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Nutritional and functional profiling of mango seed powder and its suitability in chakali

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Abstract
Mango (*Mangifera indica*. L) is the national fruit of India. Peels and seeds are the by-products obtained during processing of mango. The study was undertaken to process mango seed and to study its nutritional and functional value. Kernels were separated from seeds and processed into flour through various processing steps. Mango seed powder is good source of protein (5.084%), fat (8.275%) and carbohyadrate (76.024%). The functional properties showed that Bulk density (0.433g/cm^3), water absorption capacities (1.024gwater/g), oil absorption capacity (0.864goil/g). Starch is extracted from the mango seed. The mango seed powder is utilized in Chakli is one of the traditional fried snacks that can be produced using different combination of ingredients. Chakli is popular product and they are mostly made from gram, rice flour etc.

Keywords: Mango seed powder, starch, nutritional properties, functional properties, chakli

1. Introduction

1.1 Mango

Mango is one of the leading processed fruit in the world and there is great demand in the market for the different valueadded products from ripe as well as raw mango. It is considered as the 'King of fruits' owning to its luscious taste, captivating flavour and high nutritive qualities. India is the largest producer of mangoes with 44.14 per cent of the total world production. Major components of mango fruit include pulp (45-60%), peel (20-30%) and seed (20-40%). Mango seeds were cleaned and washed, then keep to dry in the air then the kernels cut into pieces and dried by tray drier. The dried cut kernels was ground in a hammer mill into a powdery form. Starch, fat and protein are major component of mango seed kernels. Mango seed contains 44.0% moisture, 6.0% protein, 12.8% fat, 32.8% carbohydrates and 2.0% ash. Whereas the seed flour contains 5.56% protein, 16.17% fat, 0.35% ash and 69.2% carbohydrates. Mango seed use in animal feed, mango kernel flour can be utilized for edible purposes.

In this regard processing of mango seed kernel is important to utilize it in food product development. mango seed powder at different replacing levels in cookies formulation. Cookies processing: Cookies samples were processed from doughs containing 20, 30, 50% of MPP and 20, 30 and 50% MKP as substituting levels for wheat flour. The formula used 200 g wheat flour, 60 g sugar, 50 g shortening, 2 g sodium chloride, 0.8 g sodium bicarbonate, 3 g ammonium bicarbonate, 4 g dextrose, 4 g skimmed milk powder and 40-42 mL water.

Indian traditional snack foods are prepared from cereals, legumes and spices. Their manu-facturing processes may include cleaning, pretreatment, soaking, roasting and frying etc. Chakli is famous in India with different names like chakli in Marathi and Kannada, Chakri in Gujarat and Murkoo in Tamil. Chakli is traditional food made from different ingredients i.e. rice flour, urad dal flour, Bengal gram, water, oil, salt and spices. The main ingredient for all types chakli is rice flour. Chakli are delicious savouries that are generally made at home and kept in airtight containers for eating as fancied and enjoyable with crunchy satisfactory.

1.2 Chakli

Chakali is one of the traditional fried snacks that can be produced using different combination of ingredients. Cereal chakali is popular product and at present they are mostly made from gram, rice etc. Chakli is a crispy and it is made from a dough mixture of rice flour and urad dhal, extracted through a mould into twisted coils and deep fried in oil. Sorghum Chakali preparation and to study the nutritional quality parameter of sorghum grains as well as its Chakali. He studied the organoleptic properties of Chakali prepared from sorghum flour were judged on the basis of colour, appearance, texture, flavour, taste and overall acceptability of the product by semi-trained judges on 9point Hedonic Scale.

Chakali was liked very much and gave highest rating of more than 8.

2. Materials and methods

The present study carried out in Department of Agricultural Engineering, MIT College of Aurangabad.

2.1 Materials

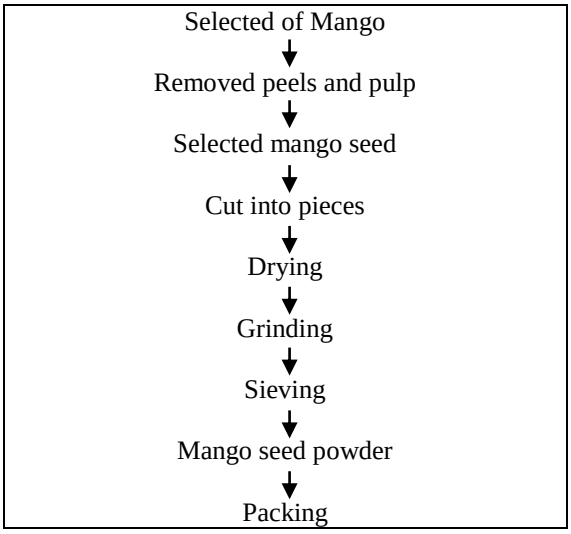
2.1.1 Raw material

- **Mango**: The Lalbaug variety of mango was purchased. The Mangoes procured from local market of Aurangabad.
- **Chakli:** For preparation of chakli product required material Rice flour, Bengal gram flour, Refined oil, chilli powder, salt, cumin seeds purchased from local market of Aurangabad.

2.2 Method

2.2.1 Preparation of Mango seed powder by tray drying

The Lalbaug variety mangoes were selected from the local market of Aurangabd. Removed peels and pulp of Selected mangoes. Then removed the seed coat from the mangoes. The mango seed coats were washed with water and kept at sun dried for 24 hours and the seeds were removed manually by separating seed coats. The seeds were chopped in to small pieces and dried in tray dryer. Mango seed was dried in tray drying at different temperature (50 °C, 60 °C, and 70 ˚C) and after completing drying process the mango seeds grinding was carried out and the powder formed of mango seed.



Flow chart for preparation of Mango seed powder

2.2.2 Extraction of starch from mango seed

The mango seed is collected and sun dried for two days. Then the mango seed is manually separated from the seed coat and cut into small pieces. 10g of raw seed sample is weighed and were grounded in a mixer grinder by adding 50ml of distilled water to obtain brownish white color slurry. The mixture keeps overnight for sedimentation. Discard the supernatant and the white layer was re-suspended and repeated washed with 70% ethanol. Then centrifuged by adding water at 2800 rpm for 15 min. This is done for 4 times and finally the starch is collected and dried in an oven for 6 hrs at 50˚ C. (Priya D. Patil, *et al.*, 2014) [6]

2.2.3 Nutritional properties

In this study Protein, Fat, Ash, Fiber, Moisture, Carbohydrate these nutritional properties are determined by according to the description in (AOAC). Crabohyadrate is determined by formula of 100 - (Moisture+ash+protein+fat).

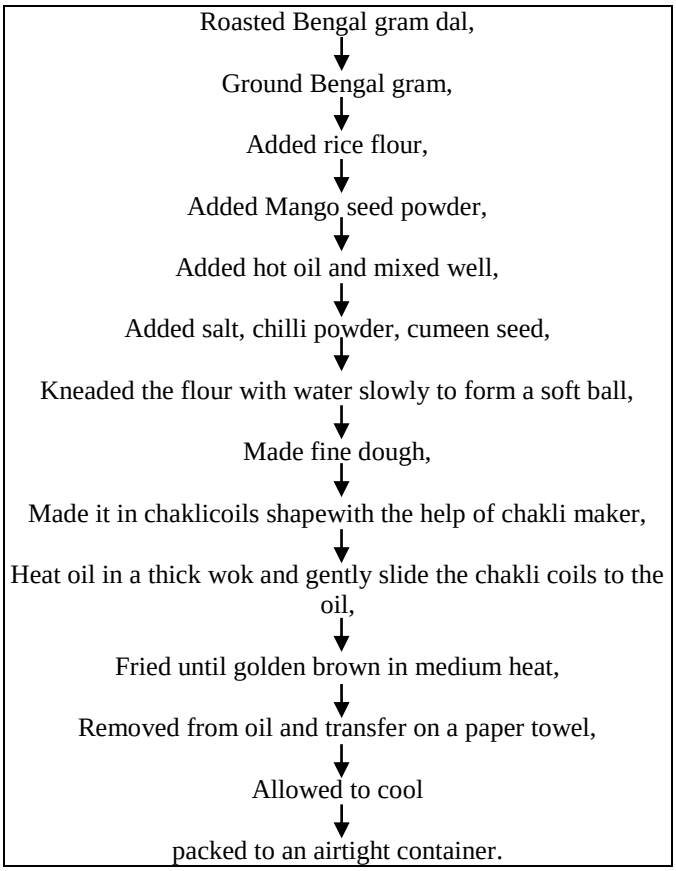
2.2.4 Functional properties

In this study the Bulk density, Water absorption index (WAI), Oil absorption index (OAI) and Water solubility index (WSI) were determined. Bulk density is determined by filling the powder in a cylinder of known volume and tap for 10 times on wooden plank until volume. Weighed in an electronic balance. The bulk density calculated from the mass and volume. (Suresh Chandra and Samsher, 2013). WAI is determined by A sample of 2 g Mango seed powder in 20ml distilled water was agitated for 1h and centrifuged at 3000rpm for 20min. The free water was removed from the wet residue, which was then drained for 10min. The wet residue was then weighed. (Lakshmi Menon *et al.*, 2014) [11]. OAI is determined by a sample of 2 g Mango seed powder in 20ml oil was agitated for 1h and centrifuged at 3000rpm for 20min. The oil was removed from the wet residue, which was then drained for 10min. The wet residue was then weighed. (Lakshmi Menon *et al.*, 2014) [11]. WSI was determined by the weight of dry solids in the supernatant from the water absorption index test expressed as percentage of the original weight of the sample. The superntant is placed in hot air oven for 5 hrs. then wieght the wieght the dry solid.

3.3

2.2.5 Manufacturing process of Chakali

Chakli is a maharashtrian traditional snack delicacy. It is very popular throughout India. It is a crispy dish and is made from a dough mixture of rice flour and Bengal gram dal, extracted through a mould into twisted coils and deep fried in oil.



(Chavan U.D. *et al*. 2016)

Flowchart for chakli making process

2.2.6 Product formulation

Preparation of chakli by using optimized mango seed powder. In this process four sample was prepared by using different concentration of mango seed powder. One is control sample which content 60% rice flour and 40% Bengal gram flour. Other four samples S_1, S_2, S_3 and S_4 are The Bengal gram flour is constant and changing the rice flour quantity add into the 5%, 10%, 15% and 20% mango seed powder respectively.

Table 1: Formulation of chakli

Product ingredient	Treatment				
	Contr	S_1	S_2	S_3	S_4
Rice flour (%)	60	55	50	45	40
Bengal gram flour (%)	40	40	40	40	40
Mango seed powder (%)	-	5	10	15	20

3. Result and Discussion

This chapter deals with the results of the investigation carried out in development of Mango seed powder and its Nutritional properties and functional properties. Preparation of chakali was done with satisfactory results by using formulated Mango seed powder. product development and their consumer acceptance also judged by 1 to 9point Hedonic Scale.

3.1 Analysis of Mango parts

The mango purchased from market. As shown in table 2 From 1 kg mango percent distribution of mango fruit was studied. Mango seed coat and seed together represent 13.80% of the whole mango fruit weight, out of which mango seed alone represents 9.60% and seed coat presented 4.20% of whole fruit weight. 17.67% peel and 68.53% pulp. According to Kittiphoom *et al*. (2013) seed content of different varieties of mangoes ranges from 9 to 23 per cent of fruit weight. In the present study the variety of mango was Lalbaug.

Table 2: Analysis of mango parts

Sr. No.	Parts	Percentage
1	Peel	17.67
2	Pulp	68.53
3	Seed coat	4.20
4	Seed	9.60

3.2 Optimization of drying process

As shown in table 3 the drying processes were undertaken on the Mango seed powder for three samples as T1, T2 and T3. These three samples were dried at temperatures 50 °C, 60 °C and 70 °C respectively at same moisture content.

Table 3: Drying temperature of Mango seed powder

Sr. No	Treatment	Time (HR: min)	Moisture (%)
1	T1(50 ^{0}C)	.6.30	5.047
2	T2(60 ^{0}C)	5.00	6.701
3	T3(70 ^{0}C)	4.30	5.527

The obtained starch powder is off-white in colour. The mango seed powder content the 62.160% starch.

3.4 Functional properties of Mango seed powder

As shown in table 4 the physical parameters like bulk density, water absorption index, oil absorption index and water solubility index for sample T1, T2 and T3 were analyzed. Bulk density ranged between 0.434 gm/cm^2 with sample T_2 having the lowest value while sample T_1 has the highest value. The water absorption index ranged between 1.024 gm water/gm with sample T_2 having the lowest value while sample T_1 has the highest value. The oil absorption index ranged between 0.864 gm water/gm with sample T_2 having the lowest value while sample T_1 has the highest value. Water soluble index ranged between 21.06% with sample T_1 having the highest value, while sample T_3 has the lowest value. Sample T_2 was significantly different from sample T_1 and T_3. The effect of drying temperature on the sample shows that water soluble index decreases with increasing in temperature.

Table 4: Analyzed data of functional properties of Mango seed powder

Sr. No	Treatment / Parameter	T1	T2	T3
1	Bulk density(g/cm^3)	0.469	0.434	0.448
2	Water absorption index (g water/g)	2.102	1.024	1.172
3	Oil absorption index (g oil/g)	1.701	0.864	1.504
4	Water solubility index (%)	12.06	11.45	10.27

3.5 Color

Color is also important property of the mango seed powder because of the temperature effect on these three samples. Color property checked in hunter colory meter, L*, a*, and b* value. L* = lightness, a*= redness and b*= yellow**.** In table 5 color result was found with significant effect at 1%level of significance**.** Increase as temperature of sample the redness and yellowness of sample increased slightly.

Table 5: Temperature effect of color

Sr. No	Sample	L*	a*	b*
1	T1	57.13	6.41	26.26
2	T2	60.42	6.26	25.19
3	T3	55.29	7.46	24.36

3.6 Nutritional properties of mango seed powder

To check the nutritional properties of mango seed powder against the three treatments as T1, T2 and T3, the following data was observed as shown in table 6 The parameters like protein, fat, fiber and ash were checked for the mango seed powder. The moisture content ranged between 5.047% sample T_1 was found to have the lowest value, while sample T_2 was found to have highest value. The protein content ranged between 5.084% sample T_2 was found to have the highest value, while sample T_1 was found to have lowest value. It has been observed that the fat content ranged between 8.275% Sample T_2 has the higest value and T_3 lowest value. Crude fiber content ranged between 2.180% Sample T_2 has the higest value and T_3 lowest value. The ash content ranged between 1.736% Sample T_2 has the lowest value and T_1 highest value. These result shows that there were no major impact of drying temperatures on the samples nutritional properties.

Table 6: Nutritional properties

Sr. No	Treatment / Parameter	T1	T2	T3
1	Moisture (%)	5.047	6.701	5.527
2	Protein (%)	4.639	5.084	4.856
3	Fat (%)	7.796	8.275	7.064
4	Crude fiber (%)	2.120	2.180	2.106
5	Ash (%)	2.228	1.736	1.936
6	Carbohyadrate (%)	78.170	76.024	78.511

Mango seed powder were dried at 50 °C (T_1), 60 °C (T_2) and 70 °C (T_3). These were analysed for nutritional and functional properties. The Mango seed dried at temperature 60 ^{0}C were of a better quality, the time required was high and the nutritional and functional properties was good. So, temperature 60 ˚C was selected for further process of making chakli product.

3.7 Applicability of mango seed powder

3.7.1 Analysis of chakali

The Mango seed powder chakli were prepared by substituting refined flour to the proportion of 0, 5, 10, 15, and 20 percent. The chakli were evaluated for moisture, protein, fat content. The moisture content 7.205% in S2 found lowest and S4 was found to have highest value. Protein content 15.308% in S4 found highest value, while S1 was found to have lowest value. Fat content 41.160% in S4 found highest value, while S1 was found to have lowest value. Control sample and other all sample Control sample and other all sample are not significantly different. are not significantly different.

Table 7: Analysis of chakli

Sr. No	Sample / Parameter	Control	S_1	S_2	S_3	S_4
1	Moist%	8.274	8.26	7.20	7.35	9.18
2	Protein%	10.1	12.1	14.1	14.3	15.3
3	Fat%	38.2	40.1	40.3	40.5	41.1
4	Ash%	3.30	2.60	2.61	2.48	2.52
5	Carbohydrate%	40.0	36.8	35.6	35.2	31.8

3.7.2 Sensory evaluation

The formulated mango seed powder chakli product, which were selected. The sensory attributes considered for the evaluation were color, appearance, odor and test and overall acceptance. A 9 points hedonic scale was used for sensory evaluation of mango seed powder chakli. Sensory evaluation was done to find the acceptability of the product on the basis of ranking scale with the characteristics of colour, texture, flavor, concept, taste and after taste. The acceptability statements and their marks used as follows.

Table 8: Hedonic scale

Sr. no.	Remarks	Score
1	Like extremely	9
2	Like very much	8
3	Like moderately	7
4	Like slightly	6
5	Neither like nor dislike	5
6	Dislike slightly	4
7	Dislike moderately	3
8	Dislike very much	2
9	Dislike extremely	1

Table 9: sensory evaluation of the mango seed powder chakli product

Sample	Color	Text.	Taste	Flav	Overall acceptability
Control	6	6	7	8	7
S1	8	7	7	7	7
S2	7	8	8	7	8
S3	8	8	9	8	8
S4	7	7	7	8	7

The Analysis of chakli for control sample and chakli replacing Rice flour with mango seed powder and Bengal gram flour was presented in above table 7 and 8 had analyzed the nutritional properties of chakli. The result were shown that the as per increasing the quantity of mango seed powder in chakli there were increasing the nutritional properties protein, fat and moisture content of chakli product. Where the carbohydrate was decreasing as increasing the mango seed powder. Sample S_4 which contain 20% mango seed powder were shown the highest quantity of nutritional properties but not good in sensory, it was shown in table 9 that the sample S_4 was not good in taste and in overall acceptability.

Whereas the sample 3 (S3) which contain 15% mango seed powder had good in nutritional properties containing protein and fat and had higher overall acceptability with mean scores of 8 (like very much). Taste is good for mango seed chakli product with mean score of 9 and also had good nutritional properties.

4. Summary and Conclusion

Mango *(Mangifera indica Linn)* is the most important fruit of India and is known as “King of fruits”. The fruit is cultivated in the largest area i.e. 2,312 thousand ha and the production is around 15.03 million tons, contributing 40.48% of the total world production of mango. The main mango producing states in India are Uttar Pradesh (23.86%), Andhra Pradesh (22.14%), Karnataka (11.71%), Bihar (8.79%), Gujarat (6.00%) and Tamil Nadu (5.09%). Total export of mangoes from India is 59.22 thousand tons, valuing Rs. 162.92 crores during 2010-11. Mango seed powder is prepared at different temperature range that is 50 ˚C, 60 ˚C and 70 ˚C. The mango seed powder were analyzed for their nutritional and functional properties. Considering all parameter, the powder prepared at 60 ˚C was optimized for utilization in chakli. The optimized mango seed powder used in chakli at 5%, 10%, 15%, and 20% proportion with replacing rice flour, and check their nutritional properties like moisture, protein, fat content.

4.1 Conclusion

It was observed that temperature had effect on the functional and nutritional properties of mango seed powder. mango seed which represent about 9 per cent of total fruit weight and treated as processing waste, can be processed into flour with maximum recovery, which can be used to incorporate into food product as supplement. Nutritive analysis of Mango seed powder reveals that it is a good source of nutrients like protein, fat and carbohydrate.

In this study the Mango seed dried at temperature 60 ^{0}C (T2) were of a better quality, the time required was not so high and less. Also, the nutritional and functional properties was good. The concluded from present work that the functional properties bulk density, WAI, OAI, WSI of mango seed powder sample T_2 (60 ^{0}C) was better than the sample T_1 and T_3. The nutritional properties of mango seed powder were also contain higher in sample T_2 (60 ^{0}C) i.e. protein 5.084%, fat 8.275%, moisture 6.701%, carbohydrate 76.024% and ash 1.736% than the sample T_1 and T_3. The obtained starch powder is off-white in color. The mango seed powder content the 62.160% starch.

From the present study it can be concluded that mango seed flour were suitable for the development of chakli. Utilization of mango seed for commercial purposes can reduce the environmental pollution which resulted as by-product from mango processing industries and contribute to food security by converting waste to valuable food products. The mango seed chakli product was good in sensory evaluation it was very good in colour and Execellent in taste. the chakli product sample 3 (S3) which contain 15% mango seed powder had higher overall acceptability and taste is good for mango seed chakli product with mean score of 9 and also had good nutritional properties.

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