International Journal of Advanced Engineering Research and Science (IJAERS)
Peer-Reviewed Journal
ISSN: 2349-6495(P) | 2456-1908(O)
Vol-9, Issue-12; Dec, 2022
Journal Home Page Available: https://ijaers.com/
Article DOI: https://dx.doi.org/10.22161/ijaers.912.68

Production and Purification of Alcohol from Fermentation of Nira Aren (*Arenga Pinnata Merr*)

Hamsina Hamsina[1], Algazali[1], M. Tang[1], Hermawati[1], Hizkia T. Paniago[1], Zulkifli Maulana[2], Ruslan Hasani[3]

[1]Engineering Faculty, University of Bosowa, Jl.Urip Sumoharjo Km.04 Makassar 90231 Indonesia
[2]Agriculture Faculty, University of Bosowa, Jl. Urip Sumoharjo Km.04 Makassar 90231 Indonesia
[3]Nursing Departement, Health Politechnic of Makassar, Jl. Monumen Emmy Saelan III No.1 Makassar 90221 Indonesia

Received: 17 Nov 2022,

Receive in revised form: 11 Dec 2022,

Accepted: 17 Dec 2022,

Available online: 31 Dec 2022

Keywords*— *Alcohol, distillation, fermentation, palm Sap

***Abstract*—** *Alcohol is one of the chemicals produced from plants that contains starch, sugar and lignocellulose. Alcohols produced from plants containing starch, sugar and lignocellulose are usually referred to as bioethanol. In general, ethanol/bioethanol has very broad benefits such as being used as raw material for alcohol-derived industries, basic ingredients for the pharmaceutical industry, as an antiseptic, as a preservative, solvent and can also be used as a fuel mixture for vehicles. The aims of study are determine the optimum combination of palm juice fermentation time to produce alcohol and determine the increase in alcohol content after distillation. The method used in this research is an experimental method, calculating the length of fermentation time and determining the alcohol content after distillation. The results showed that: The length of time the palm sap fermentation had an effect on the alcohol content of the palm sap, with the optimum fermentation time for 48 hours, which was 5.5%; The process of distillation of palm sap stage I at 48 hours of fermentation with a volume of 3 liters obtained as much as 410 ml of alcohol with a level of 47%. Then phase II distillation was carried out to increase the alcohol content to a higher level, obtained 112 ml of alcohol with an alcohol content of 89%; The alcohol yield resulting from the distillation of 3 liters of palm sap for 90 minutes was 3.37%.*

I. INTRODUCTION

Alcohol is one of the chemicals produced from plants that contains starch, sugar and lignocellulose. Alcohols produced from plants containing starch, sugar and lignocellulose are usually referred to as bioethanol. In general, ethanol/bioethanol has very broad benefits such as being used as raw material for alcohol-derived industries, basic ingredients for the pharmaceutical industry, as an antiseptic, as a preservative, solvent and can also be used as a fuel mixture for vehicles.

Bioethanol raw materials are plants that contain starch, sugar and lignocellulose. Cassava and corn have long been the main commodities of raw materials for ethanol production. Whether we realize it or not, the development of bioethanol production made from food commodities will create new problems in terms of national food security, so it is very risky if it is developed on a large scale.

Indonesia's natural wealth of biodiversity has opened up opportunities for us to research what plants have the most potential as raw materials for making ethanol apart from staple foods. One of the sugar-producing plants that can be used as raw material for bioethanol is palm sap. Sugar palm (Arenga pinnata Merr)

is a plant that easily adapts to the lowlands up to 1400 m above the surface. This plant has benefits in every physical and tree production, such as leaves, stems, fibers, roots, fruit, sap and starch/flour). However, sap is the main product of the plant which is used as palm sugar, vinegar and alcohol. Palm sap can only be stored for 4 hours, because the sap can undergo a natural fermentation process by Saccharomyces cerevisiae which comes from free air during the tapping process or the roof of the tapping place is dirty.

Consuming fresh palm sap can function as a stamina enhancer because it contains glucose, but consuming palm sap with high ethanol content can cause dependence or addiction, relieve stress, sedatives (Rezkiani, 2016), feel happy and can increase self-confidence (Rezkiani, 2016). Maula and Yuniastuti, 2017).

According to Effendi (2010), sugar palm is one of the plants that has the potential as a source of biofuel, namely bioethanol/ethanol. The product that has economic value from the sugar palm plant is the tap water, namely sap. Fresh palm sap has a sweet taste, smells good, is colorless and has a pH of about 5.5-6. The sweet taste of sap is due to the presence of sucrose, glucose, fructose and other sugars. With each composition, namely glucose around 0.4-0.5%, fructose 0.5-0.6% and sucrose around 10-13% (Pontoh, 2007). These three sugars can be fermented into ethanol.

Palm tree sap (Arenga pinnata Merr) is generally used by the people of South Sulawesi to make palm sugar, vinegar and alcoholic beverages by fermentation known as Ballo or some areas in Sulawesi know it as Tuak. This traditional drink in various cases can become an abuse of liquor because in the simple distillation process of palm sap by the community can be obtained about 30 - 45% ethanol. Palm sap (Arenga pinnata Merr.) is the basic ingredient for making alcohol through a fermentation process. The fermentation process has long been known to people because the need for alcohol continues to increase day by day. Alcohol is widely used for needs such as: beverage industry, in the health sector such as pharmaceutical industries and for beauty products. Fermentation is the process of producing energy in cells under anaerobic conditions (without oxygen). In general, fermentation is a form of anaerobic respiration, but there is also a definition that says fermentation is respiration in an anaerobic environment. In the fermentation process under anaerobic conditions alcohol will be formed from sugar and sugar is the main ingredient for the ongoing fermentation process. Some examples of fermentation products are ethanol, lactic acid, and hydrogen. However, several other components can also be produced from fermentation such as butyric acid and acetone. Fermentation of ethanol alcohol and CO_2 by microbes, carbohydrates will be broken down first into simple sugars by hydrolysis of starch into glucose units. The aim study of Determine the optimum combination of palm sap fermentation time to produce alcohol and Determine the increase in alcohol content after distillation.

II. METHODOLOGY

The method used in this research is an experimental method, calculating the length of fermentation time and determining the alcohol content after distillation.

2.1 Preparation phase

The preparation stage is the initial stage before carrying out this research, the preparation stage includes the preparation of tools and materials.

2.2 Implementation Stage

a. Nira Aren Fermentation

1. Fresh palm sap that has been obtained is then filtered to remove impurities carried during the process of taking palm sap.

2. Furthermore, the palm sap is added with yeast with a concentration of 5 g/liter palm sap.

3. Cover and let stand the palm sap for 96 hours.

4. Take samples every 24, 48, 72 and 96 hours, to determine the alcohol content in the palm sap.

5. Open the tutu a little every morning and evening to let the air in the drum out.

b. The Process of Refining Aren's Nira

1. While waiting for the fermentation process to complete, make a distiller with the following materials: pressure cooker, bucket, screw clamp, hose clamp, iron glue, flexible hose, compressor hose, ac hose, water hose, hose clamp, rubber seal, bucket, jerry can .

2. After that enter the palm sap into the distillation pan and then heated.

3. Heat the palm sap until the heating temperature reaches 90°C so that steam is formed which is alcohol, this steam will enter through the distillator pipe and condense the liquid (distillate) which will later drip in the storage jerry can.

4. Reheat the distilled alcohol at 80°C to increase the alcohol content.

III. RESULT AND DISSCUSSION

3.1 Long fermentation time of palm sap

Table 2. The length of time for the fermentation of palm sap.

Fermentation Time (Hour)	Alcohol content (%)
0	0
24	3.7
48	6.5
72	3.5

The raw material used in this research is palm sap which is sold by traditional farmers in Simbang District, Maros Regency. Fermentation is done by adding commercial yeast (fermipan) with a concentration of 5g/liter into the palm sap. The addition of the yeast Saccharomyces cerevisieae to the sap aims to help the process of breaking down sucrose in the nira.

Palm juice liquid can produce alcohol naturally because it has a fairly high sugar content. The main sugar that makes up sap is sucrose, which ranges from 9.2-16.4% (Steive and Lay, 2006). However, sap also contains glucose and fructose, but in small amounts.

Based on Table 2, it is found that the alcohol content increases with the longer fermentation time. This is influenced by the conversion of sucrose into alcohol. The sugar content of sucrose in the sap will turn into glucose and fructose, then the enzyme will convert glucose and fructose into ethanol and carbon dioxide which is characterized by the appearance of an acidic aroma and white foam like foam. as for the fermentation reaction of sucrose into ethanol as shown in Figure 1.

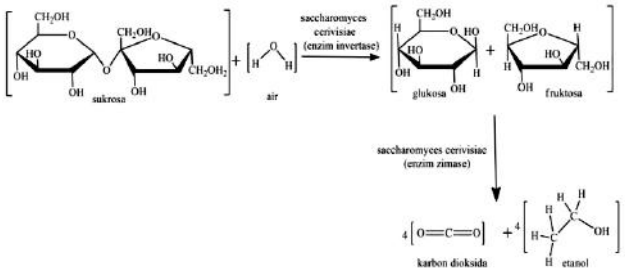

Fig.1. Fermentation reaction of palm sap

The fermentation process in palm sap occurs due to the presence of bacteria or microorganisms. In the palm sap fermentation, the dominant microorganism is found, namely Saccharomyces cerevisiae. Saccharomyces cerevisiae also has two enzymes, namely the invertase enzyme, which is a hydrolase enzyme that functions as a catalyst, to convert sucrose into glucose and fructose or simple sugars, while the zimase enzyme plays a role in converting glucose or simple sugars into ethanol and carbon dioxide. , 2016). In addition, Saccharomyces cerevisiae is also known as a good microorganism in fermenting glucose into ethanol, because it is easily adaptable at 4-32oC, is resistant to high sugar, and produces high levels of fermented ethanol and is also resistant to other microbes (Subrimobdi, 2016) .

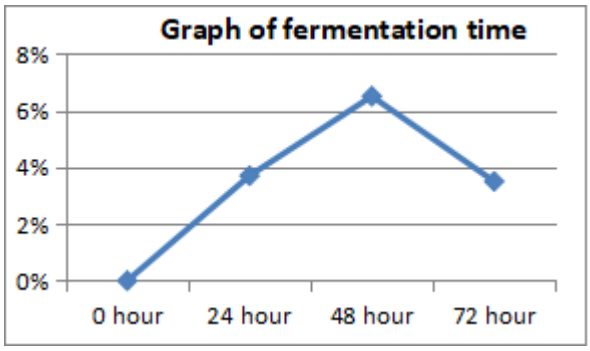

Fig.2. Graph of fermentation time

It can be seen in Figure 2, the optimal fermentation time obtained is at a fermentation time of 48 hours, which is 6.5%, where in this phase Saccharomyces cerevisiae experiences very fast growth, in this phase there is a large-scale breakdown of sugars to meet the growth needs of Saccharomyces cerevisiae. . The result of the breakdown of sugar by Saccharomyces cerevisiae under anaerobic conditions produces alcohol. At 72 hours of fermentation the alcohol content begins to decrease, this is because the number of microbes and nutrients that are present is decreasing, so that the alcohol formed will be broken down or broken down by microbes into vinegar (acetic acid). So for the distillation/distillation stage, a sample of palm sap with a fermentation time of 48 hours is used, because in this phase a lot of alcohol is formed.

3.2 Alcohol Purification

a. Observation of the 1st Distillation Process at a temperature of 70-90 °C

In the distillation process in this study, first the fermented raw materials were poured into a distillation pan and then placed on the stove, and turned on the gas stove which became the heater in this distillation. During the distillation process, the raw material vapor will pass through the fraction tube until it reaches the condenser for the cooling process. After the distillation lasted ± 20 minutes, there was evaporation. The steam in the sap then enters the fractional tube of the distillation apparatus, until the steam reaches the end of the fraction tube which then goes to the condenser and undergoes cooling. The resulting

vapor or gas then condenses and creates a liquid, this liquid which drips into ethanol. This distillation lasts ± 90 minutes. The distillation treatment of palm sap was carried out for ± 90 minutes and the temperature of the palm sap was maintained at a temperature between 70ºC to 90ºC. The results of observations on the distillation process of palm sap are as follows:

Table 3. Observation of the Distillation Process 1

A	B	C	D	E	F
2	3	90	70-90	410	43

Information:

(A) Duration of fermentation (days)

(B) Volume (Liters)

(C) Heating time (minutes)

(D) Temperature (°C)

(E) Volume of alcohol (ml)

(F) Alcohol content (%)

From table 3 it can be seen that the alcohol content after distillation appears to increase with the distillation carried out. the distillation process experienced an increase in ethanol content, where the palm sap distillation process stage I at a 48 hour fermentation time with a volume of 3 liters obtained 410 ml of alcohol with a level of 43%. The increase in alcohol content was caused by the more ethanol that was evaporated during the distillation process. The alcohol content obtained in the first distillation is still very low, this is because there are still many other liquid phases that are evaporated apart from the alcohol which is also evaporated during the distillation process at a temperature of 70-90°C. Therefore, a second distillation is needed to increase the alcohol content of the palm sap.

b. Observation of the 2nd Distillation Process to Purify Alcohol at a temperature of 70-78 °C

The results of observations on the re-distillation process, where the ethanol produced in the first distillation process is distilled again in this distillation, which aims to increase the ethanol content produced. The palm sap re-distillation treatment was carried out for ± 90 minutes and the temperature of the palm sap was maintained at a temperature between 70ºC to 78ºC. The results of observations on the distillation process of palm sap are as follows:

Observations of the re-distillation process can be seen in table 4.

Table 4. Observation of the Re-distillation Process

A	B	C	D	F	F
2	410	90	70-78	112	89

Information:

(A) Duration of fermentation (days)

(B) Volume (Liters)

(C) Heating time (minutes)

(D) Temperature (°C)

(E) Volume of alcohol (ml)

(F) Alcohol content (%)

The ethanol content in the re-distillation process has increased from the ethanol content before re-distillation by 43% to 89%, this happens because in the re-distillation process at a temperature of 70-78°C the water content that is evaporated is slightly compared to the alcohol that is also evaporated. , this happens because of the difference in boiling points between water and alcohol.

3.3 Alcohol Yield from Palm Oil After Re-distillation

Alcohol yield is calculated from the results of measuring the volume of alcohol obtained from the distillation of the fermented palm sap divided by the volume of the base material/initial product (Suastini, 1994).

$$\text{Yield} = \frac{\text{Final Product Volume}}{\text{Initial Product Volume}} \times 100\ \%$$

Table 5. Alcohol yield of palm sap

Duration of fermentation (Days)	Distillation Time (Minute)	Initial Volume (ml)	Final Volume (ml)	Yield (%)
2	90	3000	112	3,73 %

According to Wenur and Waromi (2017) the yield shows the percentage of yield obtained from a refining process. Yield can be observed as a percentage of the yield to the total input of the material or to the amount of evaporated juice. The yield of bioethanol produced from palm sap is presented in Table 5, in Table 5 it can be seen that the yield of alcohol produced from distillation of palm sap is 3.37%. The yield value is not only affected by the distillation temperature, but also greatly influenced by the distillation equipment used, the raw materials and the process/work at the time of distillation. To obtain a large yield, it is necessary to reduce errors during the distillation process, and also to pay attention to the distillation

equipment used whether there is no leakage during the distillation process.

IV. CONCLUSION

Based on the results of the study it can be concluded that:

1. The length of time for fermentation of palm sap affects the alcohol content of palm sap, with an optimum fermentation time of 48 hours, which is 6.5%.
2. The process of distillation of palm sap stage I at a 48 hour fermentation time with a volume of 3 liters obtained 410 ml of alcohol with a level of 47%. Then phase II distillation was carried out to increase the alcohol content to a higher level, obtained 112 ml of alcohol with an alcohol content of 89%.
3. The yield of alcohol produced from the distillation of 3 liters of palm sap for 90 minutes is 3.37%.

REFERENCES

[1] Effendi, D. S. 2010. Prospek pengembangan tanaman aren (Arenga innata Merr) mendukung kebutuhan bioetanol di Indonesia. Jurnal Perspektif. 9(1).

[2] Hidayati, N. 2011. Manfaat Pohon Aren.*(http://niahidayati.net*).

[3] Irmayuni, E., Nurmila dan Sukainah, A. 2018.. Efektivitas air nira lontar (Borassusflaberllifer) sebagai bahan pengembang adonan kue apem. *Jurnal pendidikan teknologi pertanian. 4.*

[4] Joseph, G.H. 2004. Pengolahan gula, cuka, dan alkohol dari nira kelapa. *Laporan Teknis Balai Pengkajian Teknologi Pertanian Sulawesi Utara*.

[5] Joseph, G.H. 2004. Prospek beberapa tanaman palma penghasil gula non tebu dan alkohol. *Prosiding Aplikasi Paket Teknologi Pertanian*. BPTP Sulut.

[6] Karouw, S. dan A. Lay. 2006. Nira aren dan teknik pengendalian produk olahan. *Buletin Palma*.

[7] Lay, A, dan S. Karouw. 2005. Nira aren dan teknik pengendalian produk olahan. *Buletin Palma*.

[8] Maula, Lia khikmatul, and Ari Yuniastuti. 2017. "Analisis Faktor Yang Mempengaruhi Penyalahgunaan Dan Adiksi Alkohol Pada Remaja Di Kabupaten Pati." Public Health Perspective Journal 2(2):168–74.

[9] Muhiddin, D . (2016). Agro Industri Papain dan Pektin. Jakarta: penebar swadaya.

[10] Pontoh, J. 2007. Analisa komponen kimia utama dalam nira aren segar. *Laporan pada Yayasan Masarang*.

[11] Ralph H, Petrucci. .2016. Kimia Dasar II. Jakarta: *Erlangga.*

[12] Riadi, L. 2017. Teknologi Fermentasi. Yogyakarta: *Gaharu Ilmu.*

[13] Richana, N. 2011. Bioetanol: Bahan baku, teknologi, produksi dan pengendalian mutu. *Penerbit Nuansa*. Bandung.

[14] Ridengan, B. dan Karouw, S. 2004. Palm wine aren. *Prosiding Seminar Nasional Pengembangan tanaman Aren Nasional*. Tondano, Minahasa Sulut.

[15] Setiawan, A. 2011. Usaha Membuat Gula Aren : *Keaksaraan Usaha Mandiri. ADF ALE Prima Cipta*: Jakarta Timur.

[16] Setiawan, A. 2018. Usaha Membuat Gula Aren. Rawamangun, Jakarta Timur: *Adfale Prima Citra*

[17] Srena, M. F. 2018. Potensi dan pemanfaatan aren (Arenga pinnata) oleh masyarakat disekitar kawasan taman nasional Batang Gadis. *Skripsi. Institusi USU*. Universitas Sumatera Utara..

[18] Steive, K., Lay, A. 2006. Nira aren dan teknik pengendalian produk olahan. *Buletin Palma*. Manado.

[19] Subrimobdi, W. B. 2016. Studi eksperimental pengaruh penggunaan Saccharomyces cerivisiae terhadap tingkat produksi bioetanol dengan bahan baku nira siwalan. *Tugas Akhir*. Yogyakarta: Universitas Muhammadiyah Yogyakarta..

[20] Tarwiyah, Kemal. 2018. Nira. Padang: Dewan Ilmu Pengetahuan, Teknologi dan Industri Sumatera Barat.

[21] Wenur, F. dan Y. Waromi 2017. Studi Pengolahan Bioetanol Tradisional Dari Nira Aren Di Minahasa Selatan. *Jurnal Teknologi Pertanian* Vol.8 (2): 1-7