International Journal of Advanced Engineering Research and Science (IJAERS)
Peer-Reviewed Journal
ISSN: 2349-6495(P) | 2456-1908(O)
Vol-9, Issue-5; May, 2022
Journal Home Page Available: https://ijaers.com/
Article DOI: https://dx.doi.org/10.22161/ijaers.95.40

Enrichment of multigrain cookies with tomato pomace powder

A.N. Kadam[1], K.A. Mane[2]

[1]MIT School of Food Technology, MIT-ADT University Loni Kalbhor, Pune, India
[2]Dept.of Food Process and Product Engineering, MIT School of Food Technology, MIT-ADT University Loni Kalbhor, Pune, India

Received: 01 May 2022,

Received in revised form: 17 May 2022,

Accepted: 24 May 2022,

Available online: 31 May 2022

Keywords*— *Tomato pomace powder, whole wheat flour, oats, finger millet, by-product, total phenolic content.

Abstract *— Now a days baking industry is one of the large segments of food processing industries. Increased awareness of people led them change the eating pattern and choose healthy food including multigrain flour base products. Tomato pomace, a by-product from tomato processing is a source of valuable bioactive components and can be used in value added product preparation. The study was carried out to utilize tomato pomace powder in multigrain (wheat, finger millet and oats) cookies to assess the nutritive value and cost of prepared multigrain cookies. Multigrain cookies were prepared in four different proportions (whole wheat flour: tomato pomace powder as 31:2, 29:4, 27:6, and 25:8) by replacing the amount of whole wheat flour with the tomato pomace powder and subjected to quality evaluation (physical, sensorial, nutritional and functional) and production cost estimation. The results revealed highest acceptability of multigrain cookies prepared with 6% tomato pomace powder in terms of colour (8.1), taste (7.6), flavor (7.9), texture (7.6) and overall acceptability (7.9). The lycopene content (0.78-1.50mg/100g), beta carotene (30.14-124.15mcg/100g), total phenolic content (0.82-1.34mg GAE/g)and DPPH % inhibition (21.88-40.95%) exhibited increasing trend in developed cookies with increase in tomato pomace powder. The moisture, fat and carbohydrate content were decreased with increase in tomato pomace powder in multigrain cookies, whereas ash, protein and crude fibers showed increasing trend with increase in tomato pomace powder in cookies. The total cost of production for tomato pomace powder (6%) multigrain cookies was estimated as Rs. 200.55per kg.*

I. INTRODUCTION

Now a days, foods are envisioned not only to fulfil hunger and provide important nutrients for humans, but also to avoid nutrition-related illnesses and enhance overall health well-being. (Mudassir and Hafiza, 2015). Increasing consciousness and technical evidence indicate a strong link between health and diet leading to the generation of new concepts for food and nutrition science, research teams are focusing on the advancement of functional foods for the betterment of society (Carnes *et al.,* 2013). By-products from the food processing industry are a valuable source of bioactive components and colour pigments. These by-products can be used to develop nutraceuticals, functional foods, food ingredients, additives, and cosmetics. Functional foods and food elements are foods that give nutritional advantages in addition to fundamental nutrition (for the purposive community). Conventional foods, fortified, enriched, or enhanced foods, and dietary supplements are some examples of functional foods (Handa*et al.,* 2011).Bakery products are favoured segments of the food processing sector and can easily be enriched and fortified to meet a

variety of nutritive needs. Cookies are the most popular bakery product and are used by people of all ages because of their taste, aroma, and flavor. This is mainly due to its ready-to-eat nature and high nutrient content, accessibility in a wide range of flavors, and low cost. (Kishorgoliya*et al.*, 2018).In the present era, cookies are being transformed by varying or substituting different elements. The composite flour of whole grains (wheat, oats, and finger millet) improves the nutritive value of the products because it contains a high concentration of fiber, minerals, and antioxidants, all of which help to protect in case of cancer, diabetes mellitus, overweight, and cardiac disease. (Aggarwal*et al.*, 2016).

Tomato (*Lycopersicon esculentum* L.) is one of the most popular and widely cultivated vegetable crop all over the world. It contains a variety of nutritional components beneficial to physical health, including vit. C and E, minerals, antioxidants, and phenolic compounds. The processing of tomatoes generates massive amounts of waste materials such as pomace and seeds (Abdullah and Sheriful, 2018). Tomato pomace, an industrial by-product from the processing industry comprises about 4-7% of the full raw tomatoes processed into tomato products. Tomato pomace is composed of the skin, seeds, and vascular tissues of the tomato and contains up to 60% of the dietary fibers. It is a rich in antioxidants (lycopene and beta-carotene) and secondary metabolites like coumaric acids and flavanols (Jelena *et al.*, 2016). The world's annual tomato waste production reaches up to 11 million ton per year including 4 million tons of tomato pomace (Yasar and Tosun, 2020). The utilization of agro-industrial waste products in food or non-food base by-products projected great demand now a days on the basis of their environmental pollution causing effects. By-products of tomato processing industry usually represent an environmental problem and the extensive research work carried out by food and nutrition scientists provided an opportunity for potential utilization of tomato pomace for their addition in the human diet and animal feed. Tomato pomace utilization in food processed products will not only reduce industrial waste processing cost but also provide a viable solution to the pollution problem associated with food processing (Alaa *et al.*, 2015).

II. MATERIALS AND METHODS

Materials

The whole wheat flour, finger millet flour, oats, margarin, crystallized sugar, milk powder and baking powder required for formulation of multigrain cookies were procured from local market of Pune. Fresh and fully ripe tomatoes as a prerequisite for preparation of tomato pomace powder were also obtained from local market of Pune.

Preparation of tomato pomace powder

Fresh and fully ripe tomatoes were washed under tap water and subjected to cutting and grinding operations to obtain puree. Tomato puree was passed from muslin cloth and remaining mass containing peels, seeds and portion of flesh was collected as tomato pomace. Drying process of prepared pomace was carried out at 70^{o}C in tray dryer.Dried pomace was subjected to grinding process inhome scale grinder to obtain tomato pomace powder.

Preparation of multigrain cookies enriched with tomato pomace powder

The multigrain cookies were prepared by using traditional creaming method. Different formulations were prepared by replacing whole wheat flour with tomato pomace powder (Table 1). Sugar and margarine were blended continuously till it forms creamy consistency and all the sugar was uniformly mixed with margarine leaving behind no crystals or granules. Dry ingredients were sieved (Mesh no. 70 US) and mixed with cream and sufficient quantity of milk was added to form dough. The prepared dough was rolled and cookie cutter was used to cut rolled dough into uniform shapes. The cookies were rounded and placed in the baking tray splattered with fat and baked at 140-150^{o}C for 15-20min (Pal *et al.*, 2018) in rotary baking oven. The baked cookies were placed out of oven for cooling, for about 5-10 min. The cookies were weighed and packed in plastic containers. The packs were then stored in hygienic storage racks at room temperature.

Table 1. Formulation of tomato pomace enriched multigrain cookies (g/100g)

Sample code	Whole wheat flour	Finger milletflour	Oats	Tomato pomace powder	Margarine	Sugar	Milk	Baking powder
C	33	5	10	0	20	22	9.5	0.5
S_1	31	5	10	2	20	22	9.5	0.5
S_2	29	5	10	4	20	22	9.5	0.5
S_3	27	5	10	6	20	22	9.5	0.5
S_4	25	5	10	8	20	22	9.5	0.5

C: Control

S_1: 2% Tomato pomace powder with 31% wheat flour

S_2: 4% Tomato pomace powder with 29% wheat flour

S_3: 6% Tomato pomace powder with 27% wheat flour

S_4: 8% Tomato pomace powder with 25% wheat flour

Determination of physical properties

Three multigrain cookies enriched with tomato pomace powder were selected.The weight of each cookie was determined by using analytical scale. Diameter was measured using Vernier Calliper. Thickness of the cookies was measured by loading three cookies one above the other three times. Further, spread ratio of the cookies was measured and expressed as diameter/thickness.

Textural analysis

The texture of cookies was measured using a texture analyzer, with the following settings: aptitude test speed 141mm/s,speed 143mm/s, after test speed 1410mm/s, and activate force 14 auto. Each and everycookie was located in the centre of the plate, and the blade was dropped to break the cookie at a 5mm distance. The top force, which denoted the hardness of the cookies, was measured. The fracture forcewas reported as the peak force required to snap the cookies. Each sample was examined in three different ways.

Proximate composition

The proximate composition of prepared multigrain cookies including moisture, ash, fat, protein, crude fiber, and carbohydrate content of the cookies was determined using standard method of AOAC (2000) and Rangana's (2005).

Assessment of functional characteristics

Lycopene extraction was carried out by standard extraction procedure using acetone-petroleum ether method (Thimmaiah, 2016). The beta carotene content of lycopene enriched multigrain cookies was determined by protocol followed by (Biswas *et al.*, 2011).The total phenolic content of the ground cookies samples was estimatedbyFolin-Ciocalteu spectrophotometric method (Bhat*et al.*, 2020).

Sensory analysis

Cookies formulated from wheat flour, finger millet flour, oats and enriched with tomato pomace powder were evaluated for sensory properties, by10 semi-trained panelistsfrom MIT School of Food Technology. The cookies were evaluated for colour,flavor, texture, tasteand overall acceptability. The ratings were on a 9-point hedonic scale ranging from 9 (like extremely) to 1 (dislike extremely).

Statistical analysis

The data generated in the experiments was recorded and subjected to statistical analysis using standard procedure by using Completely Randomized Design (CRD), according to method by Panse and Sukhatme (1967).

III. RESULTS AND DISCUSSION

Proximate composition of tomato pomace enriched multigrain cookies

The proximate composition of tomato pomace enriched cookies was determined and depicted in table 2.The decreasing trend in moisture content (6.72%), fat (0.29%) and carbohydrate (1.19%) were recorded in cookies with increase in tomato pomace powder content. However, increasing trend in ash (54.93%), protein (8.88%) and crude fibers content (14.85%) was observed in cookies with increase in tomato pomace powder content. The moisture, protein and ash content were found to be in the range of 3.33-3.57%, 5.07-5.52% and 0.71-1.1%, respectively. The increase in ash content was attributed to addition of tomato pomace powder content. Similar results were observed in a study of tomato powder incorporation in cookies by Naseer and Ahsan (2020). The fat, crude fibers and carbohydrate content of tomato pomace enriched cookies were found to be 16.96-17.02%, 2.02-2.32% and 70.76-71.61%, respectively. The highest value of crude fibers content was observed for S_4 (8% tomato pomace powder) formulation, attributing to the increased amount of tomato pomace powder and presence of finger millet and oats.

Table 2. Proximate composition of tomato pomace enriched multigrain cookies

Sample	Moisture (%)	Ash (%)	Fat (%)	Protein (%)	Crude Fiber (%)	Carbohydrate (%)
C	3.57	0.71	17.02	5.07	2.02	71.61
S_1	3.47	0.82	17.00	5.16	2.11	71.44
S_2	3.42	0.91	16.99	5.28	2.23	71.17
S_3	3.39	1.02	16.96	5.41	2.26	70.96

S_4	3.33	1.10	16.97	5.52	2.32	70.76
Mean	3.44	0.91	16.99	5.29	2.19	71.33
SE ±	0.04	0.01	0.01	0.02	0.20	0.01
CD @5%	0.14	0.01	0.02	0.02	0.02	0.02

Physical properties of tomato pomace enriched multigrain cookies

Physical characteristics of cookies enriched with tomato pomace powder were evaluated and recorded in table 3. The results showed that the weight, diameter and thickness of tomato pomace powder enriched cookies were in the range of 11.42-12.62g, 5.48-5.53cm and 0.69-0.77cm, respectively (considering all five formulations). The thickness of cookies was found lowest in control and is observed to significantly higher in other formulations containing comparatively high content of tomato pomace powder.

The spread ratio was found to be in the range between 7.16 and 7.91, with the highest value of spread ratio in control formulation. Thus, decreased spread ratio and increased thickness of cookies could be attributed to addition of tomato pomace powder contributing to better rising ability. The volume of control (without tomato pomace powder) and S_4 formulation (8% tomato pomace powder with 25% wheat flour) was found to be 16.35 cm^3 and 18.59 cm^3, respectively. The density of enriched cookies showed to be in the range of 0.68-0.74 g/cm^3.

Table 3. Physical properties of tomato pomace enriched multigrain cookies

Sample	Weight (g)	Diameter (cm)	Thickness (cm)	Spread Ratio	Volume (cm^3)	Density (g/cm^3)
C	11.42	5.48	0.69	7.91	16.35	0.70
S_1	12.20	5.49	0.71	7.70	16.88	0.73
S_2	12.54	5.46	0.73	7.45	17.18	0.73
S_3	12.53	5.51	0.71	7.82	16.87	0.74
S_4	12.62	5.53	0.77	7.16	18.59	0.68
Mean	12.26	5.49	0.72	7.61	17.17	0.72
SE ±	0.01	0.01	0.02	0.07	0.23	0.01
CD @5%	0.02	0.02	0.02	0.25	0.72	0.14

Textural properties of tomato pomace enriched multigrain cookies

The textural properties of tomato pomace enriched (6%) cookies presented in table 4.depicted the hardness of cookies as 2619g, adhesiveness as 0.10mJ while cohesiveness as 0.74. The hardness of cookies could be attributed to development of gluten network during processing, as reported by Aslam *et al.* (2014). The springiness and springiness index, of developed cookies were recorded as 3.91mm and 0.98, respectively. Whereas chewiness and chewiness index were recorded as 4153g and 4070, respectively.

Table 4. Texture properties of tomato pomace enriched multigrain cookies

Parameters	Result
Hardness (g)	2619
Adhesiveness (mJ)	0.10
Springiness (mm)	3.91
Springiness Index	0.98
Chewiness (g)	4153.00
Chewiness Index	4070.00
Gumminess (g)	4153.00 g
Cohesiveness	0.74

Functional characteristics of tomato pomace enriched multigrain cookies

The lycopene and beta carotene content of control cookies were not detected, as control formulation is devoid of tomato pomace powder. Whereas, lycopene and beta carotene content of developed cookies formulations were in the range of 0.78-1.50mg/100 g and 30.14-124.15mcg/100 g, as depicted in table 5. It was observed that both above stated functional properties increased significantly and could be attributed to increase in tomato pomace powder content in developed cookies, due to the high carotenoids content of tomato. The total phenolic content was found in the range of 0.82-1.34mgGAE/g. Moreover, DPPH% inhibition in all formulations was recorded in the range of 21.88- 40.95%.

Table 5. Functional characteristicsof tomato pomace enriched multigrain cookies

Sample	Lycopene (mg/100g)	Beta Carotene (mcg/100g)	Total Phenolic Content (mg GAE/g)	DPPH Inhibition (%)
C	Nil	Nil	0.82 ± 0.03	21.88 ± 0.22
S_1	0.78 ± 0.05	30.14 ± 0.04	1.20 ± 0.04	28.50 ± 0.23
S_2	0.91 ± 0.05	62.29 ± 0.22	1.26 ± 0.08	32.00 ± 0.32
S_3	1.34 ± 0.08	93.26 ± 0.28	1.30 ± 0.08	37.46 ± 0.25
S_4	1.50 ± 0.04	124.15±0.16	1.34 ± 0.06	40.95 ± 0.75
Mean	1.15 ± 0.06	77.46 ± 0.18	1.184 ± 0.06	32.158 ± 0.35
SE	0.02	0.07	0.02	0.12
CD @5%	0.06	0.26	0.06	0.4

Sensory properties of tomato pomace enriched multigrain cookies

The results acquired from sensory evaluation of tomato pomace enriched multigrain cookiesevaluation are presented in table 6.The multigrain cookies prepared with 6% tomato pomace powder and 27% wheat flour recorded highest sensory score for colour (8.1), taste (7.6), flavor (7.9), texture (7.6) and overall acceptability (7.9) as compared to other samples, hence justified its status as standard cookies formulation with enrichment of tomato pomace powder.The effect of tomato pomace powder on sensory score of multigrain cookies was found statistically non-significant at 5%level of significance.

Table 6. Sensorial characteristics of tomato pomace enriched multigrain cookies

Sample	Colour	Taste	Flavor	Texture	Overall Acceptability
C	7.1	6.9	7.3	6.8	7.0
S_1	7.3	7.1	6.8	6.8	6.7
S_2	7.3	7.2	7.4	6.0	7.2
S_3	8.1	7.6	7.9	7.6	7.9
S_4	7.3	7.2	7.3	6.8	7.4
Mean	7.40	7.10	7.30	6.70	7.20
SE ±	0.13	0.12	0.12	0.14	0.11
CD @5%	0.39	0.34	0.37	0.42	0.34

IV. CONCLUSION

In present investigation, multigrain (wheat, finger millet and oats) cookies were enriched with tomato pomace powder in four different proportions by replacing the amount of whole wheat flour with the tomato pomace powder (31:2, 29:4, 27:6 and 25:8) and subjected for quality evaluation (physical, sensorial, nutritional and functional). The results revealed highest acceptability of

multigrain cookies prepared with 6% tomato pomace powder in terms of colour (8.1), taste (7.6), flavor (7.9), texture (7.6) and overall acceptability (7.9). The lycopene content (0.78-1.50mg/100g), beta carotene (30.14-124.15mcg/100g), total phenolic content (0.82-1.34mg GAE/g) and DPPH % inhibition (21.88-40.95%) exhibited increasing trend in developed cookies with increase in tomato pomace powder. The moisture, fat and carbohydrate content were decreased with increase in tomato pomace powder in multigrain cookies, whereas ash, protein and crude fibers showed increasing trend with increase in tomato pomace powder in cookies.

REFERENCES

[1] Abdullah A., Dr. Sheriful A. (2018). Utilization of Fruits and Vegetable Waste in Cereal Based Food (Cookies),*International Journal of Engineering Research & Technology*, ISSN: 2278-0181.

[2] Aggarwal D., Sabikhi L., Kumar S. (2016). Formulation of reduced-calorie biscuits using artificial sweeteners and fat replacer with dairymultigrain approach, *NFS Journal*, 2, 1-7.

[3] Alaa A. G., Mohsen S. A., Zeinab A. S., Bagato O., Ali MA (2015). In-vitro, Antiviral, Antimicrobial and Antioxidant Potential Activity of Tomato pomace,*Int. Journal. Pharm, Sci. Rev. Res.*, 32(2), 262-272.

[4] AOAC (2000). Association of Official Analytical Chemists. Official Methods of Analysis, 17th edition.

[5] Bhat N. A., Wani I. A., and Hamdani A. M. (2020). Tomato powder and crude lycopene as a source of natural antioxidants in whole wheat flour cookies, *Heliyon*,6 (e03042).

[6] Biswas, Sahoo A. K. J., andChatli, M. K. (2011). A simple UV-Vis spectrophotometric method for determination of β-carotene content in raw carrot, sweet potato and supplemented chicken meat nuggets, *Food Science and Technology*, 44(8), 1809–1813.

[7] Brand-WilliamsW., CuvelierM.E., BersetC. (1995). Use of a free radical method to evaluate antioxidant activity, *LebensmittelWissenschaft und- Technologie*, 28, 245-251.

[8] Carnes, J., Larramendi, C. H. D., Ferrer A., Huertas, A. J., Lripez M., PagrynM. A., NavarroJ. A., Garcra A L., VicarioJ. L.S. &Peia, M. (2013). Recently introduced foods as new allergenic sources: Sensitisation to goji berries (lyciumbarbarum),*Food Chemistry*, 137, 130-135.

[9] Handa C.,Goomer S. and Siddhu A. (2011). Physicochemical properties and sensory evaluation of fructoligosaccharide enriched cookies, *Journal Food Sci Technol*., 49(2),192–199.

[10] Jelena M. T., Miona M. B., Aleksandra M. Torbica, Biljana S. P., Ivana S. L., Jovana S. P., Aleksandar Z. F. (2016). The Influence of Addition of Dried Tomato Pomace on The Physical and Sensory Properties of Whole Grain Rye Flour Cookies, *Food and Feed Research*, 43(2), 145-152.

[11] Kishorgoliya N., Mehra M., and Goswami P. (2018). Nutritional quality of the developed multigrain flour and cookies, *Journal of Pharmacognosy and Phytochemistry*, SP1, 2886-2888.

[12] Mudasir A. B., and Hafiza A. (2015).Physico-Chemical Characteristics of Cookies Prepared with Tomato Pomace Powder,*Journal of Food J Processing & Technology*, 7,1 DOI: 10.4172/2157-7110.1000543.

[13] Pal V., Jacob T., Kumar., Binod K., Bharti and Neha P. (2018). Development and quality evaluation of multigrain cookies,*The Pharma Innovation Journal*, 7(7), 1002-1007.

[14] Panse V. G. and Sukhatme P. V. (1967). Statistical methods for agricultural workers 2nd edition, ICAR, New Delhi.

[15] Ranganna, S. (2005). Handbook of analysis and quality control for food products, 3rd edition.

[16] Thimmaiah S. K. (2016). Standard methods of biochemical analysis reference book, 2nd edition.

[17] Yasar S. and Tosun R.(2020). Improving Nutritional Qualities of Tomato Pomace by Pleurotusostreatus and Phanerochaetechrysosporium Fermentation, KSU *J. Agric Nat*., 23 (2), 527-534.