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Review on 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. Particle size distribution of the flour was studied. Mango seed powder is good source of protein, fat and energy. The functional properties showed that Bulk density, water absorption capacities, oil absorption capacity. Starch is extracted from the mango seed. The mango seed powder is utilized invalue added produc like biscuits, cookies, bread et. Chakali is one of the traditional fried snacks that can be produced using different combination of ingredients. Chakali is popular product and they are mostly made from gram, rice flour etc.

Keywords: Mango seed powder, nutritional properties, functional properties, Chakali

1. Introduction
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. 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 [1]. Major components of mango fruit include pulp (45-60%), peel (20-30%) and seed (20-40%). [2]. 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 [3]. 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 [4]. 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 [5]. 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 [6].

Indian traditional snack foods are prepared from cereals, legumes and spices. Their manu-facturing processes may include cleaning, pretreatment, soaking, roasting and frying etc. Chakali is famous in India with different names like Chakali in Marathi and Kannada, Chakri in Gujarat and Murkoo in Tamil. Chakali is traditional food made from different ingredients i.e. rice flour, urad dal flour, Bengal gram, water, oil, salt and spices [7]. The main ingredient for all types Chakali is rice flour. Chakali are delicious savouries that are generally made at home and kept in airtight containers for eating as fancied and enjoyable with crunchy satisfactory [8].

2. Review of literature
2.1 Extraction of starch from Mango seed
Priya D. Patil, *et al.* (2014) [4] studied Starch is as a renewable and biodegradable natural resource, is an important polysaccharide reserved in higher plants. Starch is widely used in the food and pharmaceutical industries for various applications. These industries depend on crops that are also the traditional sources of food resulting high demands with consequence

economic implications. The results showed that the moisture content (14.93%) was higher while ash content (0.12%) was low.

Shilpa Yatnatti (2015) studied the Extraction of starch from mango seed kernel. The result showed in this study starch content in mango kernel flour was found to be 68.50 per cent. Recovery of starch was 50.5 g per 100 g of kernels.

Maninder Kaur and Narpinder Singh (2006) studied the Starch was also isolated from chickpea cultivars and evaluated. Selected properties of chick- pea seeds were significantly correlated with the properties of their starches and flours.

Manisha Sonthalia and Sikdar D. C. (2015) [13] studied Mango (*Mangifera Indica*. L) is the national fruit of India. Starch is used in food and pharmaceutical industry. The result was the maximum yield of starch was 59.06 percent, the amylose content 16.3 percent and ash content between 0.12 to 0.15 percent. The purity of the starch obtained was 97.18 percent when compared to market starch which was 92.59 percent. Thus, it can be concluded that the starch obtained from mango seed kernel can be used in food industry. the starch produced from mango seed kernel is 97.82% when compared to the market starch that is 92.59%.

L.A. Bello Perez, *et al.* (2005) studied the Mango starch had an amylose content of about 13%, the fat content of "criollo" variety starch (0.1–0.12%), was similar to that of commercial corn starch used as control (0.2%); both mango starches had higher ash amount(0.2–0.4%) than corn starch. Mango starches presented a smaller granule size (10µm) than corn starch (15µm), along with an A-type X-ray diffraction pattern with slight tendency to a C-type. All values of water retention capacity WRC increased with the temperature. When the temperature increased, solubility and swelling val- ues increased and in general, mango starches had higher values than corn starch. Both mango starches had gelatinization temperatures lower than the control, but "criollo" variety starch presented higher enthalpy values than "manila" variety and corn starches. Overall, it was concluded that due to its morphological, physicochemical and functional properties, mango starches could be a feasible starch source with adequate properties, suitable for using in the food industry.

2.2 Preparation of Mango Seed Powder

I.S. Ashoush and M.G.E. Gadallah (2011) [2] studied the mango peels and seed kernels are the major by-products of mango juice industry. Collected Ripe mango seeds, mango seeds washed then dried and the kernels were removed manually from seeds. The kernels cut and dried at 50 °C. The dried kernels were ground in a hammer mill into a Powdr form.

Shilpa Yatnatti, *et al*. (2014) [8] studied processing of ripe mango fruit, generates its peel and seed as waste, which is approximately 40-50% of the total fruit weight. Mango kernels were separated from seeds and processed into flour through various processing steps. Particle size distribution of the flour was studied. Results showed that recovery per cent of mango kernel flour was 80.6 and maximum flour particles passed through 60 mesh.

Gumte S.V, *et al*. (2018) [12] Studied that during processing of mango, kernel is generated as waste which is rich in various nutrients. Processing of Mango Kernel into Flour Mango seeds were washed and dried in hot air at 60 °C for 6 hours. Kernels were separated from seed manually using stainless steel knife and dried in hot air oven at 50 ºC for 4 hours and stored in air tight containers. During processing stored kernels were soaked (18-20 hr) in water, chopped into small pieces, blanched (1-2 min), dried (60 ºC for 5 hours) and ground into flour in electric blender, sieved and stored in air tight container.

M.A. Augustin and E.T. Ling (1987) [10] Studied the Composition of Mango Kernel. The moisture content of the kernels was variable. The average moisture contents of kernels of the MA 128, MA 205 and the unclassified varieties were between 44 - 59%.

Lakshmi Menon, *et al.* (2014) [8] studied fruit residues and seed flours have been used to supplement food and feed because of their nutrient dense composition. The study was undertaken to identify the feasibility of utilizing cereal-legume-seed kernel composite flour in preparation of bread.

Amee Ravani and D C Joshi (2013) [9] studied that the mango is one of the most important tropical fruits in the world and currently ranked 5th in total world production among the major fruit crops. As mango is a seasonal fruit, about 20% of fruits are processed for products such as puree, nectar, leather, pickles, canned slices, and chutney.

Asma Ahmed and Easa Elgindy (2017) Studied the Preparation of Mango seed flour. 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 and kept in a closed dark glass bottle and stored.

2.3 Nutritional Properties of Mango Seed Flour

Shilpa Yatnatti, *et al*. (2014) [8] Studied The nutrients analyzed for mango kernel flour were moisture, protein, fat, crude fiber, ash, calcium, magnesium, potassium, sodium, manganese, copper, zinc and iron by standard methods. Carbohydrate and energy contents were computed. MKF is good source of protein (7.53 g/100g), fat (11.45 g/100 g) and energy (421 k.cal /100g). It also contains appreciable levels of calcium (170 mg/100g), magnesium (210 mg/100g) and potassium (368 mg/100g) which are important macro minerals required for vital functions of the body. Oil yield from mango kernel flour was found to be 11.5 per cent which was studied for selected physical and chemical properties.

M.A. Augustin and E.T. Ling (1987) [10] studied on mango seed. The result showed in this study 5.25 - 5.34% protein, 1.65 - 1.75% crude fiber, 2.47 - 2.75% ash and 6.98-7.82% crude fat on a dry weight basis and also found 13.7% oil, 7.08% crude protein, 1.75% ash and 2.95% crude fiber.

Okpala, *et al.* (2013) [15] Studied that flours from India and Indochinese cultivars and the results reveald protein contents of 6.00 and 4.95%; moisture, 5.00 and 10.36%; fibre, 11.00 and 15% while the carbohydrate was 74.41 and 64.23% respectively.

M. A. Fowomola (2009) Studied The results of proximate analysis show that mango seed contains 10.06 crude protein, 14.80% oil, 2.62 ash, 2.40 crude fibre, 70.12% carbohydrate and energy content (453.92 ± 4.32 KJ/100g).The results also show that mango seed is very rich in glutamate 13.00 g/100 g of protein

Samata Airani (2007) Studied The proximate compositions of seed flour and the results are 14.07 of moisture, 9.03 protein, 1.10 of fat, 2.25 of crude fibre, 3.01 total mineral matter and 70.26 of carbohydrates with the calorific value 376 K. cal.

Kakali Bandyopadhyay, *et al.* (2014) [1] studied the mango processing industries leave behind considerable of mango seed kernels and peels which are generally discarded as waste. Mango kernels and peels are rich sources of natural bioactive compounds which play an important role in prevention of

diseases. The results showed that that MPP has higher ash, crude fiber, water holding and oil holding capacity than that of MKP whereas, MKP has higher moisture, fat and protein compared to MPP. WHC and OHC of MPP were higher than MKP, representing higher fibre content in MPP compared to MKP. The table shows that the total phenolics content present in both MKP and MPP (27.9 and 24.3 mg GAE/g respectively) were significantly high.

Messay B. L. and Shimelis A. E. (2012) [14] Studied Proximate composition of mango kernel flour and blend flour. Moisture content, crude protein, crude fat, total ash, crude fiber and pH value of mango kernel flour and blend flour were. The raw mango kernel flour was found to contain 9.8% moisture, 5.55% crude protein, 12.8% crude fat, 2.5% crude fiber, 2.1% total ash and 67.25% carbohydrates all are presented in dry weight basis; and pH and energy value of 4.8 and 406.4 kcal.

S.S. Diarra (2014) Studied Nutritive composition of mango seed kernel (MSK) Mango seeds consist of about 68% kernel, 29% shell and 3% testa. The nutritional properties showed that protein (4.0-8.1%), fat (3.7-12.6%) and ash (1.0-3.7%).

2.4 Functional properties of Mango seed flour

I.S. Ashoush and M.G.E. Gadallah (2011) [2] studied the function al properties of the mango seed flour and the result showed an increase in water absorption from 60.4 to 67.6%, while decrease in MKP. The content of phenolics increased from 3.84 to 24.37 mg/g of biscuit incorporated with deferent levels of MPP and MKP. The biscuits incorporated with MPP and MKP exhibited an improvement in their antioxidant

Suresh Chandra and Samsher (2013) [5] Studied The functional properties of mango seed flour that are swelling capacity, water absorption capacity, oil absorption capacity, emulsion activity and stability, foam capacity and stability. Potato flour is highest value of swelling capacity, water absorption capacity, oil absorption capacity and emulsion stability. Highest bulk density observed for rice flour while foam capacity.

Kittiphoom S. (2012) [3] studied the mango is one of the most important tropical fruits in the world. The study of major components of mango seed are starch, fat and protein. The oil of mango seed kernel consist of about 44–48% saturated fatty acids (majority stearic) and 52–56% unsaturated. Mango seed kernels have a low content of protein but they contain the most of the essential amino acids, with highest values of leucine, valine and lysine.

Priya D. Patil, *et al.* (2014) [4] studied The aim of present work was to isolate the starch from black variety of mango and evaluate the physicochemical as well as functional properties. The results showed that the moisture content (14.93%) was higher while ash content (0.12%) was low. Amylose content was 35.06%.

Sunday Y. G. and Dickson A. B. (1992) studied The proximate composition and functional properties of raw, germinated and fermented full-fat fluted pumpkin flour were studied. Functional properties evaluated that water and fat absorption, bulk density, foam capacity and stability.

Okpala, *et al.* (2013) [15] Studied results from the functional properties showed that flours from both of the cultivars had water absorption capacities of 2.0 g/g and 1.5 g/g; oil absorption capacity of 2.16 g/g and 1.83 g/g while foaming capacity was 3.79 g/g and 3.75 g/g.

Samata Airani (2007) Studied The total yield of the flour was as 67.50 grams. The functional properties indicated that the jack seed flour had 112.00 ml/100 g of water absorption and 126.90 ml/100 g of oil absorption capacity.

R.O. Adeleke and J.O. Odedeji (2010) [22] Studied the functional properties of wheat and sweet potato flour blends were investigated. The functional properties are the Water absorption capacity, Viscosity, Swelling power, Foaming capacity and foaming stability

Heena Jalal, *et al.* (2018) [21] Was studied the Functional and nutrional composition of the Pomegranate seed powder.

S.Y. Sonaye and Dr. R. N. Baxi (2012) the present study on the measuring the particle size of organic dust (different types of flour). Sieve analysis technique is used in the present study for estimation of weight percentage of micron sized (light weight and flyable) flour particles.

Shilpa Yatnatti, *et al.* (2014) [8] Studied Particle size distribution Particle size of mango kernel flour was studied Maximum per cent of flour particles (64%) were passed through 60 mesh sieve, followed by 16 per cent of flour particles passed through 72 mesh sieve. Only 6 per cent of flour particles had particle size more than 44 mesh sieves which remained in the sieve and about 14 per cent had particle size of 44 mesh, which passed through the same mesh number and remained on 60 mesh sieve.

2.5 Storage study

Akusu OM and Kiin-Kabari DB (2013) Studied that the storage quality of Ogbono flour. The fifteen bags of the tied Ogbono flour were stored at room temperature. Samples removed in one week during storage analyzed for moisture content and selected functional properties of oil absorption and viscosity and sensory properties were also evaluated.

Ghorpade P. (2010) Studied and observed that the mango seed flour could be safely stored in polyethylene pouches at room temperature and protect from the insects and prevention of spoilage and retention of quality of mango seed kernel flour.

Shilpa Yatnatti (2015) was studied Mango seed kernel flour is highly hygroscopic in nature. This might lead to the spoilage of the flour during storage. Mango seed kernel flour was packaged in five different packaging materials and stored under ambient conditions.

Ajit K. Sahoo (2014) Studied the Effect of drying methods on quality of banana powder i.e. effect of drying methods on moisture, Effect of drying methods on ascorbic acid, Effect of drying methods on pH

2.6 Value added products in Mango seed flour

Kakali Bandyopadhyay, *et al.* (2014) [1] studied carried out on mango seed powder and mango peel 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.

Messay B. L. and Shimelis A. E. (2012) [14] Studied seed kernels flour was prepared to produce value added product. Blends of wheat and mango kernel flours for biscuit formulations were prepare. Biscuit samples were processed from dough's containing 10, 20 and 30% MKF as substituting levels for wheat flour according to a commercial formulation and baking practice of Kality Food Share Company. Biscuit dough was formulated by blending wheat flour, mango kernel flour with other ingredients. The formulated blends were mixed for 15 min at 125rpm (speed 2) using a mixer. Each batches of the dough were removed from the mixer and

allowed to rest for 10 min. The dough pieces were sheeted and flattened using roller into a sheet of about 8 mm thickness, and then cut into rectangular pieces with size, 75 mm × 75 mm. Samples were baked in an electric oven at 249 oC for 18 min. After baking, biscuits were left to cool at room temperature and were wrapped tightly with polypropylene pouches and kept until further analyses took place. Blending processes were conducted by substituting specified proportions of (10%, 20%, and 30%) mango kernel flour from the total percent of wheat flour (100%).

Asma Ahmed Easa Elgindy (2017) studied The present study aimed to benefit from the flour of mango kernels in the preparation of biscuits after some industrial processing operations to reduce kernels' content of tannins. Nutritional value of the flour of mango kernels and wheat and prepared biscuits by replacing 10%, 20%, 30%, 40% and 50% of wheat flour by the flour of mango kernels. Results showed that the content of the flour of mango kernels of raw fat was 12.39% and the ratio of unsaturated fatty acids was 55.3%. Results also revealed that by increasing replacement proportion the content of biscuits of fibers, ash and fats increased while its content of proteins and carbohydrates decreased. Sensory properties of biscuits also improved by increasing the replacement proportion until 40%. Thus, the results confirm that the use of the flour of mango kernels as an alternative for wheat flour, with 40% of replacement, in the preparation of biscuits improves the nutritional value and quality of biscuits.

Baba M. D. *et al.* (2015) studied the use of whole wheat and banana flour blends in the production of toasted breads was studied, essentially, to determine the effect of banana flour on the sensory qualities of toasted bread. The flour blends of whole wheat and banana were composites at varying inclusion levels of 10, 20 and 30% as samples B, C and D respectively, while the whole wheat flour toasted bread (sample A) served as control. The bread loaves were produced using the straight-dough procedure and were subsequently evaluated for their sensory attributes. The sensory analysis showed that there was no significant difference between the whole wheat toasted bread and the banana fortified samples in the sensory attributes of taste, aroma, appearance and texture. While significant difference (p<0.05) was observed in the overall acceptability. Our conclusion is that a substitution of up to30% banana flour into wheat flour would give the toasted bread a high acceptability.

Khin Swe Oo and Yee Yee Win (2011) Studied on the Banana powder is used chiefly in the baking industry for the preparation and filling for cubes and biscuits and is also used for invalid and baby foods.

2.7 Chakali

Kanchana Jayakumar (2013) Studied that Chakali is a traditional South Indian snack and is very popular throughout India. Chakali 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.

Sana saiyed and Rupali Sengupta (2014) [18] Studied about Chakali. Chakali is a maharashtrian delicacy that was developed from BHAJNI. The Chakali is prepared by frying.

U. D. Chavan, *et al*. (2015) Studied 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 9 point Hedonic Scale. Chakali was liked very much and gave highest rating of more than 8.

Prabhakar P K, Srivastav P P (2015) [16] Studied Soru-chakali is one of such traditional food of West Bengal. He studied preparing soru-chakali. Traditional knowledge offers enormous potential for development of social-economic conditions of the particular area and state.

T.B. Surpam, *et al*. (2014) Studied The sorghum utilization can be increased by popularizing various indigenous products such as kharodya (wadi), Chakali, papad, ghari, Ambil etc. which can increase the crop or food value in the market. The processes such as Ambil preparation are being explored in the production of instant or ready-to-eat sorghum food products such as breakfast cereals. It is hoped that use of these new processes would increase industrial utilization of sorghum.

S.D. Patekar *et al.* (2017) [17] Studied 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. By suitable processing it might be feasible to produce Chakali from sorghum. The different formulations of sorghum: finger millet in the ratio of 10:40, 20:30 and 30:20 and 40:10 and the control are prepared.

Table 1: Proximate composition of mango seed powder

Characteristics	Mango seed powder
Moisture (%)	6.57
Ash (%)	1.46
Fat (%)	8.15
Protein (%)	7.76
Crude fiber (%)	0.26
WHC (g H O/g)	2.08
OHC (g oil/g)	1.74

I.S. Ashoush and M.G.E. Gadallah (2011) [2]

3. Conclusion

Based on the above review of literature, it was concluded that the mango seed powder was good source of starch. Mango seed is rich in fat, protein, carbohydrate. High contain of nutritional and functional properties. The mango seed powder utilized as a byproduct in to value added products of bakery like biscuits, cookies, bread etc. It was concluded that the mango seed powder may be utilized in preparation of Chakali product.

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