the toxicity of the medications, provides guidance regarding the protocol, check information such as weight and height, chemotherapy doses and chemotherapy support medications. Thus characterizing the nursing consultation. Thus ensuring safety and greater effectiveness in the administration of protocols (BRASIL, 2021).

With the consultation, one of the most important behaviors of the nurse is the choice of the chemotherapy infusion device, which is very important for the success of the treatment. In this evaluation, the nurse analyzes the patient's venous network and, together with the multidisciplinary team, chooses the best option for the treatment to be carried out.

Some drugs may be infused into peripheral veins by peripheral puncture. However, for some medications, protocol, due to venous fragility or depending on the clinical evaluation, the implantation of the fully implanted catheter (Port-A – Cath) or the peripherally inserted central venous catheter (PICC) may be indicated, which are deeper access into a larger central vein. The Port-a-Cath is a siliconized rubber device, whose distal end is coupled to a punctureable camera, which remains under the skin, embedded in a pocket in the subcutaneous tissue of the

thoracic region , on a bone surface. It is implanted through a surgical procedure. This catheter, in addition to offering greater functional comfort, has a lower infection rate when compared to other available catheters (JOHAN et al. 2012).

IV. CONCLUSION

From the results of this research, it was possible to know the care developed by nurses who work in pediatric oncology, their experiences of pleasure and suffering, as well as to identify the strategies used by them to provide care to children with cancer. In view of the analysis of the studies, although there are publications regarding the use of playful activities in the hospital environment, the reality is still far from what is observed in the articles, because, as observed, even among nursing professionals who know the benefits of playful resources , the resource is little used during the practice of care for the hospitalized child, with emotional support being the most used resources as strategies and is present in all the cited studies. As for the difficulties and facilities encountered by the nurses, it was observed that both the difficulties and the facilities are together in the nurses' routine, as both can be generated by the child's suffering, depending on the situation. Such as child care, living with the children's families and issues related to the work environment in which the nurse works.

We observed that oncology is one of the areas that most causes pain, suffering, anxiety and stress to pediatric nurses. Because of this, it is important to emphasize that the institutions where these professionals are inserted must adhere to a more humane policy and with a different look at these professionals who have suffering as their work routine. In view of this, much is still needed to advance in practice that includes more humane and individualized care in the treatment of children with cancer, not only routine procedures must be advocated, but the uniqueness and fantasy of each child.

In conclusion, the nursing team implements ludic activities in their daily practice, enabling their use in assessment, diagnosis and nursing intervention. And it is expected that the institutions where nurses work in the care of children with cancer, have a different look at these professionals.

ACKNOWLEDGEMENTS

I would like to thank my colleagues, professors and friends for their participation in the elaboration of this work.

REFERENCES

[1] A.C.CAMARGO Câncer Center. Tudo sobre o câncer – infantil. Disponível em:http://www.accamargo.org.br/tudo-sobre-ocancer/infantil/16/. Acesso em:3 de junho de 2022.
[2] ABRACE, Câncer infanto/juvenil, disponível em: https://abrace.com.br/ Acesso em 08 de maio de 2022.
[3] BARRETO, Ricardo Azevedo O lúdico em odontopediatria. In: CORRÊA, Maria Salete Nahás Pires. Consulta Clínica e Psicológica na Odontopediatria. Livraria Santos e Editora. 2. Edição. São Paulo: 2013.
[4] BRASIL, InstitutoVencerocancer.Disponivel,em:https://vencerocancer.org.br/. Acesso 02 de Abril de 2022.
[5] BRASIL, Ministério da Saúde (BR), Secretaria de Atenção à Saúde, Departamento de Atenção Especializada e Temática. Protocolo de diagnóstico precoce para oncologia pediátrica http://portalarquivos2.saude.gov.br/images/pdf/2017/fevereiro/17 Protocolo-de-Diagnostico-Precoce-do-Cancer-Pediatrico.pdf
[6] BRASIL, Ministério da Saúde (BR), Secretaria de Atenção à Saúde, Departamento de Atenção Especializada e Temática. Protocolo de diagnóstico precoce para oncologia pediátrica [Internet]. 2017. [acesso 2018Jul 14]. Disponível em: http://portalarquivos2.saude.
[7] BRASIL, Ministério da saúde, Câncer infanto-juvenil. Brasília-DF.2019. Disponível: https://www.inca.gov.br/tipos-de-cancer/cancer-infantojuvenil.
[8] BRASIL, Ministério da saúde. CÂNCER INFANTIL. São Paulo-SP 2021. Disponivel:www.oncoguia.org.br/cancer-home/cancer-infantil/4/124/
[9] BRASIL, Ministério da saúde. O que é pesquisa clínica. São Paulo-SP .2021. Disponivel:www.oncoguia.org.br/conteudo/o-que-e/15335/1292/.
[10] BRASIL, Ministério da saúde. SEGURANÇA DO PACIENTE. Brasília-DF. 2013. Disponível:https://bvsms.saude.gov.br/bvs/publicacoes/documento_referencia_programa_nacional_seguranca.pdf.
[11] BRASIL. Ministério da Saúde. Documento de referência para o Programa Nacional de Segurança do Paciente Brasília DF: Ministério da Saúde, 2014.
[12] INCA – Instituto Nacional de Câncer. Tipos de Câncer: Câncer Infantil. 2016.
[13] INCA – Instituto Nacional do Câncer [online]. (2019) Tipos de câncer: Câncer infantojuvenil. [acesso em 16 jun. 2019]. Disponível em: https://www.inca.gov.br/tipos-de-cancer/cancer-infantojuvenil
[14] INCA, cuidando de crianças com câncer, Fundação Sara, Disponível em: https://www.fundacaosara.org.br/, acesso em 211 março de 2022.
[15] INCA, Estimativas 2016. Disponível em: http;//www.inca.gov.br.Acesso em 26/04/2022.
[16] INCA, tudo sobre câncer infantil, Abrale, associação Brasileira de Linfoma e Leucemia, disponível em:https://www.abrale.org.br/doencas/cancerinfantil/Acesso em 15 de maio de 2022.
[17] INCA. Estimativa 2018: incidência de câncer no Brasil.

[Internet]. Rio de Janeiro: INCA; 2017. [. Acesso agosto 2021]. Disponível em: http://www.inca.gov.br/estimativa/2018/estimativa-2018.pdf

[18] INSTITUTO DE CANCER INFANTIL, dê um lugar para o amor morar. Disponível em: https://ici.ong/?gclid. Acesso em 17 dezembro de 2021.

[19] LEÃO, Eliseth Ribeiro. ESPECIALIZAÇÕES EM ENFERMAGEM, cuidados de enfermagem oncológicos. Editora Yendis Ltda. Volume ll. Rio de Janeiro: 2012.

[20] MICHALOWSKI MB, LOREA CF, RECH A, SANTIAGO P,LORENZONI M, TANIGUCHI A, et al. Diagnóstico precoce em oncologia pediátrica. Bol. Cient. Ped. 2012;1(1):13-8.

[21] MORAIS, V. L. L. de. Onco-Hematologia. In: JÚNIOR, D. C.; BURNS, D. A. R. Tratado de Pediatria: Sociedade Brasileira de Pediatria. 3. ed. Barueri: Manole, 2014. p. 2226-2351.

[22] MUTTI, C.F. et al. Assistência à saúde da criança com câncer na produção científica brasileira. Rev bras cancerol, v. 56, n. 1, p. 71-83, 2010.

[23] ORGANIZAÇÃO MUNDIAL DA SAÚDE (OMS). Conferência Sanitária Pan-Americana, Sessão do Comitê Regional, 54. Qualidade da assistência: segurança do paciente. Organização PanAmericana da Saúde: Washington, DC, p. 1112, 2327, set. 2002. Disponível em: <http://www.ops-oms.org/portuguese/gov/csp/csp26-26-p.pdf>. Acesso em: 3 jun. 2015.

[24] RODRIGUÊS, Andreia Bezerra ONCOLOGIA PARA ENFERMAGEM. São Paulo-SP. Editora Manole. 2016. 523p.

[25] SANTOS, Solange Silva dos; et al. A ludoterapia como ferramenta na assistência humanizada de enfermagem. Revista Recien; v. 7, n. 21, p. 30-40, 2017.

[26] SILVA, Thiago Privado et al. Cuidados de enfermagem à criança com câncer: uma revisão integrativa da literatura. Revista de Enfermagem da UFSM, v. 3, n. 1, p. 68- 78, 2013.. Disponível em: Acessado em: 23/10/2016

[27] SOUZA, V., Frizzo, H., Paiva, M., Bousso, R., & Santos, Á. (2015). Espiritualidade, religiosidade e crenças pessoais de adolescentes com câncer. Revista Brasileira de Enfermagem.

[28] VARELA, Dráuzio. Câncer nas crianças. Disponível em: http://drauziovarella.com.br/crianca-2/cancer-nas0criancas/ Acesso em: 21 março de 2022.

[29] VIANA, Dirce Laplaca. ESPECIALIZAÇÕES EM ENFERMAGEM, atuação, intervenção e cuidados de enfermagem. Editora Yendis Ltda. Volume ll.Rio de Janeiro: 2012.

International Journal of Advanced Engineering Research and Science (IJAERS)
Peer-Reviewed Jounal
ISSN: 2349-6495(P) | 2456-1908(O)
Vol-10, Issue-4; Apr, 2023
Journal Home Page Available: https://ijaers.com/
Article DOI: https://dx.doi.org/10.22161/ijaers.104.11

Calculating gross photosynthesis in C3 and C4 metabolisms

Calculando a fotossíntese bruta em metabolismos C3 e C4

Benjamim Pereira da Costa Neto

Pós-graduado em Biologia Vegetal e Biodiversidade; Biólogo; Assessor Técnico da Rede das Escolas Famílias Agrícolas Integradas do Semiárido (REFAISA)

Received: 31 Jan 2023,

Receive in revised form: 25 Feb 2023,

Accepted: 20 Mar 2023,

Available online: 28 Apr 2023

***Keywords*— Thermodynamics, photosynthetic energy, plant physiology.**

***Palavras-chave*— Termodinâmica, energia fotossintética, fisiologia vegetal.**

***Abstract*—** *Photosynthesis is the main metabolic process for guaranteeing life on earth, through energy transfer relationships in the food chain. Studying this magnificent process is an immense privilege for those who have it. Nowadays, the carbon balance has gained a lot of space regarding the photosynthetic characterization of species, but its use can mask the real results of photosynthesis, which by the way is a process of energy production and transport. Therefore, this work aimed to develop a logical reasoning, through simple equations, to calculate the energy produced during the species cycles of C3 and C4 metabolisms, based on the volume of water absorbed and transpired by the plant.*

***Resumo*—** *A fotossíntese é o principal processo metabólico para garantia da vida na terra, por meio das relações de transferência de energia na cadeia alimentar. Estudar esse processo magnífico se constitui de um imenso privilégio para quem o tem. Nos tempos atuais, o balanço de carbono ganhou muito espaço no tocante a caracterização fotossintética das espécies, mas seu uso pode mascarar os resultados reais da fotossíntese, que por sinal é um processo de produção e transporte de energia. Assim sendo, esse trabalho objetivou desenvolver um raciocínio lógico, por meio de equações simples, para calcular a energia produzida durante os ciclos de espécies dos metabolismos C3 e C4, com base no volume de água absorvido e transpirado pela planta.*

I. INTRODUÇÃO

A fotossíntese é o mecanismo pelo qual os vegetais superiores e algumas bactérias e algas marinhas produzem compostos orgânicos utilizando a luz como fonte de energia, essa energia fixada via fotossíntese é armazenada em compostos orgânicos os quais são utilizados no metabolismo celular da planta (MARENCO et al., 2014; TAIZ & ZEIGER, 2013; TAIZ et al., 2017).

O estudo e entendimento de ideias que envolvem o campo da fisiologia vegetal não podem ser desprendidos da compreensão geral da fotossíntese, nas suas mais variadas dimensões, sejam eles em boas condições de desenvolvimento e/ou submetidas a diferentes fatores potenciais de estresse.

Assim, o presente estudo objetivou desenvolver um conjunto de equações simples para calcular a fotossíntese bruta - a partir da relação entre o volume de água absorvido e o transpirado pela planta - em espécies dos metabolismos C3 e C4, sem considerar as perdas por fotorrespiração e respiração.

II. METODOLOGIA

Os dados apresentados no trabalho podem ser consultados em Neto (2022) e Neto (2023).

Desenvolvimento

Equação 01: Calculando o número de moléculas de H2O em um volume conhecido de água.

(Tomando como exemplo 1 litro de água)

Dados:

Densidade da água = 1 g/mL

Volume de água = 1 L = 1000 mL

Massa Molar da água = 18 g/mol

Número de Avogadro = $6{,}02.10^{23}$ moléculas/mol

Cálculos:

Massa de água = densidade x volume = 1 g/mL x 1000 mL

Massa de água = 1000 g

Mols de H2O em 1 litro - Regra de 3

1 mol ------ 18 gramas

X mol ------ 1000 gramas

X = 1000/18 = 55,56 mols

Número de moléculas de H2O em 1 litro - Regra de 3

1 mol ----- $6{,}02.10^{23}$ moléculas

55,56 mol ----- Y moléculas

Y = 55,56 x $6{,}02.10^{23}$ = 334.10^{23}

Y = **$3{,}34.10^{25}$ moléculas de H2O**

Equação 02: Calculando o número de moléculas de ATP produzidos a partir do número de moléculas de H2O.

((mH2O/2) x 9)

Onde:

mH2O = Moléculas de H2O produzidas por volume de água conhecido;

2 = Representa o número de moléculas de H2O para formar 3 ATP´s e 2 NADPH2;

9 = Número total de ATP´s a partir de 2 moléculas de H2O.

Equação 03: Calculando o número de moléculas de glicose e a energia produzida em Kilojoule (KJ) durante o ciclo.

((mATP/ATPn) x Ent)

Onde:

mATP = Moléculas de ATP total;

ATPn = Número de moléculas de ATP necessárias para formar uma molécula de glicose;

Ent = Entalpias das ligações químicas por molécula de glicose em KJ.

Observações importantes:

1. Lembrando que aproximadamente 1% do que as plantas absorvem pelas raízes é utilizado na fotossíntese e em outras reações metabólicas (Taiz e Zeiger, 2013). Para fins de cálculos, Neto (2022) e Neto (2023) consideraram que apenas 25% desse 1% são utilizados no metabolismo fotossintético das culturas.
2. O número de moléculas de ATP formados na equação 02, depende intrinsecamente do número de moléculas de H2O formados na equação 01, que está intimamente ligado à relação entre volume de água absorvido e o transpirado pela cultura.
3. O ATPn vai depender do metabolismo fotossintético da cultura, em que, para o metabolismo C3 o ATPn é de 54 ATP´s e de 66 ATP´s para o metabolismo C4.

III. CONSIDERAÇÕES FINAIS

O desenvolvimento de técnicas simples para calcular a fotossíntese com base nas entalpias das ligações químicas, se torna imprescindível diante de um cenário em que se utiliza técnicas que mascaram o real potencial fotossintético das espécies, sejam elas de ecossistemas naturais ou agrícolas. Assim, o presente trabalho permite desenvolver um raciocínio lógico acerca dos resultados de produção total de energia das espécies que apresentam tanto metabolismo C3 quanto C4. Entretanto, estudos elementares, sobretudo envolvendo as perdas pela fotorrespiração e respiração, são imprescindíveis para dar robustez a estudos posteriores.

REFERÊNCIAS

[1] Marenco, R. A., Antezana-Vera, S. A., Gouvêa, P. R. dos S., Camargo, M. A. B., Oliveira, M. F. de, & Santos, J. K. da S. (2014). Fisiologia de espécies florestais da Amazônia: fotossíntese, respiração e relações hídricas. *Revista Ceres*, *61*, 786–799.

[2] Neto, B. P. da C. (2022). Energy balance in maize (Zea mays L .). *International Journal of Advanced Engineering Research and Science*, *9*(12), 103–105.

[3] Neto, B. P. da C. (2023). Photosynthetic efficiency in species with C3 and C4 metabolisms. *International Journal of Advanced Engineering Research and Science*, *10*(1), 1–3.

[4] Taiz, L., & Zeiger, E. (2013). *Fisiologia vegetal* (5th ed.). Artmed.

[5] Taiz, L., Zeiger, E., Møller, I. M., & Murphy, A. (2017). Fisiologia e Desenvolvimento Vegetal. In *Biochemical Education* (6th ed.). Artmed.

International Journal of Advanced Engineering Research and Science (IJAERS)
Peer-Reviewed Jounal
ISSN: 2349-6495(P) | 2456-1908(O)
Vol-10, Issue-4; Apr, 2023
Journal Home Page Available: https://ijaers.com/
Article DOI: https://dx.doi.org/10.22161/ijaers.104.12

Associativism as strategy of reaching territorial rights, programs, projects and public policies of rural development: The case of the São Francisco do Mainã community, Manaus, AM

Lindomar de Jesus de Sousa Silva[1], Gilmar Antonio Meneghetti[2], José Olenilson Costa Pinheiro[3], Alessandro Carvalho[4], Marcos Roberto Brito de Carvalho[5], Rafael de Lima Erazo[6], Francisco Mateus da Silva[7]

[1]Sociólogo, Embrapa Amazônia Ocidental, Manaus, AM. https://orcid.org/0000-0002-4816-486X
[2]Agrônomo, Embrapa Amazônia Ocidental, Manaus, AM. https://orcid.org/0000-0001-5645-8916
[3]Economista, Embrapa Amazônia Ocidental, Manaus (AM). https://orcid.org/0000-0003-0036-6646
[4]Economista, Embrapa Amazônia Ocidental, Manaus, AM. https://orcid.org/0000-0003-0116-7155
[5]Economista, Embrapa Amazônia Ocidental, socramrb@bol.com.br
[6]Geografo, Secretaria de Estado de Educação do Amazonas (SEDUC), https://orcid.org/0000-0002-6841-1717
[5]Agricultor Familiar, pescador artesanal e presidente da Associação Comunitária do Mainã

Received: 10 Mar 2023,
Receive in revised form: 15 Apr 2023,
Accepted: 22 Apr 2023,
Available online: 28 Apr 2023

***Keywords*— associativism, territorial rights, traditional Amazonian community.**

***Abstract*—** *Associativism has been an important tool for Amazonian communities to guarantee territorial rights, to recognize traditionality and to access public policies. This article is the result of a case study, with qualitative bias, with interview techniques and dialogues with leaders. It shows how the transition from a socio-cultural association to a socio-economic and political one added to the São Francisco do Mainã community to retake their territorial rights usurped by the Brazilian State in the 1970s, for the installation of the Center of Instruction of War in the Forest (CIGS), administered by the Brazilian Army. The association, with socio-economic and political purposes, influenced public and private institutions in order to access programs, projects and public policies of rural development. The results of this process are the recognition of the traditionality of the community, which has lived in the area for over 100 years with the possibility of managing production actions and living with the Army in their areas, and having access to governmental programs such as Luz para Todos and agricultural production incentive ones, in addition to reinforcement of community spirit and mutual commitment between farmers.*

I. INTRODUCTORY ASPECTS

Associativism is an old strategy of humanity destined to overcome surviving limitations in searching for and producing food, defense and in meeting socio-economic and political concerns. To Canterle (2004, p.1),"associativism forms a historic and deep demand of improving the quality of human existence" through "exchanging of experiences", living and interaction between people, giving opportunity to collective growth and development.

Sebrae (2009, p.8) understands association is, in a broad meaning, any "formal or informal initiative that brings private people or other legal societies with common goals

together, pursuing to overcome difficulties and to create benefits for their associates". Its law form consists in the legalization of a "people bonding around their interests", which will enable the "construction of better conditions than the ones the individuals would have individually for the accomplishment of their goals".

Muenchen (1996) states that, to small farmers, associativism occurs when the interests converge to the solution of common problems. In the same line of thought, Lazzarotto (2000, p.2) affirms that the "small farmers organization in associations, whether as for production, or otherwise as for production, trading, service, constitutes one of the most viable forms of support to small production units" to overcome obstacles.

Sabourin (2009, p.89), analyzing forms of farming association, establishes three classical models: the union, the cooperative and the producers association. The author affirms that the association has a more local character and the possibility of evolution because it is in the "formal organizations of Associative Law" group, which base themselves in voluntary adhesion and are conceived for the "defense of interests and the management of common assets". Berthome and Mercoiret (1999, p.12) argue the associations "become tools to be used by the local society to act on its external environment and to increase its capacity of negotiation with the external actors (individuals and groups with which the local society needs to maintain a relationship)". Fagotti (2017, p. 34) corroborates the idea that in the rural environment "the associations emerge as an easier way to obtain agricultural credits, trading and demands organization channels before governmental instances".

To Almeida (1994), Amazon has a great diversity of groups, peoples and communities, what reflects itself on the forms and purposes of associations. Maneschy *et al.* (2008, p.86) catalog among these groups, "artisanal fishermen, farmers, riverside population, quilombolas, residents in units of conservation,extractive communities, not to mention the indigenous ones, which exhibit various forms of cooperation, traditional or new ones" and recently switched to "a specific manner, officially privileged, of cooperation: the legal form of 'association'".

Fernandes (2004, p.70) understands associations have shown the "arrival of new patterns of political relations in the country and in the city", which since 1998 is "consolidating itself beyond the traditional milestones of patronage control", and embodies "ethnical and ecological, genre and collective self-definition criteria, which ones join themselves to relativize the political-administrative divisions and the conventional manner of forwarding demands to public authorities".

Maneschy et al.'s studies (2008) point to different motives for the creation of associations in Amazon communities. Among them is the need to search for bank credit access by finance institutions, by North Constitutional Fund (FNO) and by the National Program for Strengthening of Family Farming (Pronaf). FNO, for concession of credit, demands the farmer to be affiliated to an associative entity.

Associations are essential to the participation of communities in the management of extractive reserves (ESTERCI; LIMA; LÉNA, 2002). The organizations of representation of the users receive many necessary obligations to the conservation of natural resources, according to Santos (2016). The existence of an associative organization expands the vision, the systemic view and sets relationships with various local and institutional actors, securing work done in a collective way and a systemic view on Amazonas rural reality (BRITO *et al*., 2018).

Peres (2003, p. 23) expresses that, among indigenous peoples, associativism emerges as fight strategy and resistance before big projects, for instance *Calha Norte*[1], implemented in the region of Rio Negro, Amazonas, and as "a new manner of connecting local demands to transnational circuits of human rights and local environment defense". This "post Federal Constitution of 1988 associativism, rooted in respect to the "diversity and the universal responsibility to social justice and environment conservation, substituted Christian communitarianism, based on the conjunction between the tools of soul salvation and of social, political and cultural emancipation of oppressed peoples".

Associativism has an important role in the socio-economic improvement of Amazonian communities. An example of the relevance of associativism is from Carauari town, situated on the left bank of Juruá River, in Amazonas, with

[1] According to Diniz (1994, p.10), the "*Calha Norte* Project, also called Northern Solimões and Amazonas Rivers Beds Development and Security", was "originally a confidential project, created by a group coordinated by the General Secretariat of the National Security Council and concluded in 1985". This project only came to public knowledge "during the works of a Parliamentary Committee of Inquiry that aimed towards investigating accusations stated in a series of media reports in *O Estado de São Paulo* journal, in 1986". The author shows us that "indigenous areas and rich mineral deposits overlapped and it created suspicions everywhere, some more explicit cases, other less explicit ones", what constituted "a typical situation of the so-called 'deaf dialogue', in which each one of the opposite sides got, in some moments, to express suspicions about the other one's reputability".

the Caruari Rural Producers Association (Asproc), created in 1992. This association created Citizenship and Solidarity Riverside Commerce (CRCS), an ingenious initiative that evolved to a model of trading. To Mazer (2013, p.14), Citizenship and Solidarity Riverside Commerce (CRCS) is a trading system which "has trading warehouses in communities along Juruá River. Such warehouses make basic consumable items available for sale to the communitarians, and take their production on the ASPROC boat". To the author, the association breaks with *regatão* trading model, which imposed "high prices to the products bought by the riverside population and, on the other side, very low prices paid for the products". In this experience, the communities could overcome distances and find an alternative to the high prices of the products practiced by the *regatões*. The associative experience benefits 53 communities and approximately 450 families from the Federal Conservation Unit for Sustainable Use - *Resex Médio Juruá*, and contributes to the production of 900 tons of communities farming products.

The text approaches the associativism dynamic in the São Francisco do Mainã community, in the rural zone of the municipality of Manaus, to guarantee the usufruct of the territory before government interest of maintaining its owning, with no restriction, for activities of the Center of Instruction of War in the Forest (CIGS), managed by the Brazilian Army[2]. It also approaches the community articulations with partnerships aimed at the community farming development, at the valorization of the endogenous potentiality, the environment, conciliating community interests to Manauara society demands.

II. METHODOLOGY

The research is a case study, with qualitative bias, whose purpose is understanding the relevance of associativism to the São Francisco do Mainã community as means of territorial rights guarantee and strengthening of the action with public and private institutions for the access to public policies, programs and projects which favor communitary development and the welfare of farmer families and extractives from the community (DANTAS; FRANCO, 2017). The research is a case study because of the following aspects: a) it explores real life situations, whose limits aren't clearly defined; b) it preserves the unitary character of the studied object; c) it depicts the situation from the context in which such investigation is being done; d) it formulates hypotheses or theories; e) it explains the causal variables of determined phenomenon in complex situations that do not allow the use of surveys and experiments (GIL, 2002, p.54).

The study used data collections techniques which considered selection and systemization of bibliographical material, as articles, reports and other information; interviews with the residents and local leaders, aiming to fill lacuna out and identify the importance of the associativism to reach community goals. The information and interviews were obtained and conducted during collective activities in the community, on the occasion of the implementation of a technology transfer project, developed by West Amazon Embrapa, with 60 associates.

The São Francisco do Mainã community is situated in "the intersection of Mainã Lake with one of the arms of Puraquequara Lake. There are 44 families, totalling 145 residents", the houses reunited on an edge of dryland, from where it is seen the intersection between the lakes Mainã Grande and Mainãzinho, and the cemetery situated in the lands of the opposite bank, in the area of direct influence of Instruction Base nº 4". This community, according to technical visit reports from the National Institute for Colonization and Agrarian Reform (Incra), in 2009, mentioned by MPF (2012, p. 19), "is very old, being probably more than 120 years-old, situated on the left bank of Amazonas River" and was composed since the decline of rubber activity and the extractive population search for "areas with proximity to Amazonas capital city and, then possessing access to services and public policies" (ROCHA, 2014, p. 21).

III. RESULTS AND DISCUSSION

Puraquequara region, where the São Francisco do Mainã community is, exists in the rural area of Manaus municipality. This region, over time, has not accessed public policies aimed to rural development and for a long time it was under threats of territory usurpation, occupied by riverside population, extractive communities and farmers. Such threats are from the Brazilian State, that meant the community area for CIGS in the 1960s and, more recently, for the construction of Manaus city Naval Pole[3].

[2] The Center of Instruction of War in the Forest (CIGS) was created by Presidential Decree nº 53.649, March 2nd 1964. Amazonas state government cedes to Brazilian Army an area of dryland primary forest between Puraquequara River and Preta da Eva River, by km 65 of Rodovia AM-010, to train soldiers to war. The intended area to CIGS "is bigger than Manaus city" (ARAÚJO, [c.a 2012], p.4).

[3] According to information released by G1-AM (2013), the Amazonas Naval Pole Project, in Puraquequara Lake, under data collected by Amazonas Economic Planning and Development (Seplan-AM) secretary of State Airton Claudino, the port could handle R$ 1 billion per year. The project foresees "the naval district might occupy an area of 38,8 kilometers situated in Puraquequara region, in Manaus East Zone".The "installation of

The most recent incentive to any development project remembered by the farmers was an action aimed towards boosting production, in 1964, by state governor Plinio Ramos Coelho[4], who created the work camp in Puraquequara, with the opening of the road and the setting of a subprefecture (ALMEIDA, 2011). According to earlier residents, the idea of a work camp was to promote agriculture, especially food cultures (manioc, beans and rice, among others), as well as industrial ones, like jute and mallow, with the purpose of supplying markets and Manaus industry (CASTRO *et al*., 2018).

This initiative finished in the same year with the "deflagration of the civil-military coup which discharged President João Melchior Goulart" and "started the period of 21 long years of authoritarianism, repression and restriction of individual and democratic freedoms" (QUEIRÓS, 2019, p. 544). The effect of the "civil-military" coup on the community was the cession, in the 1960s, of the mentioned area to the CIGS for military training, not taking in consideration the presence of communities that lived in the region for decades.

The President of the Association, Mr. Francisco da Silva, affirms "the Government made this donation without the minimum responsibility to the residents who live in this region", what became "a very disappointing thing for us, who live in this situation, it's really disappointing because we've had a whole life, we have a story and we see ourselves, from an hour to the next, losing everything, it's very hard" (ALMEIDA, 2011, p. 3). The occupation of the territory led the Army to forbid hunting, fishing and planting, as the communitarian Nilson Pereira told us:

Today we continue in this back and forth, nothing is decided, hunting and fishing are damaged, fishing is forbidden like it was soldiers' vivarium, and it isn't! It's nature's! If people begin to forbid it, how can we look for what to eat? It's wrong! All hunger! Then, today the right thing is to place a hectare of plantation field [*roça*], it's forbidden! We are prohibited from producing two bags of charcoal and taking it to sell there, on the stairway, to make money for the *rancho* because Ibama takes them away! He must not hunt, he must not fish! He must not extract wood, he must not do anything! How are we going to live? (ALMEIDA, 2011, p.7).

The presence of the Army precluded the "sociocultural model of space occupation and the use of the natural resources target, especially, the survival of the family with weak articulation with the market, based on the use of family labor and low impact technologies derived from traditional knowledge, generally, of sustainable foundations" (SANTOS *et al*., 2018, p. 44). That situation reduced the number of families in the community and increased the migration to the city, lowering the "community population from 100 to 20 families" (SILVA *et al*., 2017, p. 1896). The families that stayed began to organize their economic life around vegetal extractivism, especially with harvesting and trading of products as *tucumã*, *açaí* and *bacaba*, animal extractivism, focusing on fishing, as also executing non-agricultural activities, whereas the Army restricted the cultivation practice in the community.

In the period related to the military regime, the community focused on resisting and protecting itself from training using firearms and bombs, since explosions of bombs were common, and the localization of explosives. In one of the reports, the resident affirms he found a projectile "five hundred meters away from the São Francisco community"; there are also various reports of a stray bullet during training, which even hit "one of the community's member house" (ARAÚJO, [c.a 2012], p. 5).

The community organization in the more associative mold resumes since the action of the Catholic Church in the 1980s, through the pastoral work of the Belgian nun Gabrielle Cogels, from Franciscan Congregation Missionaries of Mary. Coelho (2006, p. 46) affirms the nun acted "not only as a missionary, but overall as an articulator and an organizer of the residents to improve their life conditions". After the formation of the religious community, it organized its association. The São Francisco

two big shipyards, six medium size shipyards and other 60 small size ones" could make "Amazonas naval industry, which employs 12 thousand people nowadays and today is the third biggest generator of jobs in this segment", one of the biggest of the country. Public Federal Ministry (2017), that accompanies the project, following the "Inter-American Court of Human Rights understanding, according to which, when a venture tend to generate significative impacts on the way of life of indigenous and traditional communities, these ones must be heard" and also have "the right of final decision about the viability of the venture". The action of Public Federal Ministry (MPF) suspended the installation of the venture "through Amazonas Federal Justice sentence, while there isn't the occurrence of previous, formal, free and informed consultation to the traditional peoples from the region", as also the "suspension had been determined on preliminary basis, in may/2014, after the request of Public Federal Ministry in Amazonas (MPF/AM) in Public Civil Action and confirmed by the judicial sentence". The MPF note still reminds us "Justice also annulled the decree that declared public utility to areas to implantation of the pole. The state of Amazonas didn't appeal, which engendered the recognition of the obligation of carrying the consultations out in the molds of Convention 169/ILO".

[4] Amazonas state governor in the period of 31 of January 1963 to 27 June 1964.

do Mainã community's residents association was created on 19 February 1997, with the purpose of developing social actions among their associates.

That period is marked by a process of tenuous associativism, characterized by family ties, directed to organize social, religious and sportive activities, such as masses, celebrations, community and commemorative parties, as also sportive tournaments. During this period, it predominates the product exchanges and common help of emergency to relatives and neighbors. The military regime period, with a little overture for participation, didn't allow the development of actions of questioning and confronting of the military presence in the community area. It's relevant highlighting the Army didn't allow the community to develop a political action aimed to question the domination of its territory.

The conjecture starts to change with the Constitution of 1988, when the "collective identities became a notable legal precept to the legitimation of specific and ethnically built territorialities" (ALMEIDA, 2004, p. 13). The meaning of "land traditionally occupied" is expanded, phrase that was ratified through the Legislative Decree n° 143, signed by the Federal Senate president and the Convention 169 of ILO, June/1989. The convention recognizes "self identification, reinforcing, to a certain extent, the logic of social movements" (ALMEIDA, 2004, p. 14). Article 2nd/Convention 169 says that the "consciousness of your indigenous or tribal identity must be had as fundamental criteria to determine the groups to which the dispositions of this Convention are applied". In Article 14/Convention 169, there are the terms of dominance, in which "The rights of ownership and possession of the peoples concerned over the lands which they traditionally occupy shall be recognised". Article 16/Convention 169 affirms that "Whatever possible, these peoples shall have the right to return to their traditional lands, as soon as the grounds for relocation cease to exist". As well as the Constitution and the International Labor Organization (ILO)'s Convention 169, the Convention on Biological Diversity (CBD) emphasizes the way of life of traditional communities, recognizing what Diegues (1999, p. 8) comments: "landscape is the result of a common and intertwined history: a human and natural history in such a way that the biodiversity is a cultural and social construct". Such an aspect propels the communities, expropriated for years by agropastoralism projects, mining, hydroelectrics and military structure (SILVA, 2014). The reconnaissance by the Constitution, by ILO and by CBD open to a new moment, a new conjecture that allows the emergence of traditional communities as political actors equipped with acknowledgement and with legal basis to take back their territories.

The changes came to the community after 2009. Even with all the openness, the community still went through censorship. Mr. Francisco, leader of the community, since an interview in 2009, when he denounced the silence imposed by the Army, has suffered harassment, and was called to testify in court. Besides Francisco, leaders, teachers and researchers who supported the cause of the community were called in court, which, for leaders, constituted a clear "attempt of intimidation and censorship to the community" by the Army.

Prompted and supported by a network of social actors and considering the environment, São Francisco do Mainã and Jatuarana communitarians restarted the process of meetings, articulation with institutions, as *Cáritas Arquidiocesana*, Public Ministry and other organizations, as strategies to take back control of their territory under the dominion of the Army since the 1960.

The front of struggle opened by the community marks the change of the organizing profile of the community, that transitions from a sociocultural associativism to a social-economic and political associativism. The first prioritizes the relation of internal cooperation of the community to meet demands for cultural, sportive and esthetic interaction. It cares about the emotional and social being of the individuals and it is founded on a moral commitment and on hope of reciprocity, with little concern with economic and political demands of the affiliates. Most times, sociocultural associativism has not much of an operational, collective and democratic structure, with little participation, superficial and it creates overcoming strategies of common problems.

The socio-economic and political associativism has actions with cultural and social approach as part of the necessary dimensions to a social cohesion, but looks for increasing the incidence of the community beside public and private institutions for economic, social and political gain. As a counterpoint to sociocultural associativism, the structure is more complex, with permanent meetings, adoption of control techniques, management and livingness of democratic practices. Its actions aim towards individual and community resilience, social transformation and the construction of collective solutions dedicated to empower and increase the capacity of incidence of the community. We may say that socio-economic and political associativism is a "participation and social organization condensed project", in which people directly involved "put themselves as subject of their doing, thinking and transforming the world they live in, in face of other people and civil society organizations as well as in face of people and governmental organisms, wider meaning" (CARVALHO, 1998, p. 5).

Carvalho's exposition (1998) shows the change in the form of the associativism that was present until the years 2004

and 2005 (sociocultural associativism), moving to the socioeconomic and political associativism, that promotes internal and external organization of the community, expanding the articulation with social and state actors to take back the territory, occupied by CIGS. As the milestone of the passage from sociocultural associativism to socio-economic and political we have the implementation of public civil investigation conducted by MPF/AM in 2014 and the "attempt to remove the communitarians of the area", in 2009.

Socio-economic and political associativism was very important to guarantee territorial rights, as well as to expand the range of partnerships of support and magnification of demands. The partnerships gave visibility to the community because they were missing for a long time and in a passive position during the act of subtraction of its way of life.

Araújo ([c.a 2012],p.10) remembers the Army, at first, "tried removing the community to another area, ignoring every material and symbolic relationship with the territory by the farmers, built overtime", and at the beginning of the negotiations "[the Army] didn't want that the meetings with MPF had the participation of community representatives"; [the Army] wanted "to impede the participation of the social movements that supported the communities, as Pastoral Commission of Land (CPT) and *Cáritas Arquidiocesana*". The existence and the strengthening of the community organization allowed to transform what previously was impossible, as subverting an Army willingness into possible and transforming "the absences in presences" (SANTOS, 2008, p.102). Araújo ([c.a 2012],p.11) thus narrates this new moment:

The communities reinforced themselves in a way that surprised the Army and provoked a retreat at the moment, being suspended any attempts of removal. It was a great victory, since it indicated the defense of public property tied to national security, as the Army intended, it couldn't ignore the traditional communities right.

The new posture of the community modified the Army's strategy that changed its form of acting, proposing the regularization of the areas, however with a set of rules, as Araújo appreciated ([c.a 2012], p.11), a model with "a few rights and many duties". The Army's model of regulation pursued reinforcing the individualism and breaking with associativism, and for that to happen, military force resumed to dialogue directly to farmers, singly, trying to convincing one by one to accept the "proposal and the use of local rules, notably the authorization to free entrance of soldiers, training practices and the impossibility of the descendants to remain in the land".

In the same perspective of weakening associativism and the community struggle, the Army tried to use the main demand to justify the denial of rights.

As if these direct negotiations weren't enough, which weakened the communities, the Army resumed to impede the realization of *Luz para Todos* Program in the communities that didn't accept the proposed land regularization. The letter n° 005-SCOMSOC/12RM, subscribed by the then commander of the 12nd Military Region, indicated to Amazonas Energia company that São Francisco do Mainã, Jatuarana and Santa Luzia do Tiririca communities were not authorized to welcome the program. The reason? The process of land regularization had not been realized. Ironically, the main communities demands, and that were constantly denied, were used to the disadvantage, as well as to deny access to the electrical power program.

Electrical power[5] issue was a way found by the Army to coerce the farmers to accept its proposition, without any constraints. Such aspect constituted a Catch-22 situation, whereas power was an essential condition to the school and the health post functioning, and for familiar comfort, in other words, historical yearnings of the community. The resistance to the Army proposition meant the São Francisco do Mainã community would live together with no electrical power, while the other communities of the same region would start to have electrical power, and that is a factor of weakening, demotivating for the associative strategy and for the maintenance of the community stake, which consisted of obtaining greater collective gains. The community had already struggled for energy since 2009; it had the process approved and ready to be installed in 2012, when the Army "was opposed to the advent of the *Luz para Todos* Program" (MPF, 2013).

Unlike what was expected by the Army, the community remained united, firm in its beliefs and aware of its rights. Such aspects didn't allow the farms to accept norm to utilize their own territory, the removal of their descendants' right of living in the territory, what meant a "clear violation of their fundamental rights, with the emptying of the constitutional and infra constitutional juridical regime that protects them"(ARAÚJO, ([c.a 2012],p.19).

The solution found by the community along with MPF was judicialization, even if that option was more complex and had little perspective of obtaining a rapid response. Judicialization had as consequence land titles amplification,

[5] Before electrical power, the community was supplied by a diesel generator provided by the Army.

presence and interest of the Union and community conditions. In this scenario, the community was defeated, since it didn't guarantee access to *Luz Para Todos* Program immediately, however it remained in the area. It wouldn't give in and, with the judicialized question, the Army's posture became evident on the part of many actors as Public Ministry, and it showed that there wasn't a friendly relationship between Army and community.

The process promoted some gains for the community, as greater approximation to Public Ministry, greater comprehension of legislation favorable to the rights invoked for territory and traditionality defense, as well as the maintenance of Public Ministry as main mediator between the community and the Army, and the inclusion of new actors, as the Federal Properties Management Office (SPU), that made available its expertise on the regularization of traditional communities areas.

The issue involving the community and the Army was received by the Senate Commission on Human Rights Legislation, where special session was performed on 28 May 282013, when the community could expose its vision about curtailment of their own territory and rights, as access to public policies, as an example *Luz Para Todos* Program.

The change of the associative profile allowed the community to resist the attempt of fragmentation of the unity, even with procrastination and time expansion to reach the objectives. On June 28/2013, new conditions were established to the concession of in rem right to use, with the strengthening of the collective use of land and respect to the ways of life in the community, setting conditions for military training and suppressing any attempt of restrictions for the descendants or time utilization. The concessions between parts were put this way: a) elaboration of a document of concession of in rem right to use as a collective; b) non imposition of use restrictions of *igarapé* Mainãzinho and *igarapé* Mainã Grande, excepting when there's training in this last case, which must be duly communicated; c) communication formalization by the Army about training execution, with identification of those ones who will execute it; d) greater rigor in the use of the flag that warns the existence of training, so the flag isn't hoisted when there isn't training; e) new area for *roçado*; f) absence of restrictions to cemetery visitation, which is on the other side of the river (ARAÚJO, ([c.a 2012]).

On 4 August 2013, the São Francisco do Mainã community celebrated the receiving of the concession of in rem right of resolvable use (CDRUR)[6] as a collective, a document that awards all the association and resistance processes established by the farmers over the years and the conquest of territory and ancestry rights. At the ceremony, Mr. Francisco said that "it took many years of struggle to arrive at this moment and have our rights recognized. This document (CDRUR) represents, for us, the possibility of having access to public policies that will bring many benefits for the community" (MPF, 2017, p.2).

Luz Para Todos Program arrived between the final of 2013 and the beginning of 2014, almost two years after being prohibited by the Army. The program is the reward for the community due to the struggle and the perception that the overcoming of invisibility doesn't allow concession or retreat before economic, military or government agents.

The conquest of territorial rights was the first step to farmers living and welfare (PEREIRA et al., 2017). After CDRUR, the community started to search for projects and alternatives to fortify agricultural economy and thereby develop systems capable of contributing for the production of food, increasing of income and human and environmental sustainability. In view of this, in 2016, from the partnership with Manaus' *Cáritas Arquidiocesana*, a Brazilian Corporation of Agricultural Research (Embrapa) technology transfer project of expansion of guarana culture - creation of the Metropolitan Circuit of Guarana Culture -, that had the purpose of "provision of primary material to the Concentrates Pole of the Industrial Pole of Manaus (PIM), in addition it will help in the stimulation of the creation of stable jobs in municipalities and income alternatives offer to farmers, besides facilitating the chain of production dynamics, bringing farmers and industry together" (ROSA, 2016).

The project was based on the associative and organizing system of the community and installed in a collective area. The project implantation and maintenance happened by means of collective effort and combined actions. Guarana is a perennial crop, of annual production, with financial feedback after the third year of cultivation. The association, in meeting with Embrapa researchers and *Cáritas* agents, decided to make an adjustment in the project, with the introduction of cultures as manioc and banana, varying, this

[6] According to Araújo ([c.a 2012], p. 25), the concession of in rem right of resolvable use (CDRUR) "is a tool through which the Public Power, instead of transferring an immovable away from its property, grants in rem right - and not obligational, so erga omnes - to the private individual's right, who might live in it, draw his/her sustenance and transfer it only to heirs. The receipt of that document assures the occupants of public land not only legal security, but recognition of the specific utilization of the land. Applicable in various situations, that institute has a true value to traditional peoples, above all riverside peoples, that generally occupy securitised lands by Union by river banks and live an unstable situation on account of eventual private individuals' and even Public Power pressure".

way, annual cultures. Thus, the production system would allow finance feedback in short, medium, long terms, reinforcing income and food security. Afterwards, *açaí* culture was introduced to diversify the production. Such adjustment was only possible due to the organizing condition of the community, that was able to establish an evaluation and negotiation process aiming the construction of a capable model of benefiting the development project, that is appropriate to its conditions and necessities. Nowadays, the community has *guaraná*, *açaí*, banana, manioc cultures and has been forming partnerships to guarantee the production processing, together with Amazonas Federal University (UFAM), which may mean a better product price on hitting the market and, consequently, greater income to the producers.

Thus, the associative dynamic of the community allowed not only condition to guarantee its rights. It allowed conditions to the community to develop a reflexive process through which the associates construct scenarios, project gains and losses and, this way, maintain the focus on their objectives, resisting co-optation strategies and community fragmentation.

Closing comments

The case study of the São Francisco do Mainã community, that strengthened the socio-economic and political associativism, shows that the condition for Amazon rural communities to reach their territorial rights, programs access, projects and public policies is in the organizing associativism and cooperative empowerment. The associativism was the tool that allowed the invisibility overcome of the community, the traditionality recognizing, the right over the territory, as the public policies access. In the case of the São Francisco do Mainã community, the CDRUR acquisition, the *Luz Para Todos* Program and its insertion in technology transfer programs aimed to the strengthening of farmers families and rural development show the importance of associativism to Amazon communities.

ACKNOWLEDGEMENT

To the National Council for Scientific and Technological Development – CNPq – Research Productivity Scholarships – PQ -2 (process nº 313782/2021-0) and Community Association of São Francisco do Mainã.

REFERENCES

[1] ALENCAR, E. **Associativismo rural e participação**. Lavras: UFLA/FAEPE, 1997.

[2] ALMEIDA, A. W. B. Universalização e localismo: movimentos sociais e crise dos padrões tradicionais de relação política na Amazônia. In: D'INCAO, M. A.; SILVEIRA, I. M. (orgs.). **A Amazônia e a crise da modernização**. Belém: Museu Paraense Emílio Goeldi, 1994.

[3] ALMEIDA, Alfredo Wagner Berno de. **Terras tradicionalmente ocupadas: processos de territorialização e movimentos sociais**. REVISTA BRASILEIRA DE ESTUDOS URBANOS E REGIONAIS, v. 6, ed. 1, maio, 2004. DOI: https://doi.org/10.22296/2317-1529.2004v6n1p9. Disponível em: https://rbeur.anpur.org.br/rbeur/article/view/102. Acesso em: 26 jul. 2020.

[4] ALMEIDA, Alfredo Wagner Berno de; NAKAZONO, E. M. ; MENEZES, Elieyd S. ; CUNHA, M. V. ; MARQUES, A. ; BRITO, M. ; LIMA, L.A.P. ; RUBIM, A. C. ; RODRIGUES, C.S. . **Nova Cartografia Social da Amazônia: pescadores e pescadoras, agricultores e agricultoras do Lago do Puraquequara e Jatuarana: luta e garra contra a opressão do exército. A vitória das comunidades ribeirinhas, área rural de Manaus**. Manaus: UEA Edições, 2011

[5] BERTHOME, J.; MERCOIRET, M.R. Organização dos pequenos agricultores. In: SPERRY, S. (org.). **Organização de pequenos produtores**. Brasília: Embrapa. 1999.

[6] BRITO, A. C. ; CASTRO, A. P. ; FRAXE, T. J. P. ; RAMOS, A.S. . Um Olhar Sistêmico sobre a Sustentabilidade da Produção de Malva em Comunidade de Várzea no Amazonas. **Revista Terceira Margem Amazônia**, 10, v. 3, p. 197-213, 2018.

[7] CANTERLE, N.M.G.A prática associativa e seus atores no processo de desenvolvimento. GestioPolis, 2004. Disponível em: https://www.gestiopolis.com/a-pratica-associativa-e-seus-atores-no-processo-de-desenvolvimento/. Acesso em 19 de jul 2020.

[8] CARVALHO, H. M. de**. Formas de associativismo vivenciadas pelos trabalhadores rurais nas áreas oficiais de reforma agrária no Brasil**: Brasília: IICA/MEPF/NEAD, agosto, 1998.

[9] CASTRO, A. P. ; GOMES, L. M. ; LOBATO, A. C. N. ; BRITO, A. C. . Estratégia para dinamização da Cadeia produtiva de juta e malva no Estado do Amazonas. **Revista Terceira Margem Amazônia**, v. 3, p. 84-99, 2018.

[10] CASTRO, A. P.; Castro, A. P. ; Fraxe, T, J. P. . UM OLHAR SISTÊMICO SOBRE A SUSTENTABILIDADE DA PRODUÇÃO DE MALVA EM COMUNIDADE DE VÁRZEA NO AMAZONAS. **REVISTA TERCEIRA MARGEM AMAZÔNIA**, v. 3, p. 197-213, 2018

[11] CONCEIÇÃO, M. F. C.; MANESCHY, M. C. Pescadores, agricultores e ribeirinhos na Amazônia Oriental: associativismo e sustentabilidade. **Boletim Rede Amazônia**, Rio de Janeiro, v. 1, n.1, p. 61-69, 2003.

[12] COSTA, F. S.; Nogueira, A.C.F.; Bordinhom, A. M.; BIASE, A.M. ; VIDAL, V. ; SANTOS, J. C. N. . Nupeas: um espaço de formação profissional interdisciplinar frente à complexidade da questão rural amazônica**. Terceira Margem: Amazônia**, v. 1, p. 1-25, 2015

[13] DANTAS, O. M. A. N. A. ; FRANCO, Maira Vieira A. **. Pesquisa exploratória: aplicando instrumentos de geração**

de dados? observação, questionário e entrevista. In: EDUCERE - XIll CONGRESSO NACIONAL DE EDUCAÇÃO, Curitiba, 2017.

[14] DIEGUES, Antônio Carlos Sant'Ana.. **Biodiversidade e Comunidades Tradicionais no Brasil**. NUPAUB-USP/PROBIO-MMA/CNPq: São Paulo, 1999.

[15] DINIZ, Eugenio**. O PROJETO CALHA NORTE: ANTECEDENTES POLÍTICOS. Mestrado** (Mestre em Ciência Política pela Faculdade de Filosofia, Letras e Ciências Humanas) - Universidade de São Paulo, São Paulo, 1994.

[16] ESTERCI, Neide; LIMA, Deborah e LÉNA, Philippe. Diversidade sociocultural e políticas ambientais na Amazônia: o cenário contemporâneo**. Rede Amazônia: diversidade sociocultural e políticas ambientais**. Ano 1, n.1. Rio de Janeiro. P.3-5. 2002

[17] FAGOTTI, L. N. **O associativo: associativismo e agricultura familiar no interior paulista**. Repositório Institucional UNESP, 2017. Disponível em: http://hdl.handle.net/11449/150693. Acesso em: 02 jul. 2017.

[18] G1-Am. Polo Naval no AM quer movimentar negócios de R$ 1 bilhão, diz Seplan - Assembleia Legislativa do AM realizou audiência para discutir projeto. Secretaria diz que moradores de área do Puraquequara não serão retirados. 09 mar 2013. Disponível < http://g1.globo.com/am/amazonas/noticia/2013/03/polo-naval-no-am-quer-movimentar- negocios-de-r-1-bilhao-diz-seplan.html > Acesso em 02 agos 2020.

[19] GIL, Antônio Carlos. **Como elaborar projetos de pesquisa**. 4. ed. São Paulo: Atlas, 2002

[20] LAZZAROTTO, J. J**.. O associativismo como estratégia para melhorar os sistemas de produção: estudo de caso de uma associação de produtores rurais do município de Pato Branco (PR)..** In: Vº Seminário Estadual de Administração Rural e Iº Seminário Sulbrasileiro de Administração Rural, 2000, Itajaí. Anais do Vº Seminário Estadual de Administração Rural e Iº Seminário Sulbrasileiro de Administração Rural. Itajaí: Abar-Sul, 2000.

[21] MANESCHY, M. C.; MAIA, M. L. S. ; CONCEIÇÃO, M. F. C. . Associações rurais e associativismo no nordeste amazônico: uma relação nem sempre correspondida. **Novos Cadernos NAEA**, v. 11, p. 65-90, 2008.

[22] MAZER, Simone. **Comércio Ribeirinho Solidário: uma alternativa para geração de renda na Amazônia**. 1. ed. Brasília, DF: IPAM/ASPROC, 2013

[23] MINISTERIO PÚBLICA FEDERAL DO AMAZONAS. **Esclarece informações sobre consultas a comunidades em projeto do Polo Naval. MPF**. 17 mar 2017. Disponível em: http://www.mpf.mp.br/am/sala-de-imprensa/noticias-am/mpf-am-esclareceinformacoes-sobre-consultas-a-comunidades-em-projeto-do-polo-naval > Acesso em: 02 ago 2020.

[24] MINISTÉRIO PÚBLICO FEDERAL. PARECER Nº 001/2012-CÍVEL5/PR/AM. Manaus/ Amazonas, 13 jul. 2012

[25] MUENCHEN, J. V. O **planejamento e o controle da produção em associações de pequenos agricultores**. (Dissertação de Mestrado), Piracicaba: ESALQ, 1996.

[26] PEREIRA, C. F.; MENEZES, T. C. C.; FRAXE, T. J. P.. Governança fundiária no Sudeste do Amazonas. **REVISTA TERCEIRA MARGEM AMAZÔNIA**, v. 2, p. 84-105, 2018

[27] PEREIRA, GEUSA DA PURIFICAÇÃO**. ORGANIZAÇÃO COMUNITÁRIA COMO FERRAMENTA DE LUTA PARA A CRIAÇÃO E CONSOLIDAÇÃO DA RESERVA EXTRATIVISTA MARINHA DE CANAVIEIRAS – BA**. Dissertação (Programa de Pós-Graduação em Extensão Rural) - Universidade Federal de Viçosa., Viçosa-MG., 2016.

[28] PERES, Sidnei Clemente. **Cultura, política e identidade na Amazônia: o associativismo indígena no Baixo Rio Negro**. TESE (Universidade Estadual de Campinas, Instituto de Filosofia e Ciências Humanas.) - Universidade Estadual de Campinas, Campinas, 2003

[29] ROCHA, Alzilene Teixeira da. **GESTÃO DA ÁGUA EM MANAUS: CRIAÇÃO DO COMITÊ DE BACIA HIDROGRÁFICA DO RIO DO PURAQUEQUARA**. Dissertação (Mestrado) - Curso de Dissertação de Mestrado do Programa de Pós Graduação em Geografia, Universidade Federal do Amazonas, Manaus, 2014.

[30] ROSA, F. Projeto vai criar corredor metropolitano da cultura do guaraná. **Embrapa Notícias**. 23 set 2016. Disponível em: https://www.embrapa.br/busca-de-noticias/-/noticia/16596088/projeto- vai-criar-corredor-metropolitano-da-cultura-do-guarana > acesso em: 02 de ago. 2020.

[31] SABOURIN, Eric. **Camponeses do Brasil, entre a troca mercantil e a reciprocidade**. Rio de Janeiro: Garamond Universitária, 2009.

[32] SANTOS, Boaventura de Souza. **A gramática do tempo. Para uma nova cultura política.** Vol. 4. 2ª. Ed. São Paulo: Cortez, 2008.

[33] SANTOS, LUIZ CARLOS BASTOS. **Cooperação e conflitos na gestão da Reserva Extrativista Marinha de Maracanã, Estado do Pará**. Dissertação (Programa de Pós-Graduação em Agriculturas Amazônicas, Núcleo de Ciências Agrárias e Desenvolvimento Rural, Universidade Federal do Pará – UFPA e Empresa Brasileira de Pesquisa Agropecuária – Embrapa Amazônia Oriental.) - Universidade Federal do Pará, Belém, 2016

[34] SEBRAE, Serviço Brasileiro de Apoio às Micro e Pequenas Empresas**. ASSOCIAÇÃO: série empreendimento coletivos**. Serviço Brasileiro de Apoio às Micro e Pequenas Empresas – SEBRAE, Brasília, DF, 2009

[35] SILVA, LINDOMAR DE JESUS DE SOUSA**. NATUREZA CAPITALISTA VERSUS NATUREZA ORGÂNICA: o advento da ALCOA e a mobilização e organização das comunidades de Juruti no Baixo-Amazonas paraense**. TESE (Ciência do Desenvolvimento Socioambiental, Núcleo de Altos Estudos Amazônicos – NAEA,) - Universidade Federal do Pará – UFPA, Belém, 2014.

International Journal of Advanced Engineering Research and Science (IJAERS)
Peer-Reviewed Jurnal
ISSN: 2349-6495(P) | 2456-1908(O)
Vol-10, Issue-4; Apr, 2023
Journal Home Page Available: https://ijaers.com/
Article DOI: https://dx.doi.org/10.22161/ijaers.104.13

Constructed Wetlands: Technology for Removing Drug Concentration from Water

Wetlands Construídos: Tecnologia Para Remoção da Concentração de Fármacos das Águas

Krisna Ridzi Kathar[1], Naema Wasim[2], Simone da Silva[3], Alexandre dos Santos Pyrrho[4], Márcia C.B.N. Varricchio[5*]

[1,2]Graduada em Farmácia – Universidade Estácio de Sá
[3] Pesquisadora do Centro de Bionegócios da Amazônia - CBA; Professora de Sistemas de Gestão Ambiental no Instituto de Tecnologia e Educação Galileo da Amazônia - ITEGAM
[4] Professor do Departamento de Análises Clínicas e Toxicológicas da Faculdade de Farmácia da Universidade Federal do Rio de Janeiro – UFRJ
[5] Adjunta Departamento Clínica Médica; Professora de Ética Ambiental-Bioética do Programa de Residência Médica da FMP-UNIFASE.
Autor correspondente: mtvarricchio7@gmail.com – Rua Dr. Nelson de Sá Earp 68/703, Centro, Petrópolis, RJ – 25680-195

Received: 10 Mar 2023,
Receive in revised form: 15 Apr 2023,
Accepted: 22 Apr 2023,
Available online: 28 Apr 2023

***Keywords*— Constructed wetlands, wastewater, pharmaceutical compounds.**

***Palavras-chave*— Zonas húmidas construídas, águas residuais, compostos farmacêuticos.**

***Abstract*—** *This work aims to present a sustainable and promising technology for the environment, in view of the quality of water and rivers contaminated with drugs and lack of sewage treatment. We highlight the Constructed Wetlands technique built so that, in an ecologically correct and low cost, contamination in waters is reduced. The research carried out consists of an integrative review with a basic purpose and a quali-quantitative approach and the Science Direct database was use. The selection of works include review and research articles published between 2010 and 2021. Works that did not deal with phytoremediation through constructed swamps and research with synthetic effluents were excluded, with only those dealing with surface water and effluents from sewage treatment and water treatment plants. Thus, this review was carried out on a basis of 25 articles. For the application of WC, basins, ponds or shallow lakes are built and substrate and vegetation are applied to them. Projects can and should be done individually, depending on the characteristics of the water and the parameters needed to be achieved. In addition, issues such as available area and topography of the environment should be observed. For this study, observing the analysis of a several parameters and configurations, it was demonstrated that WCs is greater efficiency than conventional water treatments. Thus, a system that combines conventional treatments with WC will have greater efficiency in water treatment, being a promising alternative in relation to improvement at low cost, benefiting Public Health.*

***Resumo*—** *O presente trabalho visa apresentar uma tecnologia sustentável e promissora para o meio ambiente, tendo em vista a qualidade das águas e rios contaminados com fármacos e falta de tratamento do esgoto. Destaca-se a técnica de Wetlands construídos para*

que, de forma ecologicamente correta e a baixo custo, reduza-se a contaminação nas águas. A pesquisa realizada consiste em uma Revisão Integrativa com finalidade básica e abordagem quali-quantitativa e a base de dados utilizada foi a Science Direct. A seleção dos trabalhos incluiu artigos de revisão e de pesquisa publicados entre 2010 e 2021. Foram excluídos os trabalhos que não versavam sobre fitorremediação através de pântanos construídos e pesquisas com efluentes sintéticos, permanecendo no estudo os que versavam sobre águas superficiais, efluentes e afluentes de estações de tratamento de esgoto e de tratamento de água. Assim, esta revisão foi realizada em uma base de 25 artigos. Para aplicação dos WC, são construídas bacias, lagoas ou lagos rasos e, neles aplicados substrato e vegetação. Os projetos podem e devem ser feitos de forma individual, dependendo das características das águas e dos parâmetros necessários a serem atingidos. Além disso deve-se observar questões como área disponível e topografia do ambiente. Neste estudo, observando a análise de diversos parâmetros e configurações, ficou demonstrado que WC demonstram maior eficiência que os tratamentos de água convencionais. Assim, um sistema que una tratamentos convencionais com WC gerará maior eficiência no tratamento das águas, sendo uma alternativa promissora em relação a melhoria a baixo custo, beneficiando a Saúde Pública.

I. INTRODUÇÃO

Dados registrados pelo Instituto Brasileiro de Geografia e Estatística (IBGE) apontam que aproximadamente 15% dos domicílios brasileiros não possuem acesso à água tratada e 31,7% não possuem o acesso básico aos serviços de coleta de esgoto (IBGE, 2020). Esses valores confirmam o fato de que o esgoto ainda é jogado em rios sem receber o tratamento adequado. A pesquisa realizada pela Agência Nacional de Águas (ANA) ressalta esses dados, revelando que mais de 110 mil Km de rios apresentam sua qualidade comprometida por carga orgânica. Assim, os efeitos gerados tanto para o meio ambiente como para as pessoas residentes de localidades próximas, comprometendo a acessibilidade à água potável, são extremamente graves e preocupantes, podendo até favorecer o aparecimento de epidemias e doenças (ANA. Brasil, 2017).

Os componentes químicos presentes no esgoto podem ocasionar o escurecimento das águas pela redução do oxigênio dissolvido e acarretar mortes de espécies aquáticas. Além disso, aumentam as chances de ocorrer um processo de eutrofização, o que provocaria um crescimento acelerado de algas marinhas, com a exalação de odores, surgimento sabor e biotoxinas na água. Esse cenário é inquietante e exige que medidas sejam providenciadas para amenizar esta situação. Muitos desses efeitos podem ser minimizados com a promoção do tratamento adequado e correto dos esgotos antes do lançamento nos efluentes (ANA. Brasil, 2017).

Em abril de 2020 o Ministério da Saúde realizou um estudo para estabelecer subsídios para discussão sobre a revisão da Consolidação 5/2017 no que se refere à inclusão de fármacos e desreguladores endócrinos para compor as substâncias que devem ter limites estabelecidos e monitoramento para o padrão de potabilidade da água. Neste documento foi estabelecida toxidade e concentração máxima, além da ocorrência nas águas brasileiras também de contaminantes emergentes, mais precisamente, fármacos e desreguladores endócrinos. Ficou estabelecido que, diante os estudos realizados, não se tem dados suficientes para inclusão dessas substâncias para monitoramento pelas empresas prestadoras de serviços (Brasil. Ministério da Saúde., 2020).

Neste âmbito, os fármacos estão entre os Contaminantes Emergentes (CEs) mais estudados mundialmente, posto que grande parte dos dejetos químicos, por meio de indústrias, hospitais, domicílios, centros urbanos e localidades, são despejados continuamente em efluentes das estações de tratamento de esgoto (ETE) e posteriormente em ambientes aquáticos, desestabilizando o equilíbrio hídrico. Mesmo sistemas avançados e tecnologias modernas não demonstraram sucesso na remoção completa de tais contaminantes do meio (Montagner et al., 2017).

Entende-se como contaminantes emergentes (CE), os compostos que são de difícil quantificação, limitando sua monitorização. Essa quantificação é medida através da concentração, que seria a mensuração da quantidade do item estudado numa mistura, como em nossas águas.

Em justificativa a este estudo ressaltamos que diversos trabalhos demonstram a ocorrência, em águas brasileiras, de inúmeros fármacos com as mais variadas concentrações. É certo, pois, que esse tipo de contaminação poderá gerar toxidade crônica, prejudicando o ecossistema e indiretamente a saúde da população (Pivetta et al., 2020).

Ressalte-se que a fitorremediação baseada na tecnologia de *wetlands* construídos tem recebido atenção mundial devido à sua capacidade de remover das águas contaminantes emergentes, inclusive produtos farmacêuticos (Matamoros et al., 2008).

Campanha e colaboradores (2015) recolheram amostras de água em diferentes pontos no rio Monjolinho, de uma região urbana do Estado de São Paulo, durante o período de 2011 a 2013. As amostras foram analisadas por cromatografia líquida de alta eficiência (CLAE) acoplada a espectrometria de massa em tandem. Como resultado, verificou-se a presença dos fármacos atenolol, propranolol, ibuprofeno, paracetamol, carbamazepina, diclofenaco, naproxeno e outros.

Diante o exposto, surge a necessidade de estudo e aprimoramento de técnicas para o tratamento das águas, sendo a fitorremediação uma possibilidade sustentável e de baixo custo.

A fitorremediação é uma tecnologia que utiliza plantas para retirar ou diminuir contaminantes do solo, da água ou do ar. Esta ideia não é recente e já é discutida há centenas de anos. Com a evolução dos estudos aliada à interdisciplinaridade das áreas de pesquisa vislumbrou-se a possibilidade de uma aplicabilidade econômica e eficaz (Salt et al., 1998).

A literatura descreve a fitorremediação subdividida em seis áreas, quais sejam, fitoextração que é o uso de plantas que acumulam em seus tecidos os poluentes extraídos sem que eles sejam eliminados ou degradados; fitodegradação que é o uso das plantas e dos microrganismos a ela associados para degradar poluentes orgânicos, além de alguns compostos inorgânicos; rizofiltração, que seria o uso das raízes das plantas para absorver os poluentes; fitoestabilização que reduz a presença de poluentes; fitovolatilização que extrai e volatiliza os poluentes (Mejía et al., 2014; Salt et al., 1998).

Pilon-Smits (2005) afirma que os poluentes inorgânicos não podem ser degradados, porém poderão ser estabilizados e sequestrados para os tecidos vegetais e posteriormente coletados. Afirma ainda que, espécies vegetais aquáticas podem absorver, degradar ou acumular os poluentes das águas, sendo movidas pela energia solar, pois dela dependem para o seu desenvolvimento.

Stephenson e Black (2014) esclarecem que fitorremediação aliada a tecnologia, entendida nos dias de hoje como fitotecnologia, é mais abrangente pois integra a engenharia ambiental à experiencias multidisciplinares como agricultura, horticultura, além de desenvolvimentos químicos.

Com isso surgem algumas possibilidades de fitotecnologias na extração de poluentes. Neste sentido, destaca-se a técnica de *Wetlands* ou jardim filtrante visando, de forma ecologicamente correta e a baixo custo, a redução de contaminação em efluentes. Este sistema usa plantas macrófitas associadas a microrganismos dispostos em sua rizosfera, podendo, desta forma, funcionar como um filtro, absorvendo e retendo poluentes (Stephenson & Black, 2014).

Essas espécies vegetais, ao decorrer do processo evolutivo migraram do ambiente terrestre para o aquático, desenvolvendo adaptações morfológicas e anatômicas imprescindíveis à sobrevivência na água, principalmente para a flutuação, como cutícula fina, tecidos esponjosos (aerênquima), caules ocos e pelos hidrofóbicos que repelem a água, e as flores que, em geral são postas fora da água. São visíveis a olho nu e as partes fotossintetizantes ativas são total, parcialmente submersas ou, ainda, flutuantes (Xavier et al., 2021).

As macrófitas aquáticas são vegetais que contribuem para estruturação e dinâmica da maioria dos ecossistemas aquáticos, habitando ambientes variados dentre os de água doce e salobra e apresentando grande capacidade de adaptação (Xavier et al., 2021).

Seu ciclo de vida engloba tanto a reprodução sexuada por polinização cruzada e autopolinização quanto a assexuada pela propagação de rizomas ou estolões, permitindo maior êxito no crescimento (Xavier et al., 2021).

Esta revisão teve como objetivo evidenciar, através da literatura, tanto a presença de contaminantes emergentes, como fármacos, nas águas, como avaliar a possibilidade de remoção por fitorremediação através da tecnologia de *wetlands* construídos. Assim, apresentando o problema quanto a presença de fármacos nas águas brasileiras, caracterizando as diferentes tecnologias de *wetlands* construídos para fitorremediação, apresentando, através da literatura, a remoção de fármacos das águas usando a tecnologia de *wetlands* existentes.

II. METODOLOGIA

A pesquisa realizada consiste em uma Revisão integrativa (Vosgerau & Romanowski, 2014) e teve o prosseguimento com finalidade básica e abordagem quali-quantitativa. As palavras-chave usadas como descritores em

Ciência da Saúde na base de dados Science Direct foram c*onstructed wetlands, wastewater, pharmaceutical compounds* e retornaram 1798 trabalhos. A seleção dos trabalhos para a realização deste manuscrito foi realizada de modo a incluir artigos de revisão e de pesquisa publicados entre 2010 e 2021, em inglês, tendo como resultado 1023 artigos retornados. Foram excluídos os trabalhos que não versavam sobre fitorremediação através de pântanos construídos e artigos de pesquisa com efluentes sintéticos, permanecendo no estudo apenas os que versavam sobre águas superficiais, efluentes e afluentes de estações de tratamento de esgoto e de estações de tratamento de água. Os artigos de revisão que não caracterizavam *wetlands* construídos foram excluídos. Assim, esta revisão foi realizada em uma base de 25 artigos de revisão e pesquisa.

III. RESULTADOS E DISCUSSÃO

3.1- Caracterização de *wetlands* construídos

Os processos biológicos, como o uso de plantas são considerados promissores para tratar contaminação de águas por fármacos. Para seleção de uma tecnologia adequada para remediar águas poluídas com fármacos é necessário levar em consideração vários aspectos. Os wetlands construídos (WC), também chamados de zonas úmidas construídas ou pântanos construídos, se espelham em zonas úmidas naturais, que são capazes de filtrar a água melhorando sua qualidade (Al-Baldawi et al., 2021).

Os WC são projetados artificialmente para tratamento de águas residuais. Para aplicação, são construídos, bacias, lagoas ou lagos rasos e, neles aplicados substrato e vegetação (Al-Baldawi et al., 2021). Os projetos podem e devem ser feitos de forma individual, dependendo das características das águas e dos parâmetros necessários a serem atingidos. Além disso deve-se observar questões como área disponível e topografia do ambiente (Turcios et al., 2021).

3.1.1- Tipos de fluxo de água

Wetlands construídos de fluxo superficial livre (WCFS) com o fluxo ocorrendo no fundo do WC, assim as águas formam uma superfície livre. Neste caso prevalecem as condições anaeróbicas, assim tem eficácia limitada para remoção de poluentes, mas pode ser eficaz para remoção de sólidos em suspensão (Turcios et al., 2021).

Wetlands construídos de fluxo subsuperficial tem a vantagem de poderem ser construídos perto de áreas residenciais por ter como característica o escoamento das águas residuais sob a superfície, evitando maus odores. Estes precisam de enchimento com substrato poroso, normalmente cascalho e areia, assim podem manter um fluxo, mas para isso precisam ter um tempo de retenção hidráulica (TRH) maior, pois o volume adicionado diminui o TRH e a taxa de carga hidráulica (TCH). Portanto, precisam de uma área maior para serem aplicados (Turcios et al., 2021).

Os *Wetlands* construídos de fluxo subsuperficial podem ser divididos de acordo com o caminho do fluxo de água, que pode ser horizontal e, portanto, é chamado de WC de fluxo horizontal subsuperficial (WCFSH), ou somente WC de fluxo horizontal, e WC de fluxo vertical subsuperficial (WCFSV) ou somente WC de fluxo vertical. Normalmente os WCFSH tem profundidade de 30 a 50 cm, assim, as raízes das plantas têm alcance total nas águas residuais. O fluxo do efluente é horizontal e contínuo, empurrando a água tratada para a sua saída para o afluente. Apesar de tender para características anaeróbicas, as plantas fornecem para a área das raízes quantidade de oxigênio suficiente para manter o desenvolvimento de uma maior variedade de microrganismos (Turcios et al., 2021).

Os WCFSV podem ter fluxo ascendente ou descendente e têm uma profundidade média de 2 metros e as águas residuais variam em influxo, assim aumentam e diminuem de carga constantemente. Isso leva a uma maior movimentação das águas residuais gerando uma maior oxigenação (Al-Baldawi et al., 2021; He et al., 2021).

A profundidade de WC pode ser na escala de centímetros ou metros. Em grandes instalações prevalecem as condições anaeróbias. E, como a remoção de poluentes está relacionada as bactérias na rizosfera, este pode ser um limitante para a remoção (Turcios et al., 2021).

3.1.2- Modo de alimentação

Os WC podem ser alimentados de modo contínuo ou em lote (alternado). No modo contínuo o efluente abastecerá o WC constantemente. No modo alternado, o WC é abastecido quando o lote anterior estiver quase todo drenado. Pode-se, ainda, estabelecer um período de descanso entre um lote e outro (fluxo de maré) (He et al., 2021).

3.1.3 - Seleção de espécies de plantas

É certo que diversos fatores contribuem para o desempenho de WC na remoção da poluição das águas e, em especial de fármacos. Entretanto, um dos aspectos a ser considerado é o tipo de planta a ser usada no projeto (Hu et al., 2021).

As macrófitas são as espécies mais usadas nos projetos de WC e são classificadas de acordo com a forma com que crescem no ambiente aquático, podendo viver em ambiente de água doce como em água salgada (Kurniawan et al., 2021).

A vegetação pode ser emersa ou emergente, submersa ou flutuante (Turcios et al., 2021). As emergentes como

Phragmites spp., *Typha latifolia* e *Cyperus spppois*, tem raízes submersas, podendo estar enraizadas, e folhas para fora da água. As submersas como *Ceratophyllum*, *Myriophyllum*, *Hydrilla* , *Egeria* e *Elodea canadensis*, estão completamente submersas e espécies como *Salvinia* molesta, *Lemna minor* e *Eichhornia crassipes* tem todo o corpo da planta para fora da água exceto suas raízes (Kurniawan et al., 2021).

Uma nova forma de uso de plantas emergentes tem sido o *floating treatment wetlands*, que consiste numa estrutura flutuante (tapete) onde as espécies emergentes são plantadas. Assim as folhas e brotos crescem acima do nível da água e as raízes ficam submersas. Assim, as raízes, rizomas e microrganismos associados formam uma rede fornecendo a área necessária para que ocorram os processos de degradação e aprisionamento dos poluentes (Oliveira et al., 2021).

As plantas submersas, podem apresentar um bom desempenho, mas não foram estudadas por longo período. As plantas flutuantes, *Salvinia molesta* e *Lemna minor*, tem ciclo de crescimento curto podendo ser usadas para situações emergenciais. Já a flutuante *Eichhornia crassipes*, apesar de ser bastante eficiente para remoção de alguns fármacos, tem uma capacidade reprodutiva muito alta e um grande consumo de oxigênio. Note-se que as espécies podem ser usadas em conjunto sendo adequadas a situações específicas (Hu et al., 2021).

As plantas mais usadas para tratar produtos farmacêuticos são as emergentes, pois apresentam maior tecido, possibilitando o acúmulo desses poluentes. Além disso possuem sistemas radiculares desenvolvidos, aumentando seu contato com a água e maior possibilidade de desenvolvimento de microrganismos na rizosfera (Hu et al., 2021).

A função das plantas no WC pode ser classificada como funções diretas e indiretas. As funções diretas dizem respeito a absorção, translocação e degradação dos poluentes. As funções indiretas dizem respeito a possibilidade de, pela sua presença, promoverem o crescimento de microrganismos radiculares, atividades enzimáticas através da liberação de metabólitos secundários no meio, e aumento de oxigênio por perda radicular (Hu et al., 2021).

A absorção de fármacos pelas plantas é dada, principalmente, pela simbiose estabelecida pela sua raiz e os microrganismos. Os compostos farmacêuticos com log kow entra 0,5 e 3 são mais facilmente absorvidos do que aqueles hidrofóbicos. Estes últimos têm a tendencia a sorção no substrato (Hu et al., 2021).

Entretanto, o fato de os fármacos hidrofóbicos tenderem a sorção, não quer dizer que não sejam absorvidos, pois podem ser identificados tanto nos brotos como nas partes aéreas da planta. Ademais, cabe ressaltar que a planta é capaz de transformar os fármacos absorvidos em produtos de baixo peso molecular podendo ser eliminados pela respiração ou serem conjugados a estruturas da planta (Hu et al., 2021).

3.1.4- Substrato

Os substratos utilizados para o projeto de WC podem ser cascalho, areia, solo do local a ser construído, carvão ativado, argila expandida e substratos a base de silício). Propriedades do substrato, como tamanho de partícula, porosidade, carga e pH, influenciam na eficiência dos WC. Um substrato mais particulado permite uma maior infiltração da água, possibilitando maior interação com o poluente. A despeito disso, um substrato com maior superfície possibilita formação de biofilme e o mais poroso possibilitará maior contato com o poluente (Al-Baldawi et al., 2021; He et al., 2021).

A areia e o cascalho são substratos de baixo custo e fornecem uma textura ideal, mas têm poucos nutrientes para crescimento de macrófitas e biofilmes. Os substratos minerais atuam via troca iônica além de promover adsorção devido sua estrutura porosa. Os substratos a base de resíduos orgânicos como o biocarvão podem ser usados para melhorar a atividade microbiana. Portanto, uma melhor adequação pode ser alcançada promovendo o uso de substratos híbridos (Kataki et al., 2021).

3.1.5- Tempo de retenção hidráulica

Quanto maior o tempo de retenção hidráulica (TRH), maior o contato da água com a planta e os microrganismos presentes na rizosfera, aumentando a possibilidade de remoção dos poluentes (Al-Baldawi et al., 2021).

3.1.6- Taxa de carga hidráulica

Uma taxa de carga hidráulica TCH mais alta, gerará um fluxo mais rápido pelo substrato, diminuindo o contato com as plantas e, consequentemente, diminuindo a eficiência de remoção (Al-Baldawi et al., 2021).

3.1.7 - Aeração

Normalmente, um WC é abastecido de oxigênio de forma natural, sendo fornecido pela atmosfera, pelo efluente ou pelas raízes das plantas. Entretanto a aeração pode ser feita de forma artificial por tubos ou bombas e pode ser intermitente ou contínua (He et al., 2021).

A aeração traz a possibilidade de uma maior oxigenação do ambiente, possibilitando maior crescimento de microrganismos e, portanto, maior eficiência na remoção de fármacos. Entretanto, deve-se observar, o quão irá impactar no estresse das plantas, devendo ser ajustado conforme o projeto (He et al., 2021).

3.2 – Presença de fármacos nas águas residuais

Avila e colaboradores (2021), evidenciou a presença de fármacos em águas residuais, que são lançadas constantemente no meio ambiente de forma acidental e proposital. Ressalta que há evidências de toxidade dessas substâncias para o bioma aquático, bem como para o ser humano, conforme mostrado na Tabela 1:

Tabela 1: Concentração de fármacos em águas verificados em outros países.

FÁRMACO	Min	Max	Média	Frequência	Onde	referência
paracetamol	7,8 ng/*l*	30,7 ng/*l*	12,3 ng/*l*	75%	Barcelona, Espanha	(Ávila et al., 2021)
diclofenaco	46,2 ng/*l*	814 ng/*l*	219 ng/*l*	100%	Barcelona, Espanha	(Ávila et al., 2021)
indometacida	0,88 ng/*l*	-	0,11 ng/*l*	13%	Barcelona, Espanha	(Ávila et al., 2021)
cetoprofeno	278 ng/*l*	2881 ng/*l*	1314 ng/*l*	100%	Barcelona, Espanha	(Ávila et al., 2021)
propilfenazona	0,73 ng/*l*	-	0,18 ng/*l*	25%	Barcelona, Espanha	(Ávila et al., 2021)
bezafibrato	0,67 ng/*l*	1,28 ng/*l*	0,44 ng/*l*	75%	Barcelona, Espanha	(Ávila et al., 2021)
fenofibrato	-	-	-	-	Barcelona, Espanha	(Ávila et al., 2021)
genfibrozil	1,14 ng/*l*	20,9 ng/*l*	7,82 ng/*l*	88%	Barcelona, Espanha	(Ávila et al., 2021)
carbamazepina	0,10 ng/*l*	0,14 ng/*l*	0,04 ng/*l*	38%	Barcelona, Espanha	(Ávila et al., 2021)
lorazepam	241 ng/*l*	892 ng/*l*	470 ng/*l*	100%	Barcelona, Espanha	(Ávila et al., 2021)
sulfadiazina	0,39 ng/*l*	1,78 ng/*l*	0,27 ng/*l*	25%	Barcelona, Espanha	(Ávila et al., 2021)
sulfametazina	-	-	-	-	Barcelona, Espanha	(Ávila et al., 2021)
sulfametoxazol	2,11 ng/*l*	3,42 ng/*l*	0,69 ng/*l*	25%	Barcelona, Espanha	(Ávila et al., 2021)
Metaciclina	63,7 ng/*l*	108 ng/*l*	-	-	Sul da China	(Cheng et al., 2021)
Sulfametoxazol	77,6 ng/*l*	106 ng/*l*	-	-	Sul da China	(Cheng et al., 2021)
ciprofloxacino	-	-	442 ng/*l*	-	São Paulo, Brasil	(Sakurai et al., 2021)
cetoprofeno	-	1,79µg/l	-	-	Espanha	(Hijosa-Valsero et al., 2010)
naproxeno	1,35 µg/l	3,53 µg/l	-	-	Espanha	(Hijosa-Valsero et al., 2010)
ibuprofeno	8,88 µg/l	24,19 µg/l	-	-	Espanha	(Hijosa-Valsero et al., 2010)
diclofenaco	0,37 µg/l	0,83 µg/l	-	-	Espanha	(Hijosa-Valsero et al., 2010)
carbamazepina	1,36 µg/l	1,52 µg/l			Espanha	(Hijosa-Valsero et al., 2010)
Ácido salicílico	9,93 µg/l	10,29 µg/l			Espanha	(Hijosa-Valsero et al., 2010)

Fonte de dados: Ávila et al., 2021; Hijosa-Valsero et al., 2010; Sakurai et al., 2021; Cheng et al., 2021

3.3 – Eficácia de remoção de fármacos nos sistemas WC

AL Falahi AO, e colaboradores (2021) projetaram três WCFSV, plantados com a espécie emergente *Scirpus grossus* em substrato de areia. Um reator operou sem sistema de aeração e os outros dois com sistema de aeração de 1 e 2 L/minuto. Funcionaram de modo continuo operando com vazões diferentes, produzindo, portanto, tempo de retenção diferentes. Receberam esgoto por 30 dias antes da introdução de águas residuais com ibuprofeno em concentração simulada. Ressalte-se que neste experimento os autores verificaram a adsorção de ibuprofeno pela areia, entretanto, conforme o aumento do TRH e maior aeração, a concentração de ibuprofeno na areia foi diminuindo, sendo caracterizada sua degradação. Conforme mostrado na Tabela 2. Outros trabalhos confirmam que o TRH mais longo estabelece um maior contato da rizosfera filtrante com o ibuprofeno, propiciando maior remoção. (Vystavna et al., 2017)

Tabela 2 – Índice de remoção mínimo e máximo na água e concentração mínima e máxima de ibuprofeno pela areia

**Sistema aerado – A * sistema não aerado – N A *Tempo de retenção hidráulica em dia - TRH *Ibuprofeno - IBU*

FÁRMACO	A TRH 3	A TRH 4	A TRH 5	N A TRH 3	N A TRH 4	N A TRH 5
IBU água	72,6-89,6%	80,5-91,9%	89,5-99,3%	34,70%	47%	56,60%
IBU areia	18 - 2,5 µg/g	17,3-3,3µg/g	14,9 -2,3 µg/g	34,7 µg/g	38,7 µg/g	23,3 µg/g

Fonte de dados: AL Falahi et al., 2021

Avila (2021) testou a remoção de paracetamol, diclofenaco, indometacina, cetoprofeno propifeno, nazona, gemfibrozil, bezafibrato, fenofibrato, carbamazepina, Lorazepam, Sulfadiazina, sulfametazina e sulfametoxazol, em três projetos de WC de fluxo subsuperficial horizontal (WCFSH) de fluxo contínuo, com planta emergente e cascalho como substrato, tendo como TRH 5,5 dias. Um WC tinha sistema de aeração contínuo, outro intermitente e o terceiro não era aerado.

Nos WC aerados de fluxo continuo paracetamol tem concentração entre 2,53-4,06 *ng/*l, para diclofenaco foi de 0,81-11,3 ng/l, para indometacina a concentração foi de 1,56 ng/l, para cetoprofeno foi entre 33-149 ng/l, propilfenazona foi de 0,73 ng/l, bezafibrato 0,20 ng/l, carbamazepina 0,07-0,10 ng/l, Lorazepam 67,9-347 ng/l , Sulfadiazina 0,7 ng/l , sulfametazina 0,67 ng/l e sulfametoxazol 2,52 ng/l (Ávila et al., 2021).

Nos WC aerados de fluxo intermitente, paracetamol tem concentração entre 5,51-7,36*ng/*l, para diclofenaco foi de 15,7-132 ng/l, para indometacina a concentração foi de 3,53 -5,80 ng/l, para cetoprofeno foi entre 64-1129 ng/l, propilfenazona não foi quantificada e bezafibrato 0,20-0,24 ng/l, genfibrozil 2,04-2,51 ng/l, carbamazepina 0,12 ng/l, Lorazepam 83,2-607 ng/l, sulfadiazina0,39 ng/l, e sulfametazina 0,31 ng/l (Ávila et al., 2021).

Nos WC sem aeração paracetamol tem concentração entre 5,32-32,5*ng/*l, para diclofenaco foi de 40,6-426 ng/l, para indometacina a concentração foi de 5,35 -19,5ng/l, para cetoprofeno foi entre 214-2140 ng/l, propilfenazona não foi quantificada e bezafibrato 0,24-0,64 ng/l, genfibrozil 2,16-259 ng/l, carbamazepina 0,14-0,19 ng/l, Lorazepam 92,4-637 ng/l, Sulfadiazina 0,39 ng/l, sulfametazina 0,31 ng/l e sulfametoxazol 1,01-1,07 ng/l (Ávila et al., 2021).

Os WCFSH aerados apresentaram índice de remoção acima de 83% para todos os fármacos, exceto para carbamazepina e Lorazepam (Ávila et al., 2021).

Alguns estudos indicam que os metabólitos da carbamazepina são convertidos ao composto original durante o tratamento biológico. (Jekel et al., 2015).

Dordio (2010) realizou um experimento com WCFSH, tendo como substrato argila expandida, planta emergente e fluxo descontínuo e TRH de 7 dias, avaliando a remoção de carbamazepina e ibuprofeno. Entre inverno e verão obteve-se índices de 88,2 a 96,7% para CMZ e 81,9 a 96,2% para ibuprofeno. A baixa remoção de carbamazepina, <12%, em sistemas não plantados reafirma sua característica recalcitrante e de difícil biodegradabilidade.

A Carbamazepina é resistente a fotodegradação, biotransformação e possui baixo potencial de sorção. Além disso, é excretada em 93% na forma glicuronídeos que podem ser convertidos no composto original. Este fato explica a possibilidade de remoção negativa (Campanha et al., 2015).

Ávila, e colaboradores (2010) usaram um sistema de três WCFSH operando em série com cascalho e TRH de 3,5 dias para investigar a remoção de ibuprofeno (IBU), naproxeno (NPX), diclofenaco (DCF). As concentrações antes de entrarem no primeiro WCFSH eram de 132µg/l, 35,7µg/l e 3,2 µg/l para ibuprofeno, naproxeno e diclofenaco, respectivamente. No primeiro sistema as concentrações reduziram para 53,1 µg/l, 2,2 µg/l e 0,3 µg/l para ibuprofeno, naproxeno e diclofenaco, respectivamente. No segundo sistema as medições foram 56,5 µg/l, 3 µg/l e 0,2 µg/l para ibuprofeno, naproxeno e diclofenaco, respectivamente. No último sistema as concentrações foram de 1,5 µg/l, 0,3 µg/l e 0,003 µg/l para ibuprofeno, naproxeno e diclofenaco, respectivamente.

Note-se que a eficiência de remoção ficou entre 97 e 98%, sendo o diclofenaco e o naproxeno removidos em 80% no primeiro e segundo WC. Já o ibuprofeno teve apenas entre 50 e 60% de remoção nos dois primeiros estágios, tendo sido correlacionado com o processo anaeróbio predominante (Ávila et al., 2010).

Cheng e colaboradores (2021), estudaram a remoção de antibióticos em WC de fluxo de maré ou *tidal flow*, com cascalho, dois deles com plantas emergentes e apenas um sem planta, operando com um TRH de 12 horas.

Este tipo de WC consiste em um sistema de enchimento, ou maré, e esvaziamento para repouso num ciclo de 1 dia. O fluxo é vertical subsuperficial ascendente e ou descendente(Sezerino et al., 2020).

A remoção dos antibióticos no WC com fluxo ascendente e descendente sem plantas foi de 77,2%, no WC com fluxo descendente com planta foi de 85,2% e no WC com fluxo ascendente e descendente com planta foi de 90,2%. O fluxo em duas direções, naturalmente, provoca maior aeração ao sistema, o que determina maior eficiência em remoção (Cheng et al., 2021).

Sakurai e equipe (2021) realizaram, em São Carlos, SP, Brasil, estudo com WCFSH e WCFSV, com cascalho e areia, plantas emergentes e fluxo contínuo e intermitente. O experimento foi realizado em 4 etapas, sendo a etapa 1 adaptação, etapa 2 TRH de 2 e 0,9, etapa 3 TRH foi 1 e 0,4 para os WCFSH e WCFSV respectivamente. Os dois WC operaram em conjunto, sequencialmente, sendo o WCFSH receptor direto das águas residuais. A concentração média de Ciprofloxacino na entrada do WCFSH etapa 1 foi de 208,4 ng/*l* com índice de remoção 85,6% nesse sistema. Na etapa 2 as amostras ficaram abaixo do limite de quantificação e detecção. Na etapa 3 a concentração média foi de 594,1 *ng/*l com índice de remoção de 95% no WCFSH. Na última etapa a concentração encontrada foi de 419,7 ng/l com remoção de 92,9% no WCFSH. Ciprofloxacino não foi detectado em nenhuma amostra no WCFSV, portanto o WCFSH foi suficiente para remoção deste antibiótico. A mesma eficiência foi relatada por outros autores (Dan A et al., 2013).

Hijosa-Valsero (2010) monitorou cetoprofeno, naproxeno, ibuprofeno, diclofenaco, ácido salicílico, carbamazepina através de sete WC, sendo WC 1 e 5 de fluxo superficial contínuo, sem substrato, com macrófitas flutuantes e TRH de 2,1 e 2,9 dias respectivamente. Os WC 2,3 e 4 tinha fluxo superficial, com cascalho, plantas emergentes em WC 2 e 4, WC 4 sem planta, todos com fluxo contínuo e TRH de 3,3, 5,1 e 6,1 dias respectivamente. Os WC 6 e 7 tinha fluxo subsuperficial horizontal, com cascalho, planta emergente no WC 6 e sem planta no WC 7, fluxo contínuo e TRH de 2,5 e 2,6 dias respectivamente. Os resultados de remoção foram de 24 a 48% para carbamazepina, 35 a 89% para ácido salicílico, 17 a 52% para diclofenaco, 27 a 96% para ibuprofeno, 27 a 83% para naproxeno e 11 a 50% para cetoprofeno. Os menores índices de remoção foram observados no inverno, este fato é explicado pela ausência de luminosidade suficiente para o desenvolvimento das plantas e consequente menor oxigenação na água (Pilon-Smits, 2005).

Sossalla (2021) testou WCFSH não aerado (H50p), WCFSH aerado e não plantado (HÁ), WCFSH aerado e plantado, WCFSV aerado e não plantado (VA) e WCFSH aerado e plantado (VAp) e um sistema misto WCCFSV o primeiro estágio e um filtro de areia (VSp) como segundo estágio. Os plantados eram com emergentes, todos com cascalho, exceto VSp. TRH de 5,5 para H50p, 3,5 para VA e VAp, 3,7 para HÁ e HAp. Os fármacos estudados foram ibuprofeno, naproxeno, diclofenaco, carbamazepina. Em H50p ibuprofeno foi removido em 51%, NPX 61%, DCF 39% e carbamazepina 24%. O autor ressalta que os baixos percentuais em H50p são devido a prevalência de condições anaeróbias. Em VAp, HAp e VA+VSp, DCF foi removido em 81%, 93% e 95%, devido ao alto potencial redox. Carbamazepina não foi efetivamente removida em nenhum sistema. ibuprofeno e naproxeno apresentaram remoção entre 89% e 99% em todos os sistemas, exceto em H50p. VAp+ VSp tiveram remoção mais alta e estável para os fármacos.

Vystavna e parceiros (2017) realizaram um estudo comparativo de eficiência de remoção de fármacos nos anos de 2012 e 2015, em quatro unidades de CW, dois deles CWFSV (1 e 2) e dois CWFSH (3 e 4) que podem ser operados individual ou simultaneamente. As plantas são emergentes, o substrato é areia, o TRH é de 10 a 13 dias e existe um sistema de aeração. Foi observado aumento de concentração de entrada de todos os fármacos de 2012 para 2015, exceto para diclofenaco, naproxeno e propranolol. A eficiência de remoção foi superior a 80% para propranolol e naproxeno e entre 50 e 80% para paracetamol, Venlafaxina, ibuprofeno, carbamazepina e diclofenaco. A maior TRH e aeração trazem um efeito positivo para a eficiência de remoção. Sendo certo que os CW têm grande papel como tratamento secundário de águas residuais.

Y. Chen e equipe (2016) avaliaram três WCFSH de grande escala que são equipados com um pré-tratamento em areia. As plantas utilizadas são emergentes, o substrato é o cascalho, o TRH ´e de 6,5, 12,9 e 5,4 dias respectivamente, nos sistemas C, B e S. Foram avaliadas as remoções dos fármacos ibuprofeno que teve efi12ciência de remoção entre 74% e 99%, cetoprofeno com eficiência de 47% a 91%, naproxeno com 75% a 76% , 76% a 97% e 69% a 96% nos sistemas C, B e S, respectivamente, diclofenaco como mínima teve índice de 17% a 48%, nos sistemas C e B, e 95% no sistema S, tramadol teve eficiência entre 54% e 85%, paracetamol teve eficiência entre 95% e 100%, atenolol com eficiência entre 58% e 99%, metoprolol com 69% a 93%, furosemida com 80% a 96%, hidroclorotiazida com eficiência de 58% a 85% no sistema C, 18% a 42% no sistema B e 90% a 91% no sistema S, Gabapentina com 53% a 88%. A baixa degradação do diclofenaco é confirmada no estudo de Hijosa-Valsero (Hijosa-Valsero et al., 2010).

Tejeda, Torres-Bojorges e Zurita (2017), estudaram a eficiência de remoção da Carbamazepina em três WC de dois estágios. O sistema I (SI) era constituído por um WCFSH seguido por lagoa de estabilização (LE) com TRH de 3 dias e fluxo contínuo, O sistema II (SII) era um

WCFSH com TRH de 3 dias que abastecia com fluxo intermitente a cada 2 horas um WCFSV. O sistema III (SIII) era uma WCFSV que foi alimentado intermitentemente a cada 2 horas com volume de 2,8 L e descarregava continuamente no WCFSH. Todos plantados com espécies emergentes. Nos SI e SII a remoção média foi de 62,5% e 59% respectivamente. No SIII a eficiência foi de 44,2%. Este estudo sugeriu que a remoção de carbamazepina é incrementada em condições anaeróbias, já que teve uma eficiência maior em SI e SII que operavam nessa condição. Este resultado é corroborado pelos achados de outros autores, que evidenciam melhor degradação da carbamazepina em condições anóxicas (Hai et al., 2011).

Hijosa-Valsero e colaboradores (2016) estudaram a remoção de ibuprofeno, cetoprofeno, naproxeno, diclofenaco, ácido salicílico e carbamazepina em sete WC que foram adaptados a uma ETE como segundo tratamento. CW1, CW2 e CW5 eram WCFSH, com plantas emergentes e cascalho como substrato, CW3, CW6 eram WCFSH, com plantas emergentes e cascalho como substrato. CW4 e CW7 era WCFSH com cascalho e sem plantas. Eram abastecidos em fluxo contínuo. Foi constatada eficiência de remoção acima de 60% para todos os fármacos exceto para diclofenaco, cetoprofeno e carbamazepina. Foram avaliadas as biomassas das plantas e constatado que são essenciais nos projetos de WC para remoção de fármacos. A presença de *I. sibirica e Z. aetiopica* em CW foi fator determinante para eficiência de remoção de carbamazepina (Tejeda et al., 2017).

Vymazal, Březinová e Koželuh (2015) selecionaram três WCFSH com substrato de cascalho, Com TRH de 8,1 dias para o CWA, 7,1 dias para o CWB e 8,7 dias para o CWC, todos com vegetação emergente.

As concentrações médias de estrona (E1) no afluente dos WC variaram de 28,1 ng/l e 56,2 ng/l. Nos WC A e B a remoção foi de 100%, pois a quantificação ficou abaixo do limite e no WC C a eficiência foi de 85%.

As concentrações de 17ÿ-estradiol (E2) foram 6,3 ng/l, 4,1 ng/l e 15,4 ng/l para os sistemas A, B e C, respectivamente. As concentrações médias de E2 de saída em todos os três sistemas estavam abaixo do limite de quantificação, pressupondo uma remoção de 100%.

Quanto ao estriol (E3) as concentrações de entrada foram 16 ng/l e 12,8 ng/l e de saída foram abaixo do limite de quantificação, nos sistemas A e B, respectivamente e no sistema C, as concentrações de entrada e saída de E3 estavam abaixo do limite de quantificação.

As concentrações de 17ÿ-etinilestradiol (E2) variam de 6,0 ng/l e 2,8 ng/l nos sistemas A e B respectivamente e no sistema C abaixo do limite de quantificação. As respectivas concentrações médias de E2 de saída foram de 2,6 ng/l, 0,52 ng/l e 2,21 ng/l.

Para testosterona foram detectadas concentrações medias de entrada variaram entre 2,8 ng/l e 10,5 ng/l enquanto para a progesterona as concentrações médias de entrada variaram entre 4,4 ng/l e 20,3 ng/l. Nenhum dos dois hormônios foram detectados na saída.

Os resultados indicam uma remoção eficiente dos hormônios nos WCFSH. Apesar de poucos relatos, em literatura, sobre a remoção de hormônios, alguns autores tiveram resultados positivos (Shappell et al., 2007).

Carranza-Diaz et al. (2014), investigaram a remoção de carbamazepina, ibuprofeno, diclofenaco, cetoprofeno e naproxeno em um WCFSH (H50P) que era plantado e outro WCFSH (H50) não plantado, os dois com substrato cascalho e TRH em média de 5,5 dias. A eficiência média de remoção para todos os fármacos ficou abaixo de 30%, sendo constatada eficiência maior no H50P, atribuindo a baixa remoção a existência de alta carga orgânica e condições aeróbias impróprias. Ao contrário, Tejeda, Torres-Bojorges e Zurita (Tejeda et al., 2017), relatam a necessidade de condições anóxicas para efetiva remoção de carbamazepina.

Ávila et al. (2014) avaliaram a remoção de ibuprofeno, acetaminofeno, diclofenaco e etinilestradiol em quatro WCFSV. VGp continha substrato de cascalho, VS1p e VS2p continham substrato de areia. VAp continha substrato de carvalho e sistema de aeração. Todos com plantas emergentes e fluxo intermitente. As concentrações dos afluentes foram em média de 44,5 ng/l para ibuprofeno e 5,58 ng/l para diclofenaco, acetaminofeno e etinilestradiol estavam abaixo do limite de quantificação. Nos efluentes essa concentração diminuiu para 0,44 ng/l de ibuprofeno em VS2p, 0,14 ng/l VS1p, 2,43 ng/l em VGp e 0,20 ng/l em VAp. Para Diclofenaco foi de 1,66 ng/l em VS2p, 2,55 ng/l em VS1p, 1,93 ng/l em VGp e 2,37em VAp. A eficiência de remoção ficou na faixa de 95% para ibuprofeno e para diclofenaco ficou entre 54 e 70%. Este resultado encontra-se em conformidade com os achados de Matamoros (Matamoros et al., 2008).

Já o grupo de Berglund (2014) teve como objetivo avaliar a eficiência de remoção de antibióticos através de quatro WCFSH (A,B,C,D). Os WC não tinham afluentes de águas residuais. O TRH era de em média 5,7 dias, substrato era argila e as plantas eram emergentes. As águas foram incrementadas com os antibióticos continuamente por 25 dias nas concentrações de 0,1 ng/l de azitromicina, 0,2 ng/l de Ciprofloxacino, 0,4 ng/l de claritromicina, 0,2 ng/l de clindamicina, 0,1 ng/l de doxiciclina, 2 ng/lde eritromicina, 1 ng/l de Norfloxacino, 0,4 ng/l de oxitetraciclina, 1 ng/l de sulfametoxazol, 1 ng/l de tetraciclina, 1 ng/l de trimetoprim

e 0,1 ng/l de vancomicina. As eficiências de remoção foram de 61%, 97%, 100%, 100%, 99%, 100%, 100%, 77%, 74%, 96% e 59% para Trimetoprim, oxitetraciclina, Norfloxacino, Ciprofloxacino, tetraciclina, doxiciclina, azitromicina, sulfametoxazol, clindamicina, eritromicina e claritromicina, respectivamente. Atribui-se a capacidade de remoção de antibióticos em WC, a adsorção ao substrato gerando íons metálicos (Zhang et al., 2014).

Dan e demais pesquisadores (2013) montaram 12 WC em diferentes configurações para avaliar a remoção de Sulfadiazina, sulfapiridina, sulfacetamida, sulfametazina, sulfametoxazol, trimetoprim. As configurações eram três CWFSV descendente, chamados de CW1, CW2 e CW3, tendo como substrato brita, vesuvanita e zeolite, respectivamente. CW1 e CW3 com plantas emergentes e CW2 não plantado, três CWFSV ascendente, chamados de CW4, CW5 e CW6, com substrato brita, vesuvianita e zeolite, respectivamente. CW4 e CW5 com plantas emergentes e CW6 não plantado. Seis CWFSH chamados de CW7, CW8, CW9, CW10, CW11 e CW2. Sendo CW7 e CW10 com brita, CW8 e CW11 com zeolite e CW9 e CW12 com vesuvianita. Os CW 9 e 12 não eram plantados. A Sulfadiazina teve eficiência de remoção em CW1 e CW3 com 72-76% no verão e 43-67% no inverno. Sulfapiridina teve alto índice de remoção em todos WC (75-88% no verão e 80-92% no inverno). CW5 removeu mais eficientemente o sulfametoxazol durante o verão (58%) e CW8 durante o inverno (69%). Sulfadiazina teve índices acima de 50% de remoção em todos os WC durante o verão e no inverno, apenas CW2 conseguiu remover acima de 50%. Sulfametazina não foi removida eficientemente em nenhum WC. Trimetoprim teve índices de remoção de 57-95% no verão e 35-97% no inverno. Ficou demonstrado a eficiência de remoção de antibióticos em WC, podendo variar de acordo com a estação do ano e tipo de fluxo (Hijosa-Valsero et al., 2010).

Historicamente, os primeiros relatos de remoção de fármacos das águas através da tecnologia de *Wetlands* Construídos, foram de anti-hipertensivos. Entretanto, diversos estudos relatam eficiência na remoção de anti-inflamatórios e, mais recentemente, antibióticos. Portanto, com diversas possibilidades de projetos acima apresentados, verificamos que não importa com qual característica foi implantado, os WC demonstram maior eficiência que os tratamentos convencionais. Sendo assim, é uma possibilidade de melhoria a baixo custo, beneficiando a Saúde Pública.

A partir dessa revisão surge como perspectiva futura, ensaios em laboratório para análise de remoção de substâncias farmacológicas de águas conforme projeto elaborado e para Fitorremediação com soluções diluídas e seus respectivos controles (solventes e extratos vegetais totais em doses ponderais correspondentes).

IV. CONCLUSÃO

Diante a problemática apresentada quanto a verificação da presença fármacos nas águas, tendo em vista a dificuldade de remoção destes contaminantes, objetivamos caracterizar os tipos de Wetlands Construídos (WC) possíveis, já que tem como característica um baixo custo de implantação e manutenção, e buscar na literatura dados para avaliar o seu funcionamento e se, de fato, seria uma opção para o tratamento de águas.

Demonstra-se nesta revisão, que WC podem ter suas configurações o mais variadas possíveis, mesclando tipo de fluxo, substrato, plantas, vazão e tempo de retenção e, em todas as configurações observadas, foi possível verificar remoção de fármacos mais eficientemente que os tratamentos convencionais.

Os Wetlands Construídos são eficazes para remoção de fármacos das águas e têm baixo custo de implantação e manutenção. Portanto, são uma excelente opção para ser um sistema adicional aos sistemas convencionais de tratamento conferindo maior eficiência no tratamento das águas.

REFERÊNCIAS

[1] Al-Baldawi, I. A., Mohammed, A. A., Mutar, Z. H., Abdullah, S. R. S., Jasim, S. S., Almansoory, A. F., & Ismail, N. 'Izzati. (2021). Application of phytotechnology in alleviating pharmaceuticals and personal care products (PPCPs) in wastewater: Source, impacts, treatment, mechanisms, fate, and SWOT analysis. *Journal of Cleaner Production*, *319*(July), 128584. https://doi.org/10.1016/j.jclepro.2021.128584

[2] AL Falahi, O. A., Abdullah, S. R. S., Hasan, H. A., Othman, A. R., Ewadh, H. M., Al-Baldawi, I. A., Kurniawan, S. B., Imron, M. F., & Ismail, N. I. (2021). Simultaneous removal of ibuprofen, organic material, and nutrients from domestic wastewater through a pilot-scale vertical sub-surface flow constructed wetland with aeration system. *Journal of Water Process Engineering*, *43*(July), 102214. https://doi.org/10.1016/j.jwpe.2021.102214

[3] ANA. Brasil. (2017). *Atlas esgotos : despoluição de bacias hidrográficas / Agência Nacional de Águas, Secretaria Nacional de Saneamento Ambiental*. https://www.gov.br/ana/pt-br/assuntos/noticias/atlas-esgotos-revela-mais-de-110-mil-km-de-rios-com-comprometimento-da-qualidade-da-agua-por-carga-organica/atlaseesgotosdespoluicaodebaciashidrograficas-resumoexecutivo_livro.pdf/view

[4] Ávila, C., García-Galán, M. J., Uggetti, E., Montemurro, N., García-Vara, M., Pérez, S., García, J., & Postigo, C. (2021). Boosting pharmaceutical removal through aeration in constructed wetlands. *Journal of Hazardous Materials*,

412(January), 1–10. https://doi.org/10.1016/j.jhazmat.2021.125231

[5] Ávila, C., Nivala, J., Olsson, L., Kassa, K., Headley, T., Mueller, R. A., Bayona, J. M., & García, J. (2014). Emerging organic contaminants in vertical subsurface flow constructed wetlands: Influence of media size, loading frequency and use of active aeration. *Science of the Total Environment*, *494–495*, 211–217. https://doi.org/10.1016/j.scitotenv.2014.06.128

[6] Ávila, C., Pedescoll, A., Matamoros, V., Bayona, J. M., & García, J. (2010). Capacity of a horizontal subsurface flow constructed wetland system for the removal of emerging pollutants: An injection experiment. *Chemosphere*, *81*(9), 1137–1142. https://doi.org/10.1016/j.chemosphere.2010.08.006

[7] Berglund, B., Khan, G. A., Weisner, S. E. B., Ehde, P. M., Fick, J., & Lindgren, P. E. (2014). Efficient removal of antibiotics in surface-flow constructed wetlands, with no observed impact on antibiotic resistance genes. *Science of the Total Environment*, *476–477*, 29–37. https://doi.org/10.1016/j.scitotenv.2013.12.128

[8] Brasil. Ministério da Saúde. (2020). *Revisão do Anexo XX da Portaria de Consolidação n o 5 de 28 de setembro de 2017 do Ministério da Saúde (antiga Portaria MS Nº2914/2011) Padrão de Potabilidade e Planos de Amostragem Substâncias Químicas – Agrotóxicos – Subsídios para Discussão e Orientaçõ*. 22. https://www.gov.br/saude/pt-br/acesso-a-informacao/participacao-social/consultas-publicas/2020/arquivos/DOCSNTESEAGROTXICOS1METODOLOGIADESELEO.pdf

[9] Campanha, M. B., Awan, A. T., de Sousa, D. N. R., Grosseli, G. M., Mozeto, A. A., & Fadini, P. S. (2015). A 3-year study on occurrence of emerging contaminants in an urban stream of São Paulo State of Southeast Brazil. *Environmental Science and Pollution Research*, *22*(10), 7936–7947. https://doi.org/10.1007/s11356-014-3929-x

[10] Carranza-Diaz, O., Schultze-Nobre, L., Moeder, M., Nivala, J., Kuschk, P., & Koeser, H. (2014). Removal of selected organic micropollutants in planted and unplanted pilot-scale horizontal flow constructed wetlands under conditions of high organic load. *Ecological Engineering*, *71*, 234–245. https://doi.org/10.1016/j.ecoleng.2014.07.048

[11] Chen, Y., Vymazal, J., Březinová, T., Koželuh, M., Kule, L., Huang, J., & Chen, Z. (2016). Occurrence, removal and environmental risk assessment of pharmaceuticals and personal care products in rural wastewater treatment wetlands. *Science of the Total Environment*, *566–567*, 1660–1669. https://doi.org/10.1016/j.scitotenv.2016.06.069

[12] Cheng, Y. X., Chen, J., Wu, D., Liu, Y. S., Yang, Y. Q., He, L. X., Ye, P., Zhao, J. L., Liu, S. S., Yang, B., & Ying, G. G. (2021). Highly enhanced biodegradation of pharmaceutical and personal care products in a novel tidal flow constructed wetland with baffle and plants. *Water Research*, *193*. https://doi.org/10.1016/j.watres.2021.116870

[13] Dan A, Yang, Y., Dai, Y. nv, Chen, C. xing, Wang, S. yu, & Tao, R. (2013). Removal and factors influencing removal of sulfonamides and trimethoprim from domestic sewage in constructed wetlands. *Bioresource Technology*, *146*, 363–370. https://doi.org/10.1016/j.biortech.2013.07.050

[14] Dordio, A., Carvalho, A. J. P., Teixeira, D. M., Dias, C. B., & Pinto, A. P. (2010). Removal of pharmaceuticals in microcosm constructed wetlands using Typha spp. and LECA. *Bioresource Technology*, *101*(3), 886–892. https://doi.org/10.1016/j.biortech.2009.09.001

[15] Hai, F. I., Li, X., Price, W. E., & Nghiem, L. D. (2011). Removal of carbamazepine and sulfamethoxazole by MBR under anoxic and aerobic conditions. *Bioresource Technology*, *102*(22), 10386–10390. https://doi.org/10.1016/j.biortech.2011.09.019

[16] He, Y., Zhang, L., Jiang, L., Wagner, T., Sutton, N. B., Ji, R., & Langenhoff, A. A. M. (2021). Improving removal of antibiotics in constructed wetland treatment systems based on key design and operational parameters: A review. *Journal of Hazardous Materials*, *407*, 124386. https://doi.org/10.1016/j.jhazmat.2020.124386

[17] Hijosa-Valsero, M., Matamoros, V., Sidrach-Cardona, R., Martín-Villacorta, J., Bécares, E., & Bayona, J. M. (2010). Comprehensive assessment of the design configuration of constructed wetlands for the removal of pharmaceuticals and personal care products from urban wastewaters. *Water Research*, *44*(12), 3669–3678. https://doi.org/10.1016/j.watres.2010.04.022

[18] Hijosa-Valsero, M., Reyes-Contreras, C., Domínguez, C., Bécares, E., & Bayona, J. M. (2016). Behaviour of pharmaceuticals and personal care products in constructed wetland compartments: Influent, effluent, pore water, substrate and plant roots. *Chemosphere*, *145*, 508–517. https://doi.org/10.1016/j.chemosphere.2015.11.090

[19] Hu, X., Xie, H., Zhuang, L., Zhang, J., Hu, Z., Liang, S., & Feng, K. (2021). A review on the role of plant in pharmaceuticals and personal care products (PPCPs) removal in constructed wetlands. *Science of the Total Environment*, *780*, 146637. https://doi.org/10.1016/j.scitotenv.2021.146637

[20] IBGE. (2020). *Pesquisa nacional de saneamento básico : 2017 : abastecimento de água e esgotamento sanitário / IBGE, Coordenação de População e Indicadores Sociais* (IBGE (Ed.)). https://biblioteca.ibge.gov.br/visualizacao/livros/liv101734.pdf

[21] Jekel, M., Dott, W., Bergmann, A., Dünnbier, U., Gnirß, R., Haist-Gulde, B., Hamscher, G., Letzel, M., Licha, T., Lyko, S., Miehe, U., Sacher, F., Scheurer, M., Schmidt, C. K., Reemtsma, T., & Ruhl, A. S. (2015). Selection of organic process and source indicator substances for the anthropogenically influenced water cycle. *Chemosphere*, *125*, 155–167. https://doi.org/10.1016/j.chemosphere.2014.12.025

[22] Kataki, S., Chatterjee, S., Vairale, M. G., Dwivedi, S. K., & Gupta, D. K. (2021). Constructed wetland, an eco-technology for wastewater treatment: A review on types of wastewater treated and components of the technology (macrophyte, biolfilm and substrate). *Journal of Environmental Management*, *283*(September 2020), 111986. https://doi.org/10.1016/j.jenvman.2021.111986

[23] Kurniawan, S B, Ahmad, A., & Said, N. S. M. (2021).

Ciência do Meio Ambiente Total Machine Translated by Google. *790*, 1–14.

[24] Kurniawan, Setyo Budi, Ahmad, A., Said, N. S. M., Imron, M. F., Abdullah, S. R. S., Othman, A. R., Purwanti, I. F., & Hasan, H. A. (2021). Macrophytes as wastewater treatment agents: Nutrient uptake and potential of produced biomass utilization toward circular economy initiatives. *Science of the Total Environment*, *790*, 148219. https://doi.org/10.1016/j.scitotenv.2021.148219

[25] Matamoros, V., García, J., & Bayona, J. M. (2008). Organic micropollutant removal in a full-scale surface flow constructed wetland fed with secondary effluent. *Water Research*, *42*(3), 653–660. https://doi.org/10.1016/j.watres.2007.08.016

[26] Mejía, Paulo Victor Laguardia; Adreoli, Fabiana De Nadai; Andreoli, Cleverson V; Serrat, B. M. (2014). Metodologia para Seleção de Técnica de Fitorremediação em Áreas Contaminadas. *Revista Brasileira de Ciências Ambientais – Número*, *31*, 97–104. https://doi.org/h

[27] Montagner, C. C., Vidal, C., & Acayaba, R. D. (2017). Contaminantes emergentes em matrizes aquáticas do Brasil: Cenário atual e aspectos analíticos, ecotoxicológicos e regulatórios. *Quimica Nova*, *40*(9), 1094–1110. https://doi.org/10.21577/0100-4042.20170091

[28] Oliveira, G. A., Colares, G. S., Lutterbeck, C. A., Dell'Osbel, N., Machado, Ê. L., & Rodrigues, L. R. (2021). Floating treatment wetlands in domestic wastewater treatment as a decentralized sanitation alternative. *Science of the Total Environment*, *773*, 145609. https://doi.org/10.1016/j.scitotenv.2021.145609

[29] Pilon-Smits, E. (2005). Phytoremediation. *Annual Review of Plant Biology*, *56*, 15–39. https://doi.org/10.1146/annurev.arplant.56.032604.144214

[30] Pivetta, R. C., Rodrigues-Silva, C., Ribeiro, A. R., & Rath, S. (2020). Tracking the occurrence of psychotropic pharmaceuticals in Brazilian wastewater treatment plants and surface water, with assessment of environmental risks. *Science of the Total Environment*, *727*, 138661. https://doi.org/10.1016/j.scitotenv.2020.138661

[31] Sakurai, K. S. I., Pompei, C. M. E., Tomita, I. N., Santos-Neto, Á. J., & Silva, G. H. R. (2021). Hybrid constructed wetlands as post-treatment of blackwater: An assessment of the removal of antibiotics. *Journal of Environmental Management*, *278*(October 2020). https://doi.org/10.1016/j.jenvman.2020.111552

[32] Salt, D. E., Smith, R. D., & Raskin, I. (1998). Phytoremediation. Annual review of plant physiology. *Annual Review of Plant Physiology and Plant Molecular Biology*, *49*, 643–668. http://www.annualreviews.org/doi/abs/10.1146/annurev.arplant.49.1.643

[33] Sezerino, P. H., Machado, Ê. L., Sousa, J. T. de, Carvalho, K. Q. de, Decezaro, S. T., Almeida, R. de A., Kaick, T. S. Van, Pelissari, C., & Filho, F. J. C. M. (2020). *ÁGUAS RESIDUÁRIAS WETLANDS BRASIL* (p. Boletim 13). https://wetlandsbrasil.com.br/publicacoes/

[34] Shappell, N. W., Billey, L. O., Forbes, D., Matheny, T. A., Poach, M. E., Reddy, G. B., & Hunt, P. G. (2007). Estrogenic activity and steroid hormones in swine wastewater through a lagoon constructed-wetland system. *Environmental Science and Technology*, *41*(2), 444–450. https://doi.org/10.1021/es061268e

[35] Sossalla, N. A., Nivala, J., Reemtsma, T., Schlichting, R., König, M., Forquet, N., van Afferden, M., Müller, R. A., & Escher, B. I. (2021). Removal of micropollutants and biological effects by conventional and intensified constructed wetlands treating municipal wastewater. *Water Research*, *201*. https://doi.org/10.1016/j.watres.2021.117349

[36] Stephenson, C., & Black, C. R. (2014). One step forward, two steps back: The evolution of phytoremediation into commercial technologies. *Bioscience Horizons*, *7*, 1–15. https://doi.org/10.1093/biohorizons/hzu009

[37] Tejeda, A., Torres-Bojorges, Á. X., & Zurita, F. (2017). Carbamazepine removal in three pilot-scale hybrid wetlands planted with ornamental species. *Ecological Engineering*, *98*, 410–417. https://doi.org/10.1016/j.ecoleng.2016.04.012

[38] Turcios, A. E., Miglio, R., Vela, R., Sánchez, G., Bergier, T., Włodyka-Bergier, A., Cifuentes, J. I., Pignataro, G., Avellan, T., & Papenbrock, J. (2021). From natural habitats to successful application - Role of halophytes in the treatment of saline wastewater in constructed wetlands with a focus on Latin America. *Environmental and Experimental Botany*, *190*(July). https://doi.org/10.1016/j.envexpbot.2021.104583

[39] Vosgerau, D. S., & Romanowski, J. P. (2014). Estudos de revisão : implicações conceituais e metodológicas. *Rev. Diálogo Educ.*, *14*, 41. https://doi.org/10.7213/dialogo.educ.14.041.DS08

[40] Vymazal, J., Březinová, T., & Koželuh, M. (2015). Occurrence and removal of estrogens, progesterone and testosterone in three constructed wetlands treating municipal sewage in the Czech Republic. *Science of the Total Environment*, *536*, 625–631. https://doi.org/10.1016/j.scitotenv.2015.07.077

[41] Vystavna, Y., Frkova, Z., Marchand, L., Vergeles, Y., & Stolberg, F. (2017). Removal efficiency of pharmaceuticals in a full scale constructed wetland in East Ukraine. *Ecological Engineering*, *108*(August), 50–58. https://doi.org/10.1016/j.ecoleng.2017.08.009

[42] Xavier, J. de O., Campos, M. de C. S., Ribeiro, S. T. M., & Mot, H. R. (2021). *Macrófitas Aquáticas - 1* (p. 96). https://www.cemig.com.br/wp-content/uploads/2021/03/livro-macrofitas-cemig-2021.pdf

[43] Zhang, D., Gersberg, R. M., Ng, W. J., & Tan, S. K. (2014). Removal of pharmaceuticals and personal care products in aquatic plant-based systems: A review. *Environmental Pollution*, *184*, 620–639. https://doi.org/10.1016/j.envpol.2013.09.009

International Journal of Advanced Engineering Research and Science (IJAERS)
Peer-Reviewed Jurnal
ISSN: 2349-6495(P) | 2456-1908(O)
Vol-10, Issue-4; Apr, 2023
Journal Home Page Available: https://ijaers.com/
Article DOI: https://dx.doi.org/10.22161/ijaers.104.14

Study of the extraction process of the Pleurotus citrinopileatus mushroom and evaluation of the biological activity of the extract

Thanh Xuan Nguyen Thi[1], Phuong Anh Nguyen Thi[2], Mai Anh Le[2], Hoang Anh Nguyen[2], Manh Ha Nguyen[2], Hoai Phuong Nguyen Thi[3*]

[1]Hanoi National University of Education, Hanoi, VIETNAM
[2]Hanoi University of Industry, Hanoi, VIETNAM
[3]Institute of Chemistry and Materials, Hanoi, VIETNAM
*Email: thanhxuannguyen.moc@gmail.com

Received: 10 Mar 2023,

Receive in revised form: 15 Apr 2023,

Accepted: 22 Apr 2023,

Available online: 28 Apr 2023

Keywords*— *β-glucan, Pleurotus citrinopileatus, biological activity, functional food.

***Abstract*—** *Pleurotus citrinopileatus, also known in Vietnam as golden oyster mushroom, is a food rich in protein, fiber, essential amino acids, carbohydrates, water-soluble vitamins, and minerals. In particular, in the composition of yellow oyster mushrooms, there is β -1.3 - glucan with high biological activity as an active ingredient contributing to the intense stimulation of immunity. The study researched the process of extracting Pleurotus citrinopileatus mushroom by the assisted extraction of a combination of ultrasonic waves and pyrolysis in an aqueous solvent at 100°C, then evaluation of the biological activity of the extract to orient the application of functional foods to support cancer treatment. Some of the conditions of the Pleurotus citrinopileatus extraction process documented through the study are as follows: The solvent used for extraction was water, sodium chloride salt was used as a catalyst, with a ratio of 1g NaCl:100 ml of solution, the sample was ultrasonically processed for 60 min and magnetic stirred at 100°C for 2 hours, the concentration of Na_2CO_3 participating in the reaction was 20%, HCl concentration was 2M, the ratio of IPA treatment/mushroom residue was 1:1 (v/v). From Pleurotus citrinopileatus mushroom powder, the research team successfully obtained β- glucan.*

I. INTRODUCTION

Functional food was first used by the Japanese in the 1980s to refer to processed foods that contain ingredients that have little nutritional value but help improve users' health [1]. Pleurotus citrinopileatus is rich in protein, fiber, essential amino acids, carbohydrates, water-soluble vitamins, and minerals [2]. With 22.10% protein and 20.78% fiber while fat only 1.32%, Pleurotus citrinopileatus is a nutritionally balanced food that is good for the body's absorption [3]. Besides, Pleurotus citrinopileatus also has many vitamins and minerals, supplementing trace elements for the body [3]. A study in the journal "Agricultural and Food Chemistry" demonstrated that a glycoprotein in this mushroom, symbol PCP-3A, is very effective in treating blood cancer [4]. Pleurotus citrinopileatus mushroom extract contains a large amount of Ergothioneine, which has a strong antioxidant effect and a substantial effect on the immune system [5].

One of the active ingredients that contributes to a strong immune stimulus found abundantly in Pleurotus citrinopileatus mushrooms is β-1,3-glucan [6]. β-glucan,

when entering the body, will produce two effects: Activating cells of the immune system to ensure they function at the most optimal level; Rapid increase in the number of immune cells [7][8]. β-glucan - a polysaccharide of natural origin present in the cell walls of plants, bacteria, and fungi [9] [10]. Some studies have shown that β-glucan helps improve health status in several ways, such as immunomodulatory, antitumor, antiviral [11] [12], cardiovascular activities, hepatoprotective, anti-inflammatory [13], radiation protection [14], anti-diabetic [15], antioxidant [16], antibacterial [17]. β-Glucan enhances adaptive immune responses that inhibit tumor growth and metastasis [18] [19] and is approved as an immuno-supportive therapy in cancer treatment in some countries [20]. Because of the great uses of β-glucan, β-glucan extraction is always of interest. Many studies have been conducted aimed at obtaining high-purity β-glucan. Some of the main extraction methods used are hot water extraction [16], alkaline extraction [22], enzymatic extraction [23], and ultrasound/microwave-assisted extraction [24]. This paper presents some research results on the process of extracting β-glucan from Pleurotus citrinopileatus by the method of assisted extraction of a combination of ultrasonic techniques and pyrolysis in an aqueous solvent at 100°C, then evaluation of the biological activity of the extract to orient the application of functional foods to support cancer treatment to orient the application of functional foods to help cancer treatment.

II. EXPERIMENTS

2.1. Chemicals - Equipment

- Chemicals: Dried Pleurotus citrinopileatus powder (Mushrooms raised at Liangshan Mushroom Farm by VIETRAP Company), distilled water, 20% sodium carbonate (Na_2CO_3) solution (China), 2M hydrochloric acid (HCl) (China), 99% isopropyl alcohol (IPA) solution (China) and sodium chloride (NaCl).

- Tools and equipments: UV-Vis Spectrophotometer (UV-Vis Drawell D8200), ultrasound machine; heating magnetic stirrer; centrifuge; drying cabinets; refrigerator; pH meter; analytical scales.

2.2. Extraction process of β-glucan from Pleurotus citrinopileatus

- Weigh precisely 16.7g of dried Pleurotus citrinopileatus mushroom powder in a 1000ml cup, then add 5g of sodium chloride and 500 ml of distilled water to the cup. Ultrasound was conducted for 60 min at room temperature, after which the mixture was stirred at 100°C for 2 hours at a stirring rate of 3/4. Take the resulting mixture to centrifugation at 3,500 rpm for 15 minutes. After centrifugation, try the solution after separating the solid residue (mushroom extract).

- The mushroom extract was adjusted to pH = 10 with a 20% solution of Na_2CO_3, then stirred at 50°C for 30 minutes at 1/4 speed. Then, centrifuging the mixture for 15 minutes at 3,500 rpm, the extract after the second centrifugation was adjusted to pH = 4 with a 2M HCl solution. Add the correct amount of isopropyl alcohol (IPA) to the volume of the mixture, then continue centrifuging at 3,500 rpm for 15 minutes. The pulp is dried at 80°C for 4-6 hours, weighing the volume is again to evaluate performance. Determination of β-glucan by UV-Vis photometric method at a wavelength of 265 nm on the Drawel instrument at the Institute of Chemistry-Materials.

The content of β-glucan extracted from the extraction technology process is calculated according to the formula:

$$m_{\beta\text{-glucan (theoretical)}} = m_{P.citrinopileatus} \times 21{,}4\% \quad (1)$$

Where: $m_{\beta\text{-glucan (theoretical)}}$: Theoretical β-glucan mass

$m_{P.citrinopileatus}$: Mass of mushroom powder Pleurotus citrinopileatus

21,4%: Percentage of β-glucan mass in Pleurotus citrinopileatus

The formula calculates the extraction efficiency:

$$H = (m_{\beta\text{-glucan (experimental)}}/m_{\beta\text{-glucan (theoretical)}})*100\% \quad (2)$$

Where: H: Extraction efficiency of β-glucan from Pleurotus citrinopileatus

$m_{\beta\text{-glucan (experimental)}}$: Experimantal β-glucan mass

$m_{\beta\text{-glucan (theoretical)}}$: Theoretical β-glucan mass

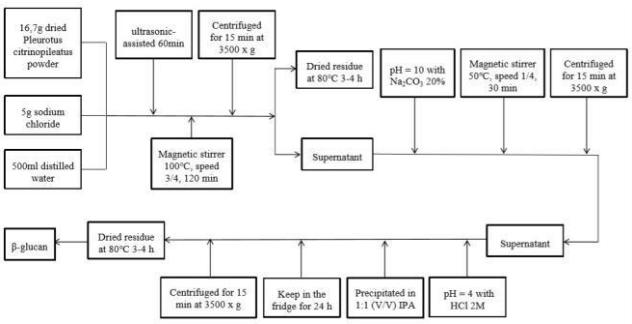


Fig 1. Extraction process of β-glucan from Pleurotus citrinopileatus

2.3. Evaluation of β-glucan extraction from Pleurotus citrinopileatus

Based on UV-Vis photometric analysis technique to evaluate the β-glucan content in samples with different extraction conditions. The β-glucan content calibration in

aqueous solvents is formulated from 100ppm, 200ppm, 300ppm, 400ppm, and 500ppm.

The calibration curve for the β-glucan content of water at a characteristic wavelength (257 nm) is shown in Figure 1. The calibration equation is:

$$y = 95{,}487x + 1{,}335 \quad (3)$$

Where: y: concentration of β-glucan (ppm)

x: adsorption intensity (au)

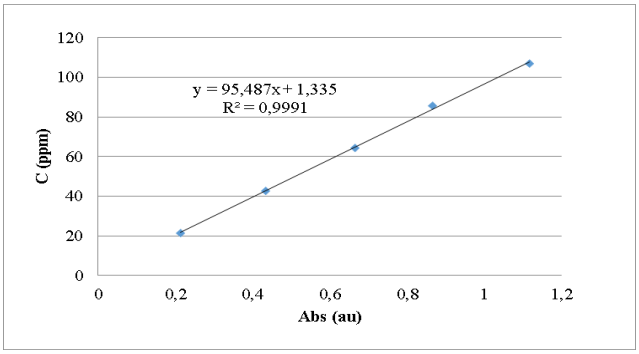


Fig 2.β-glucan content calibration curve

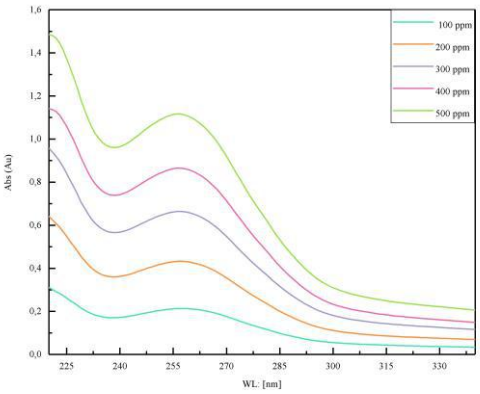


Fig 3. UV-Vis spectrum of β-glucan

2.4 Evaluation of the antioxidant capacity and cell proliferation ability of Pleurotus citrinopileatus mushroom extract

2.4.1 DPPH antioxidant capacity evaluation test

Mushroom extracts were determined for antioxidant capacity using the DPPH method by Abramovič et al. (2018) with modifications to suit laboratory conditions. The suction of the studied sample (100 µL) mixed at concentrations of 100 – 20 – 4 – 0.8 mg/mL, add 100 µ L DPPH 0.25 µM in methanol (100%), then incubate at room temperature for 30 minutes in the dark. The absorption of the reaction is read at a wavelength of 517 nm. The DPPH free radical scanning operation is calculated using the equation:

$$\%\ SA = (OD_{control} - OD_{sample})*100/OD_{control}\ (\%) \quad (4)$$

Where: $OD_{control}$: Optical density at the well does not contain reagents (minus OD blank)

OD_{sample}: Optical density at the well containing the reagent (minus OD blank)

2.4.2 MDA antioxidant capacity evaluation test

- Mushroom extracts were determined for their antioxidant capacity through MDA testing performed according to the methods of Badmus et al. (2011) and Hodges et al. (1999), with slight modifications to suit laboratory conditions. Aspiration of the studied sample (0.2 mL) mixed at concentrations of 1000 – 200 – 40 – 8 mg/mL reacted with 1 mL of isologous liver fluid and an additional 0.7 mL phosphate buffer, together with 0.1 mL of the Fenton system. The system is sufficient for 2 mL, and the sample concentration in the test tube is reduced ten times to 100 – 20 – 4 – 0.8 mg / mL.

- Take 1mL of mouse liver isotope fluid added to 0.1 mL of the test sample at concentrations and 0.8mL phosphate buffer, and add 0.1mL of Fenton system ($FeSO_4$ 0,1 mM: H_2O_2 15 mM at 1:1 ratio). Incubate the mixture at 37°C for 15 minutes.

- Stop the reaction with 1 mL of 10% trichloroacetic acid. Centrifugal 12000 turns in 5 minutes.

- Clear fluid reacts with 1 mL of 0.8% thiobarbituric acid (in a ratio of 2:1). Incubate at 100°C for 15 minutes. Cool and take measurements at wavelength λ = 532 nm.

The formula for calculating antioxidant activity percentage (HTCO)

$$HTCO\ (\%) = [(ODC - ODT)/ODC] \times 100 \quad (5)$$

Where: OD_C: Optical density of certification wells without test specimens (minus OD blank)

OD_T: Optical density of test specimen (minus OD blank)

2.4.3 MTT proliferate cell ability evaluation test

- Mushroom extracts were determined for immune cell proliferation through MTT testing by Tim Mosmann (1983) with macrophage cell lines at the Institute of Biotechnology.

- After adjustment for appropriate cell density, put 190 mL of cells into the wells of the 96-well tray that already had 10 µL of reagent. On the same test dish, several wells were arranged as a control with no test samples, only the sample phase solvent was DMSO 1%. The well has no cells and specimens, only the culture medium is considered a blank wall.

- Place the culture dish in the CO_2 incubator at 37°C, 5% CO_2, culture for 72 hours.

- After 72 hours, 10 µL MTT (final concentration is 5 mg/mL) is added to each well.

- After 4h, removing the medium, formazan crystals are dissolved by 50 µL (DMSO) 100%. The OD value was measured at a wavelength of 540 nm using a BioTek spectrometer.

The percentage of cell proliferation induction in the presence of a reagent will be determined through the following formula:

$$\% \text{ proliferation} = (OD_{sample} - OD_{blank})/(OD_{DMSO} - OD_{blank}) \quad (6)$$

Where: OD_{sample}: Optical density of the sample

OD_{DMSO}: Optical density of DMSO 1%

OD_{blank}: Optical density of blank well

III. RESULT AND DISCUSSION

3.1. Evaluation of β-glucan extraction efficiency in Pleurotus citrinopileatus mushroom

Conducting UV-Vis spectroscopy measurements from solid samples obtained a maximum UV absorption result at a wavelength of 256 nm (figure 4), similar to the results obtained on β-glucan spectroscopy published by Pawadee Methacanon et al. (2011). Thus, the team successfully isolated β-glucan from Pleurotus citrinopileatus.

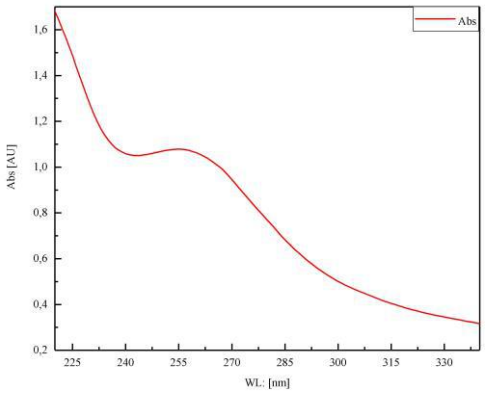


Fig 4. UV-Vis spectroscopy of experimentally obtained β-glucan

From 16.7 grams of Pleurotus citrinopileatus mushroom powder after the extraction process, 0.363 grams of β- glucan is obtained. The efficiency of the β-glucan extraction process in Pleurotus citrinopileatus mushrooms is about 10.157%.

Effects of extraction techniques

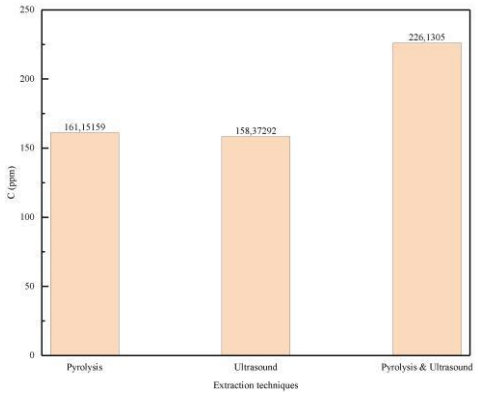


Fig 5.Effect of technique on the β-glucan content obtained

In addition to conventional pyrolysis extraction techniques, the research team surveyed with ultrasound-assisted extraction techniques. The results showed that the extracted β-glucan content was optimal under the same extraction conditions when combining two methods, pyrolysis, and ultrasound (figure 5). This is explained by the cavitation phenomenon caused by ultrasonic waves, this energy destroys the cell wall, allowing water to penetrate higher into which cell wall of the mushroom powder particle. Bhaskaracharya et al. (2009) and Patist and Bates (2008) both believe that the energy generated from bursting air bubbles (cavitation) breaks cell walls and increases the release of cellular materials such as polysaccharides. However, if the ultrasound time is increased, there will be a decrease in the β-glucan extraction yield. This indentation is due to the side effect of ultrasound waves on destroying the β-glucan chain [24]. Therefore, when combining two pyrolysis and ultrasonic techniques, the research team developed a shorter ultrasound time than the pyrolysis time.

Effect of extraction temperature

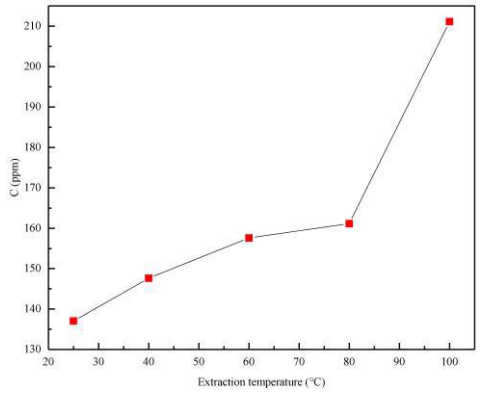


Fig 6.Effect of temperature on the β-glucan content obtained

Figure 6 shows a significant effect of temperature on the extraction yield of β-glucan. The β-glucan content gradually increased from 40°C to 80°C and spiked from 80°C to 100°C. The solvent used is water, with a boiling point of 100°C. Based on the severity coefficient equation to evaluate the hydrolysis reactions [25], the research team surveyed the extracted β-glucan content. at different temperatures (room temperature - 40°C - 60°C - 80°C - 100°C). The obtained β-glucan content increased with temperature. The change in water properties when the temperature is increased to 100°C helps to weaken the bond between the studied polysaccharide and the fungus Pleurotus citrinopileatus, promoting the release of β-glucan. However, Óscar Benito-Román et al. (2016) have shown that if the temperature is raised above 100°C, the hydrolysis kinetics will increase significantly and dominate the increase in solubility [26]. Specifically, maximum β-glucan content is rapid at temperatures above 100°C, hydrolysis of soluble β-glucan occurs almost instantaneously, with major products being detected. In this process are: cellobiose, glucose, fructose, pyruvaldehyde, and HMF [26]. Therefore, the team used 100°C in an aqueous solvent as the optimal β-glucan extraction condition.

Effects of extraction time

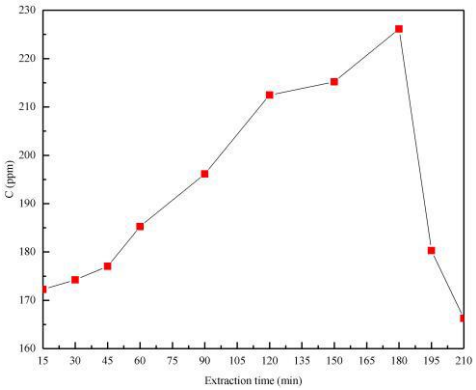


Fig 7.Effect of extraction time on β-glucan content obtained when extracted at 100°C

In addition to temperature, time also affects the performance of the extraction process. The content of extracted β-glucan gradually increases with increasing extraction time from 15 minutes to 3 hours and decreases sharply when the extraction time is more than 3 hours. With the same extraction temperature of 100°C, the results in Figure 7 shows that the longer the β-glucan is exposed to high temperatures, the higher the decomposition, so β-glucan after being dissolved, the sterilization process (rated in MW) takes place, the longer the high-temperature exposure, the lower the MW. Therefore, after investigating the β-glucan content extracted at 100°C for different periods, the research team concluded that the maximum extraction time of β-glucan from Pleurotus citrinopileatus is 3 hours. The content decreases markedly after 3 hours of extraction.

Effect of catalyst

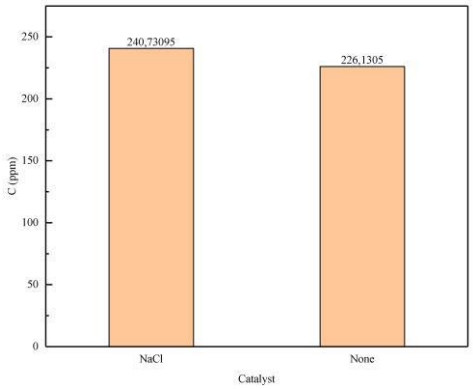


Fig 8. Effect of catalyst on the β-glucan content obtained

After evaluating the effects of extraction technique, temperature, and time on the process, the team investigated the impact of the catalyst on the β-glucan content obtained. Sodium chloride salt is used as a catalyst, with a ratio of 1g catalyst: 100 ml of solution. Figure 8 shows that the β-glucan content obtained is higher when using NaCl as a catalyst. Adding NaCl decreases the solubility of organic analytes and increases the distribution constant, reducing the organic analytes' solubility in the aqueous phase due to the salting-out effect, which is often favorable for extraction [27]. Therefore, the research team proposed the conditions for extracting β-glucan from Pleurotus citrinopileatus: Catalyst ratio 1g NaCl: 100ml solution, combining two pyrolysis techniques and ultrasound-assisted, extraction temperature is 100°C and extraction time is 3 hours.

3.2. Evaluation of the antioxidant capacity of Pleurotus citrinopileatus mushroom extract

3.2.1 Antioxidant Activity Test (DPPH Method)

The results of determining the antioxidant activity of mushroom extract through the DPPH free radical neutralization test are shown in Figure 8. DPPH's ability to neutralize free radicals increases as the concentration of the sample increases. Pleurotus citrinopileatus mushroom extract demonstrated antioxidant activity through DPPH's free radical neutralization test with IC values of 50 = 41.22 ± 2.94 (mg/ml). This indicates that Pleurotus citrinopileatus mushroom extract exhibits antioxidant capacity, so Pleurotus citrinopileatus mushroom can

potentially apply functional foods to support cancer treatment.

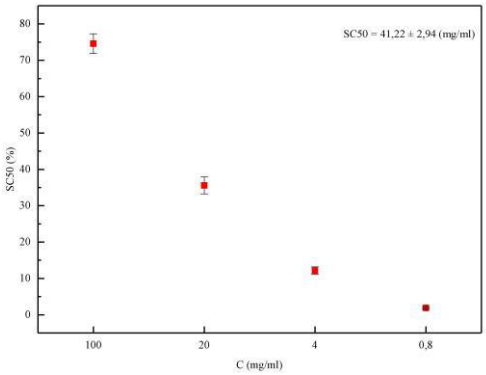


Fig 9. DPPH's ability to neutralize free radicals of mushroom extracts

3.2.2 Lipid Antioxidant Activity Test (MDA Method)

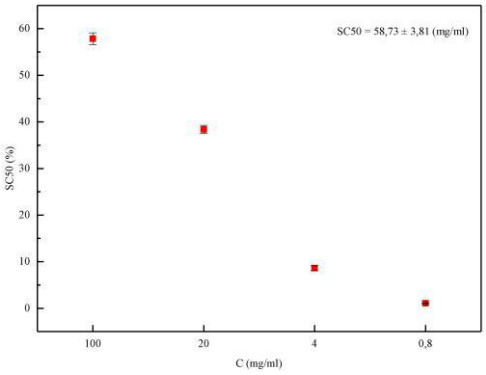


Fig 10.Ability to inhibit lipid peroxidation (MDA test) of mushroom extract

Lipid peroxidation is a mixture of extreme reaction products of lipid peroxidation, a standard process in all biological systems, and hurts cell membranes and DNA [28]. Malondialdehyde (MDA) is a primary oxidation product of peroxidized polyunsaturated fatty acids, and low MDA content has been used as an essential indicator of cell membrane lipid peroxidation [29]. As shown in Figure 9, the inhibition of lipid peroxidation of Pleurotus citrinopileatus mushroom extract intensifies with increasing concentration. The above results show that Pleurotus citrinopileatus mushroom extract exhibited antioxidant activity through lipid peroxidation inhibition test with IC_{50} = 58.73 ± 3.81 (mg/ml). Therefore, Pleurotus citrinopileatus mushroom can potentially apply functional foods to support cancer treatment.

3.3 Evaluation of cell proliferation capacity of Pleurotus citrinopileatus mushroom extract

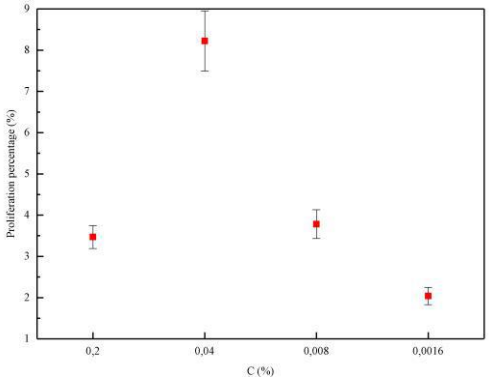


Fig 11.Macrophage cell proliferation capacity of mushroom extract

The cell proliferation capacity of Pleurotus citrinopileatus extract was evaluated through MTT, using tetrazolium salt (MTT-(3-(4,5-dimethylthiazol-2-yl)- 2,5-diphenyltetrazolium)) as a reagent in colorimetry, thereby assessing cell survival and growth. The results shown in Figure 10 show that the cell's ability to survive and grow is affected by the sample solution concentration. Pleurotus citrinopileatus mushroom extract exhibits macrophage cell proliferation induction activity at a concentration of 0.04%, the percentage of cell proliferation decreases significantly with increasing concentration. Thus, the extract of Pleurotus citrinopileatus mushroom can promote cell survival and proliferation, opening up potential applications in preparing functional foods to support cancer treatment.

3.4 Evaluation of the stability of Pleurotus citrinopileatus mushroom extract

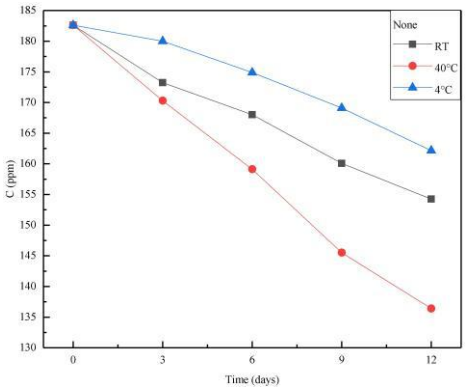


Fig 12. Stability of the extract under the additive-free condition

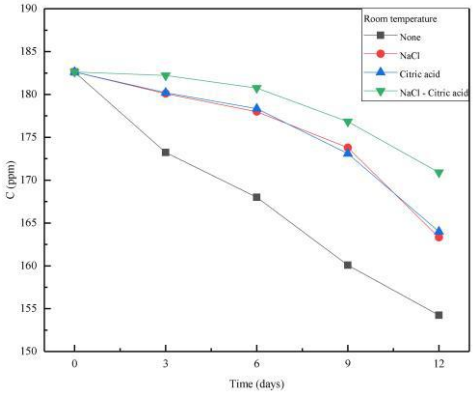


Fig 13. Stability of the extract under the additive condition

The research team evaluated the stability of the Pleurotus citrinopileatus mushroom extract in the laboratory for one week, provided there were no additives (Figure 12) and additives (Figure 13). The results in Figure 12 show that after a week of storage in the absence of additives, the β-glucan content decreased rapidly at 40°C, gradually decreased at room temperature, and was the least changed at 4°C. Besides, the stability of the extract is also affected in the presence of additives. Figure 13 shows that, after one week, the retention of β-glucan was higher in the fact of the additive, and it was highest in the presence of the two additives, NH_4Cl, and citric acid. These results supported our hypothesis that the β-glucan content in the mushroom extract can break down over time and that storage conditions will affect their stability. The ideal conditions for preserving the extract are refrigerated storage and the presence of two additives, NH_4Cl, and citric acid.

IV. CONCLUSION

Through the research process, the research team determined the optimal parameters for the Pleurotus citrinopileatus extraction process recorded through the study as follows: The solvent used for extraction was water, the sample was ultrasonically treated for 60 min and magnetic stirred at 100°C for 2 hours, the concentration of Na_2CO_3 participating in the reaction is 20%, the concentration of HCl is 2M, the ratio of treated IPA / fungal residue is 1: 1 (v/v). From the mushroom powder Pleurotus citrinopileatus, the thematic group successfully obtained β- glucan. Pleurotus citrinopileatus mushroom extract achieved antioxidant capacity through DPPH free radical neutralization test with IC value 50 = 41.22 ± 2.94 (mg/ml) and lipid peroxidation inhibition test with IC value50 = 58.73 ± 3.81 (mg/ml). In addition, mushroom extract can proliferate cells through MTT testing, which proves that Pleurotus citrinopileatus extract is a potential food source in the application of cancer treatment supplements.

ACKNOWLEDGMENTS

This study was financially supported by Institute of Chemistry and Materials, VIETNAM.

REFERENCES

[1] *Functional Foods Research*. (2010). Retrieved from United States Department of Agriculture, Agricultural Research Service.

[2] A.B. Boraston, A. L.-B. (2007). Carbohydrate–Protein Interactions: Carbohydrate-Binding Modules. 3, 661-696. doi 10.4489/MYCO.2008.36.4.228.

[3] Abdollah Hematian Sourki, A. K. (2017). *Ultrasound-assisted extraction of β-d-glucan from hull-less barley: Assessment of physicochemical and functional properties.* 95, 462-475. doi: 10.1016/j.ijbiomac.2016.10.111.

[4] Andrea T.Borchers, C. L. (2004). *Mushrooms, tumors, and immunity: An update.* 229 (5), 393-403. doi: 10.1177/153537020422900507.

[5] B.A. Freeman, J. C. (1981). *Hyperoxia increases oxygen radical production in rat lung and lung mitochondria. Journal of Biological Chemistry, 256, 10986–10992.* doi.org/10.1016/S0021-9258(19)68544-3.

[6] Bin Du, F. Z. (2014). *β-Glucan extraction from bran of hull-less barley by accelerated solvent extraction combined with response surface methodology.* 59 (1), 95-100. doi.org/10.1016/j.jcs.2013.11.004.

[7] Bin Du, Z. B. (2014). *A review of skin health promotion effects of natural beta-glucan derived from cereals and microorganisms.* 28(2), 159-166. doi: 10.1002/ptr.4963.

[8] C. Schacht, C. Z. (2008). *From plant materials to ethanol using supercritical fluid technology.* 46, 299-321. doi.org/10.1016/j.supflu.2008.01.018.

[9] Chao Deng, Z. H. (2012). *Chemical analysis and antioxidant activity in vitro of a β-D-glucan isolated from Dictyophora indusia.* 51 (1–2), 70-75. doi: 10.1016/j.ijbiomac.2012.05.001.

[10] Chen, J.-N., Wang, Y.-T., & Wu, J. S.-B. (2009). A Glycoprotein Extracted from Golden Oyster Mushroom Pleurotus citrinopileatus Exhibiting Inhibitory Growth Effect against U937 Leukemia Cells. 57(15), 6706-6711. doi: 10.1021/jf901284s.

[11] Dong Hee Lee, H. W. (2014). *Innate Immunity Induced by Fungal β-Glucans via Dectin-1 Signaling Pathway.* 16 (1), 85–94. doi: 10.1615/intjmedmushr.v16.i1.10.

[12] Elena De Marco Castro, P. C. (2020). *β-1,3/1,6-glucans and Immunity: State of the Art and Future Directions.* 65 (1). doi: 10.1002/mnfr.201901071.

[13] Galappaththi MCA, D. L. (2021). Nutritional and medicinal benefits of Oyster (Pleurotus) mushrooms: a review. 1(2), 65-87.
DOI:10.5943/FunBiotec/1/2/5.

[14] Jicheng Liu, Y. S. (2012). *Purification and identification of one glucan from golden oyster mushroom (Pleurotus citrinopileatus (Fr.) Singer).* 87(1), 348-352.
doi: 10.1016/j.carbpol.2011.07.059.

[15] Kankan K Maity, S. P. (2013). *A β-glucan from the alkaline extract of a somatic hybrid (PfloVv5FB) of Pleurotus florida and Volvariella volvacea: structural characterization and study of immunoactivation.* 370, 13-18.
doi: 10.1016/j.carres.2013.01.016.

[16] Karren D Beattie, R. R. (2010). *Antibacterial metabolites from Australian macrofungi from the genus Cortinarius.* 71 (8–9), 948-955.
doi: 10.1016/j.phytochem.2010.03.016.

[17] Kenji Ina, T. K. (2013). *The use of lentinan for treating gastric cancer.* 3(5), 681-688.
doi: 10.2174/1871520611313050002.

[18] Kubow, S. (1995). *Routes of formation of toxic consequences of lipid oxidation products in foods. Free Radical Biology and Medicine.* 12, 63-81.
doi: 10.1016/0891-5849(92)90059-p.

[19] Kwang-Ho Lee, et al. (2014). *Bacterial β-(1,3)-glucan prevents DSS-induced IBD by restoring the reduced population of regulatory T cells.* 219(10), 802-812.
doi: 10.1016/j.imbio.2014.07.003.

[20] Mohammad-Fata Moradali, H. M.-A. (2007). *Immunomodulating and anticancer agents in the realm of macromycetes fungi (macrofungi).* 7 (6) 701-724.
doi: 10.1016/j.intimp.2007.01.008.

[21] Nuhu Alam, R. A. (2008). Nutritional Analysis of Cultivated Mushrooms in Bangladesh - Pleurotus ostreatus, Pleurotus sajor-caju, Pleurotus florida and Calocybe indica. 36(4), 228-232.
doi: 10.4489/MYCO.2008.36.4.228.

[22] Óscar Benito-Román, A. M.-C. (2016). *Dissolution of (1-3),(1-4)-β-Glucans in Pressurized Hot Water: Quantitative Assessment of the Degradation and the Effective Extraction.*
doi.org/10.1155/2016/2189837.

[23] Taek Joon Yoon, S. K. (2013). *The Effects of β-glucans on Cancer Metastasis.* 13(5), 699-708.
doi: 10.2174/1871520611313050004.

[24] Tina Immerstrand, B. B. (2009). *Extraction of β-Glucan from Oat Bran in Laboratory Scale.* 86 (6), 601-608.
doi: 10.1017/S0007114510000553.

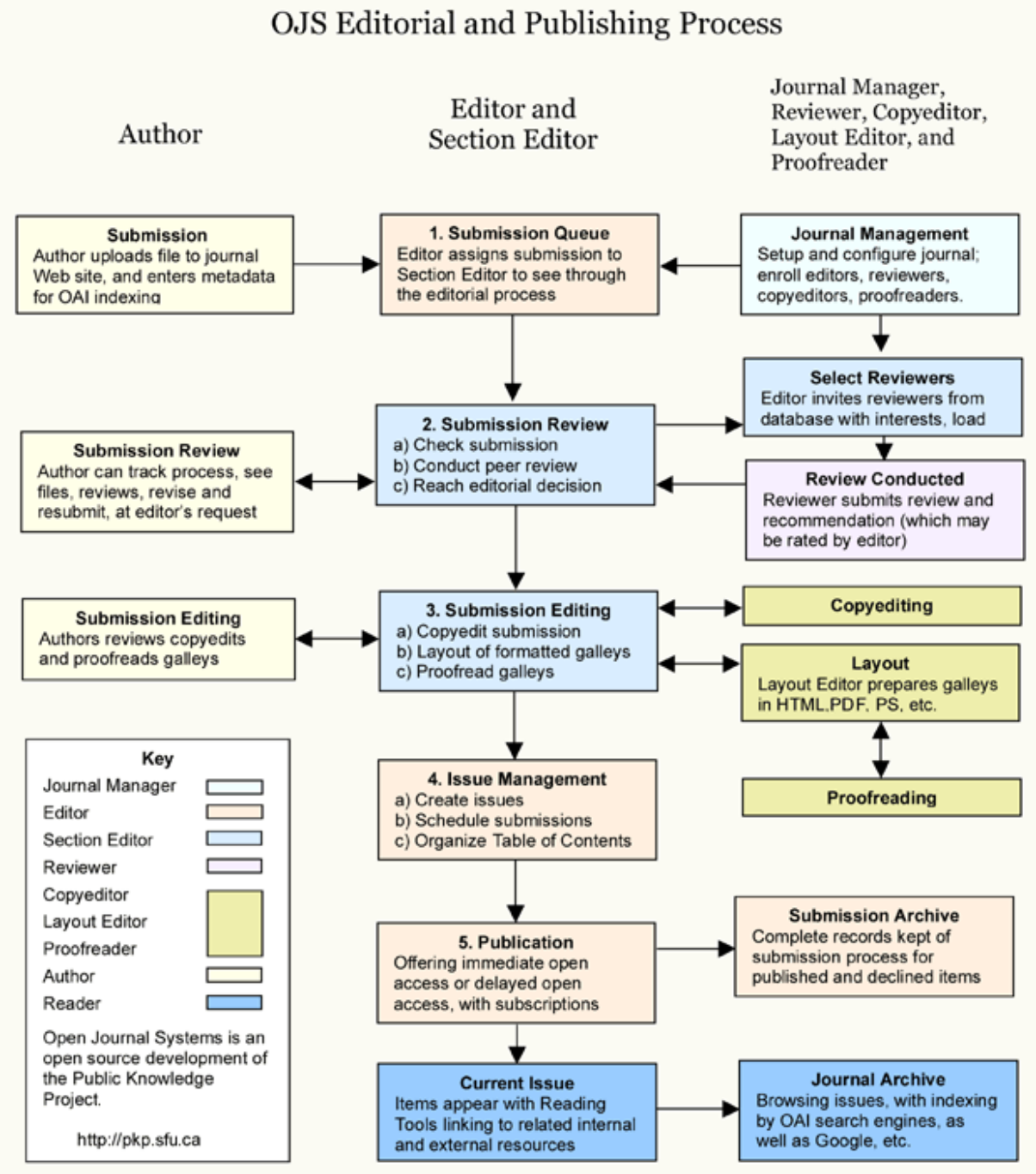
[25] Thulasi G Pillai, P. U. (2013). *Mushroom beta glucan: potential candidate for post irradiation protection.* 751 (2), 109-115.
doi: 10.1016/j.mrgentox.2012.12.005.

[26] Ulrike Lindequist, et al (2005). *The Pharmacological Potential of Mushrooms.* 2(3), 285-299. doi: 10.1093/ecam/neh107.

[27] Lu Wang, X. Z. (2014). *Graphene oxide as a micro-solid-phase extraction sorbent for the enrichment of parabens from water and vinegar samples.* 37 (13), 1656-1662.
doi: 10.1002/jssc.201400028.

[28] Yea-Woon Kim, K.-H. K.-J.-S. (2005). *Anti-diabetic activity of β-glucans and their enzymatically hydrolyzed oligosaccharides from Agaricus blazei.* 27,483–487.
doi: 10.1007/s10529-005-2225-8.

[29] Yu-LingLee, G.-W. H.-C.-L. (2007). *Antioxidant properties of three extracts from Pleurotus citrinopileatus.* 40 (5), 823-833.
DOI:10.1016/j.lwt.2006.04.002.



~IJAERS Workflow~

Important links:

Paper Submission Link:
https://ijaers.com/submit-paper/
Editorial Team:
https://ijaers.com/editorial-board/
Peer Review Process:
https://ijaers.com/peer-review-process/
Publication Ethics:
https://ijaers.com/publication-ethics-and-publication-malpractice-statement/
Author Guidelines:
https://ijaers.com/instruction-to-author/
Reviewer Guidelines:
https://ijaers.com/review-guidelines/

Journal Indexed and Abstracted in:

- Qualis-CAPES (A2)-Brazil
- Normatiza (Under Review-Ref.020191511)
- NAAS Score: 3.18
- Bielefeld Academic Search Engine(BASE)
- Aalborg University Library (Denmark)
- WorldCat: The World's Largest Library Catalog
- Semantic Scholar
- J-Gate
- Open J-Gate
- CORE-The world’s largest collection of open access research papers
- JURN
- Microsoft Academic Search
- Google Scholar
- Kopernio - powered by Web of Science
- Pol-Index
- PBN(Polish Scholarly Bibliography) Nauka Polaska
- Scilit, MDPI AG (Basel, Switzerland)
- Tyndale University College & Seminary
- Indiana Library WorldCat
- CrossRef DOI-10.22161/ijaers
- Neliti - Indonesia's Research Repository
- Journal TOC
- WIKI-CFP
- Scinapse- Academic Search Engine
- Mendeley-Reference Management Software & Researcher Network
- Dimensions.ai: Re-imagining discovery and access to research
- Index Copernicus Value(ICV): 81.49
- Citeseerx
- Massachusetts Institute of Technology (USA)
- Simpson University (USA)
- University of Louisville (USA)
- Biola University (USA)
- IE Library (Spain)
- Mount Saint Vincent University Library (Halifax, Nova Scotia Canada)
- University Of Arizona (USA)
- INDIANA UNIVERSITY-PURDUE UNIVERSITY INDIANAPOLIS (USA)
- Roderic Bowen Library and Archives (United Kingdom)
- University Library of Skövde (Sweden)
- Indiana University East (campuslibrary (USA))
- Tilburg University (The Netherlands)
- Williams College (USA)
- University of Connecticut (USA)
- Brandeis University (USA)
- Tufts University (USA)
- Boston University (USA)
- McGill University (Canada)
- Northeastern University (USA)
- BibSonomy-The blue social bookmark and publication sharing system
- Slide Share
- Academia
- Archive
- Scribd
- ISRJIF
- Cite Factor
- SJIF-InnoSpace
- ISSUU
- Research Bib
- infobaseindex
- I2OR
- DRJI journal-repository

AI Publication
International Journal of Advanced Engineering Research and Science (IJAERS)
104/108, Sector-10, Pratap Nagar, Jaipur, India