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Nutritional properties of cookies incorporated with mango stone kernel flour

■ P.N. Patil[1]*, S.P. Sonawane[1] **and** S.P. Divekar[2]

[1]Department of Agricultural Process Engineering, College of Agriculture (Dr. BSKKV), **Dapoli (M.S.) India**
[2]Agricultural Engineering Section, College of Agriculture (Dr. PDKV), **Akola (M.S.) India**
Email: pratikpatilp964@gmail.com; spsonawane1@gmail.com; santosh.divekar75@gmail.com)

*Author for Correspondence

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SUMMARY :

Mango is one of the leading processed fruit in the world and there is great demand in the market for the different value-added products from ripe as well as raw mango. Mango processing industries generate a huge quantity of solid waste comprising mainly of peels and stones. After consumption or industrial processing of mangoes, approximately 40 to 60% waste is generated during processing of mangoes; 12 to 15% consists of peels and 15 to 20% of kernels. The mango seed kernel rich in starch, fat, protein and minerals is potentially a good source of nutrients for human and animal feed. The food value of mango seed kernel flour is reported to be nearly equal to that of rice and could be used in foods replacing cereal flours like rice, wheat, corn, etc. Cookies are the most popular bakery items consumed nearly by all levels of society. This is mainly due to its ready-to-eat nature, good nutritional quality, and availability in different varieties and affordable cost. It was found that the moisture, ash, fibre and carbohydrate content increased with increase in proportion of mango stone kernel flour, whereas protein, fat and energy content of cookies decreased with increase in proportion of mango stone kernel flour. The colour analysis of cookies shows that-there is a decrease in L*, a* and b* values with increase in proportion of mango stone kernel flour. The result of sensory sensory evaluation shows that the cookies of treatment T_5 (20% mango stone kernel medium size flour (0.55 mm particle size) and it's incorporation had highest overall acceptability among all treatments. It can be concluded that the incorporation of mango stone kernel flours upto 20 % level with particle size of 0.55 mm in cookies is recommended which results high fibre cookies as compared to cookies prepared with only refined wheat flour.

KEY WORDS : Nutritional properties, Physical properties, Sensory analysis, Colour analysis, Breaking Strength

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Mango is one of the leading processed fruit in the world and there is great demand in the market for the different value-added products from ripe as well as raw mango. Mango processing industries generate a huge quantity of solid waste comprising mainly of peels and stones. After consumption

or industrial processing of mangoes, approximately 40 to 60 % waste is generated during processing of mangoes; 12 to 15 % consists of peels and 15 to 20 % of kernels. According to mango varieties, the stone constitutes about 10 to 25 % of the whole fruit weight. The kernel inside the stone constitutes about 45 to 75 % of the seed and about 20 % of the whole fruit (Karunanithi *et al.,* 2015).

The kernel is a major by-product of the mango processing industry. The potential availability of mango kernel in the country is around one million tones. After processing of mango fruits, the by-product available is peel and seed. The mango seed has oil and other nutritive content. It is an important source of sugars and minerals. The de-oiled mango seed flour can be used further for preparation of value-added products.

The flour obtained from mango stone kernel can be utilized for oil extraction. Besides its use in animal feed, mango stone kernel flour can be utilized for the preparation of edible products. The residue left after extraction of oil from mango stone kernel has sufficient amounts of starch and can be used in the baking.

EXPERIMENTAL METHODS

The mango stone were broken and kernels were obtained. These kernelsde-oiled flour following standard operating procedure (Yatnatti *et al.,* 2014).

Use of mango stone kernel flour in cookies making:

The cookies were prepared using AACC micro method (No. 10-52). Cookies were processed from dough containing 0 %, 10 %, 20 % and 30 % of mango stone kernel flour in substitution with refined wheat flour. Procedure followed for making cookies is as follows.

Physical parameters of cookies:

The physical parameters of the cookies such as diameter, thickness, spread ration. Cookies diameter were measured.

Diameter (D) of cookies was determined by using a Vernier Caliper. The cookies were rotated at an angle of 90° for duplicate readings. This process was repeated thrice to get an average value and results were reported in millimeter.

Cookies thickness :

The thickness (T) of the cookies was determined by using a Vernier Caliper. This process was repeated thrice to get an average value and results were reported in millimeter.

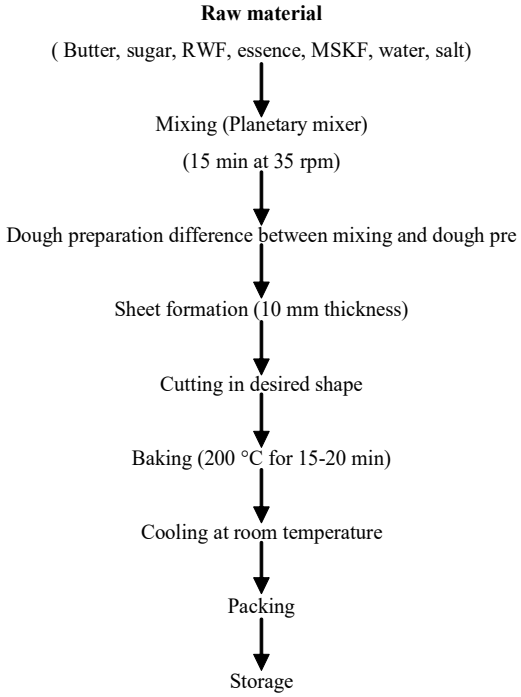

Fig. A : Flow chart for cookies preparation

Cookies spread ratio:

Cookies spread ratio was determined from the diameter and thickness, using the following formula.

$$\text{Spread ratio} = \frac{D}{T}$$

where,
D = Diameter
T = Thickness.

Nutritional properties of cookies:

The developed cookies were powdered using mortar and pestle. Then the nutritional properties of cookies such as moisture, fat, protein, crude fibre, ash, carbohydrate and energy were determined according to standard AOAC, 1990 methods.

Moisture content:

Air oven method was followed for moisture content determination. Moisture content in percent was calculated from the loss in weight.

$$\text{Moisture (\%)} = \frac{(W_1 - W_2)}{(W_1 - W_2)} \times 100$$

where,
W = Weight of empty dish in g.
W_1 = Weight of dish + undried sample in g.
W_2 = Weight of dish + dried sample in g.

Fat content:

The crude fat content was determined by the Ether extraction using Soxhlet's apparatus.

The standard procedure of fat determination was followed. The fat content was determined using following formula:

$$\text{Crude fat (\%)} = \frac{\text{Weight of fat (g)}}{\text{Weight of sample (g)}} \times 100$$

Ash content:

The standard procedure was followed for determination of ash content. The ash was calculated using the following formula:

$$\text{Ash (\%)} = \frac{\text{Weight of ash (g)}}{\text{Weight of sample (g)}} \times 100$$

Crude fibre:

The standard procedure was followed for determination of fibre content. The loss in weight represented crude fibre.

$$\text{Crude fibre (\%)} = \frac{(W_1 - W_2)}{\text{Weight of sample (g)}} \times 100$$

where,
W_1 = Weight of the sample before ashing, g.
W_2 = Weight of the sample after ashing, g.

Protein:

The protein content was determined using Micro-Kjeldahl's apparatus. The standard procedure was followed. Protein content was calculated using the following formula.

$$N(\%) = \frac{(S - B) \times N \times 14.007}{[\text{Weight of sample (g)}] \times \frac{\text{Valume made (ml)}}{\text{Volume taken (ml)}}} \times 100$$

where,
S = ml of HCl required for sample titration.
B = ml of HCl required for blank titration.
N = Normality of HCl (0.1 N).

Protein (%) = Nitrogen (%) x 6.25

Carbohydrate:

Carbohydrate was calculated by the difference method as follows.

% Carbohydrate = 100- % (Moisture + Crude fat + Crude protein + Ash + Crude fibre

EXPERIMENTAL FINDINGS AND ANALYSIS

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Physical properties of cookies:

The diameter of cookies ranges from 44.51 mm to 49.44 mm. The thickness ranges from 7.99 mm to 10.86 mm. The spread ratio of cookies rages from 4.23 to 5.62.

Breaking strength of cookies:

The breaking strength was measured with the help of texture analyzer. The value of breaking strength was obtained in Newton.

The breaking strength ranges from 30.29 to 35.16 N. The highest breaking strength was observed in T9 (35.16 N), whereas the lowest breaking strength was

Table 1 : Physical properties of cookies

Sr. No.	Treatments	Diameter (mm)	Thickness (mm)	Spread ratio
1.	T_0	44.51	7.99	5.57
2.	T_1	46.83	8.33	5.62
3.	T_2	46.14	9.26	4.98
4.	T_3	44.68	9.48	4.71
5.	T_4	47.82	8.75	5.47
6.	T_5	46.57	9.39	4.96
7.	T_6	45.07	9.55	4.72
8.	T_7	49.44	9.10	5.43
9.	T_8	46.78	9.40	4.98
10.	T_9	45.91	10.86	4.23

observed in T0 (30.29 N).

Nutritional properties of cookies

The maximum moisture content was observed in T_0 (3.15%), whereas the minimum moisture content was found in T_7 (1.52%). The results obtained during the present study were resembles to the results reported by Bandyopadhyay *et al.* (2014) and Aslam *et al.* (2014).

The highest protein content was recorded inT_0 (6.74%), whereas the lowest protein content was recorded in T_2 (6.06%). The results obtained were resembles to the results reported by Arogba (2002) and Aslam *et al.* (2014).

The highest fat content was noticed in T_7 (30.97%), whereas the lowest fat content was noticed in T_3 (27.20%). The highest ash content was observed in T_0 (0.98%), whereas the lowest ash content was observed in T_1 (0.74%). Legesse and Emire (2012) reported 0.98 per cent ash. Elgindy (2017) reported 1.11 per cent ash, whereas Aslam *et al.* (2014) reported 1.07 per cent ash in mango stone kernel flour incorporated cookies.

The highest crude fibre content was noticed in T_9 (1.27%), whereas the lowest crude fibre was noticed in T_4 (0.88%). Elgindy (2017) reported 0.92 per cent fibre, whereas Kaur and Brar (2017) reported 0.81 per cent of fibre in mango kernel four incorporated cookies.

The highest carbohydrate content was observed in T_3 (62.51%), whereas the lowest carbohydrate content was observed in T_0 (58.88%). The similar result was also reported by Arogba (2002) that is carbohydrate content is 61 per cent. Kaur and Brar (2017) reported 66.83 per cent carbohydrate in mango stone kernel flour cookies.

Conclusion:

– The physical analysis shows that diameter of cookies decreases and thickness increases with increase in proportion of mango stone kernel flour from 10 per cent to 30 per cent.

– The breaking strength of cookies increases with

Table 2 : Breaking strength (N) of cookies

Sr. No.	Treatments	Breaking strength (N)
1	T_0	30.29
2	T_1	32.03
3	T_2	32.89
4	T_3	34.96
5	T_4	31.88
6	T_5	32.72
7	T_6	34.38
8	T_7	32.10
9	T_8	32.98
10	T_9	35.16

Table 3 : Nutritional properties of cookies

Treatments	Moisture	Protein	Fat	Ash	Crude fibre	Carbohydrate
T_0	3.15	6.74	29.37	0.98	0.89	58.88
T_1	1.67	6.21	28.85	0.74	1.09	61.44
T_2	1.97	6.06	27.54	0.81	1.14	62.48
T_3	2.25	5.99	27.20	0.85	1.21	62.51
T_4	1.69	6.54	30.53	0.78	0.87	54.59
T_5	1.88	6.27	29.27	0.80	1.00	60.78
T_6	1.96	6.25	28.25	0.84	1.21	61.49
T_7	1.52	6.66	30.97	0.80	0.88	59.16
T_8	1.76	6.56	30.86	0.84	0.97	59.02
T_9	1.59	6.12	30.36	0.82	1.27	59.84

increase in proportion of mango stone kernel flour from 10 per cent to 30 per cent

– The chemical analysis of cookies shows the moisture, ash, fibre and carbohydrate content increases with increase in proportion of mango stone kernel flour, whereas protein, fat and energy content of cookies decrease with increase in proportion of mango stone kernel flour.

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