Value-added Products from mango kernel flour for Food Security and Sustainable Development

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Fruit processing generates high amounts of by-products that are often wasted and decomposed in open fields, emitting harmful greenhouse gases. Recycling these by-products back into the food system is essential to protect the environment and reduce the social and economic burden. Mango (*Mangifera indica* L.) is among the top 10 fruits of major economic importance cultivated in Africa. It belongs to the family of *Anacardiaceae* and is considered a high-quality fruit as the 'King of fruits' in the Orient. Over 8 million tonnes of mangoes are produced in the region per year and are often consumed either as fresh fruit or processed into various products such as pulp/juice, puree, pickle, jam, powder, and nectar. Mango processing generates approximately 3 million tonnes of by-products (seeds, peels, kernels) making up 25–40% of fresh fruit. These are rich sources of nutrients and bioactive compounds, i.e., mango seed and kernel are excellent sources of dietary fiber, carotenoids, protein, fat, minerals, and phenolic compounds. The bioactive compounds in mango by-products have antioxidant, antibacterial, cardioprotective, anti-inflammatory, and anti-proliferative properties that protect against chronic non-communicable diseases. Hence, mango by-products could be transformed into useful products. The mango seed kernel possesses anticancer activity against breast and colon cancer due to its high antioxidant activity. Mango seed kernel flour has an effective potential as an antifungal and antibiotic, so, it can be used to treat food infections and poisoning caused by disease causing microorganisms in the food industry.

Processing of the Mango Seed Kernel flour

During processing, the kernels were obtained by decortication of the mango seed coat. Mango seed kernels were washed with potable water and dried in a hot air oven at 60°-70°C for approximately 15 hours. Then, the kernels were soaked in cold water for 6-7 hours and blanched for 1-2 minutes. The kernels were redried in a hot air oven at 60°-70°C again for 15 hours. Later, the mango seed kernels were powdered, sieved, and then stored in Ziplock bags.

Fig 1: Mango seed kernel

Fig 2: Mango seed kernel flour

Functional Properties of Mango Seed Kernel Flour

A unique quality attribute of foods and food products is functional properties. The functional properties of flour reflect the behaviour of ingredients during preparation and cooking. The sensory characteristics like appearance, texture, and taste of a finished food product are affected due to the functional properties of flour used in preparing the product. The functional properties include bulk

Table 1. Proximate Composition and Functional Properties of Mango Seed Kernel Flour

Nutrients	Estimated Value
Moisture	10±0.28 g/100 g
Ash	1.561±0.89g/100g
Protein	6.14±0.61 g/100g
Fats	6.17±0.59 g/100g
Carbohydrate	55.62±1.0 g/100g
Energy	384.4±3.16 Kcal/100g
Crude Fiber	12.59±0.50 g/100g
Iron	1.36±0.31 mg/100g
Calcium	76.36±0.37 mg/100g
Phosphorus	6.74 mg/100g
Parameters	**Amounts**
Bulk Density	0.41±0.06 g/ml
Water absorption capacity	0.75±0.07 g/g
Oil absorption capacity	1.68±0.05 g/g
Swelling power	8.5±0.05 g/g
Solubility capacity	0.87±0.02 %
Starch	57.6±2.36 g/g

density, swelling power, solubility, water absorption capacity, and oil absorption capacity. Bulk density is a measure of the heaviness of solid samples; it determines the material handling, packaging requirements, and utility in the food industry. Water absorption capacity refers to the amount of water retained by a food product after filtration and application of mild pressure of centrifugation. Oil absorption capacity deals with protein's ability to bind fat. It is an important factor since fat acts as a flavour retainers and increases the mouth feel of food. The swelling capacity measures the ability of starch to absorb water and swell and focuses on the extent of associative forces present in the granules of starch. Swelling capacity is considered as a quality measure of some bakery products. Amylase content affects the swelling power of a food product. So, higher the amylase content in a material there will be more hydrophilic groups to bind more water and increase the swelling power of the food. Besides, the amount of amylase content, the size of starch granules also affects the swelling power. The high swelling power of flour indicates its wide use in the food industry to develop bakery products with improved characteristics.

Development of Value-Added products from Mango Seed Kernel Flour

Mango Seed Kernel Rusk

For product development, a plain surface was greased with ghee and it other ingredients (sugar, water, salt) were added and later the mixture was

kneaded to form smooth dough. Then, the dough was kept for 2 hours at room temperature for proofing. Later, it was rolled and then cut into pieces, placed on a perforated tray, and baked for 20 minutes at a temperature of 150° C. The baked pieces were further baked at 150°C for 20 min. The baking was done to impart perfect colour development and crispiness.

Mango Seed Kernel Biscuits

Firstly, all dry ingredients were sieved and mixed together. Sugar and fat were creamed together.

Soft dough was prepared in dough mixer with all the ingredients and an adequate amount of water. Dough was spread into a sheet and cut into suitable shapes and size. Cut pieces were gently placed on baking tray. Tray was placed in oven for approximately 15 minutes at 170 °C. Baked biscuits were removed from oven and cooled. Prepared Biscuits were packed in suitable packaging material.

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