



Mango Peel as an Active Source of Functional Ingredients

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INTRODUCTION

Mango is a tropical fruit and ranks fifth in the total world fruit production with large number of consumers and enormous products that are globally available. These products are notable because of their unique and pleasing palatability. Generation of these products leads to the production of byproducts such as peel and kernel. Approximately a mango fruit constitute around 20% of peel and the seed contributes about 20% to 60% of the total fruit depending on the variety of the mango. In addition to this, byproducts are also generated during the mishandling of fruits during post-harvest. Many studies have shown that these byproducts are a natural source of bioactive compounds and have major medicinal properties along with high functional and nutritional assets. Mango peels can also be used as a natural and economic source of polyphenol and pectin together with nutraceutical properties. Aside from the wastage of nutritional and beneficial properties, environmental pollution is also a major drawback due to the generation of these by-products as they remain unutilized. Therefore, it is essential that these by-products are used to generate economic benefit and profits for the food industry thus mitigating and resolving the environmental issue as well.

Properties of Mango peel

Rich in fibre: It is known that fibre should be an integral part in human diet and has several health benefits. Mango peels are rich in fibre which can be used for products low in fibre or directly in food ingredients. It was found that the dietary fibre in mango peel varies from 28 to 78%, depending on the variety. Dietary fibres (DF) are classified into two classes, i.e., soluble (15-50) % and insoluble (12-28) % moreover mango peel has ample amount of both the mentioned classes.

The percentage of dietary fibre may vary depending upon the variety, extent of ripeness, area of cultivation etc, the soluble dietary fibre (SDF) has whooping amount of pectin content thus can be potentially used as a natural source in the economical production of pectin.

Evaluation of pectin derived from mango peels manifest that it has 23% more gelling power and thickening properties when compared with those found in other common sources such as apple. The dietary fibre in the mango has various practical properties, including WHC.

Antioxidant capacity: Antioxidant activity is defined as a limitation or inhibition of nutrient oxidation (especially lipids and proteins) by restraining oxidative chain reactions. We are well aware that oxidative stress can lead to the various physical and neurodegenerative conditions like cancer, aging, cardiovascular and autoimmune diseases. Thus, it becomes mandatory to incorporate foods in our diet which are lauded with antioxidants. Mango peels are infused with antioxidants such as mangiferin, norathyriol, and resveratrol, triterpenes and triterpenoids, which are beneficial for various type of cancers and diabetes.

Nutrients components: Wholesome advantages of mango are deep rooted. It's a magnificent source of fibre, nutrients and vitamins like A, C, E and B6, as well as the minerals. Mango peel is plentiful of minerals and vitamins. Potassium, zinc, copper, manganese, iron, and selenium are a few to name. Different varieties of mango peel have ample amount of important minerals essential

for human body. One such variety is the Haden mango (or 'Hayden') and is one of the most primarily cultivated breed in the world. Its peel is found to have great benefits on human health as it has high amount of calcium, iron and zinc. This huge mineral substance makes the mango peel a preferable source of dietary supplements over the pulp.

Therapeutic properties: Mango peels are rich in phytochemicals which possess nutraceutical and therapeutic properties. One of such compounds is magneferin which is known to control the cholesterol level due to the presence of dietary fibre and benefits your body. Also dietary fibres present in mango peel can be used for the management of diabetes as the soluble dietary slows down the speed with which the glucose reaches the blood due to the improvement of digestive mobility thus making it an excellent raw material for the production of diabetic friendly products. Obesity is expanding at a disturbing rate which turns out to be further threatening because of production of reactive oxygen species (ROS). In light of the current examination results, it tends to be presumed that bioactive mixtures from farming waste (mango peels) present an extensive solution for battle against the ROS created in the body. Consequently, these are useful in forestalling harms caused, utilizing efficient assets that generally go waste and become a wellspring of contamination. Mango peels are rich in flavonoids which resist premature aging and grant a dewy gleam to the skin.

Table 1: Composition of mango peel (Lebaka et al., 2021)

Component (Per 100 g)	Peel
Water (g)	52.6
Carbohydrate (g)	18.2
Protein (g)	3.6
Total lipid (fat) (g)	2.2
Sugars, (g)	22
Calcium (mg)	150
Iron (mg)	40.6

Magnesium (mg)	100
Potassium (mg)	75
Sodium (mg)	50
Zinc (mg)	1.74
Copper (mg)	10.4
Vitamin C (total ascorbic acid, mg)	183
Vitamin A, retinol activity equivalents (µg)	100
Vitamin E (α-tocopherol, mg)	0.59

Value-added products from the mango peel

Mango peels offers a scope of potential outcomes to advance value added items. Nutritional value and characteristics of mango peel makes it a desirable by-product and a potential raw material for the production of various raw material such as food additives and numerous food supplements. Therefore, making mango peel an economical and easily available by-product for the production of valuable and consumer friendly products. These kinds of products have potential to create a healthy market and new business development for the reason of its easily available raw material and nutritive value.

Production of pectin from mango: Pectin is the gelatinous material in fruit. It's the stuff that holds the fruit's fibre together. To produce pectin mango peels were dried in hot air oven for 24 hours at a temperature of 45 degree Celsius and grinded to a molecule size of 40 BS. The dried and grounded peels were weighed around 15g and 50mL of 0.05 HCl was added. The pectin was extracted by boiling the mixture at 100 degrees Celsius. It was observed that totapuri mangoes are rich in pectin (18.2%, w/w).

Production of pectinase from mango peel:

Mango peels were used for the production of pectinase enzyme using fungal strains. Pectinases are enzymes that breaks down the long and complex molecules known as pectin. They are majorly utilized for the clarification and depectinization of juices. SSF and SSM was used to culture *A.foetidus* so that the efficacy of PGA and PL produced could be compared during the enzyme production. The

catalyst creation of both PGA and PL was higher in SSF (Solid state fermentation) than SMF (Submerged fermentation). consequently, higher creation of pectinase is because of less catabolic suppression in SSF than in SMF. Now this pectinase can be used replacing the commercial pectinase used in juice industry for the clarification of cloudiness of juice

Lactic acid formation: Lactic acid is an excellent additive and works as a food preservative in processed food apart from this it has multiple usage in food industry. Commercially it is produced by the fermentation of carbohydrate like sucrose, glucose or lactose or by chemical synthesis, which is quite expensive. The development of lactic acid using mango peel is done through a two-venture system; pre-treatment followed by acid hydrolysis of the mango peel followed by microbial fermentation. The creation of lactic acid from mango peel results appears to enjoy a functional benefit in light of the fact that the technique is monetarily reasonable since the expense of the natural substance (mango side-effect) has minimal expense. In present scenario the production of lactic acid is very costly and can be alternatively substituted with mango peel as it is easily available and cost efficient

Agro-industrial usage of mango peel

By now we know that the mango peel is of magnificent industrial value for the reason that it has high nutritional properties and can be used in numerous ways for the production of different products in the food industry. Mango peel can be conveniently used to produce mango powders as these powders are excellent

food supplements. Mango peel powder (MPP) can be used in diverse food industries, beverages, bakery items, dairy products are a few to name.

Natural dye: In the present biologically cognizant world, we're continually searching for better approaches to decrease our influence on the climate. One of these issues is supplanting the petrol based engineered colours with regular colours. Natural color could be extricated from various variety yielding plants and food waste one such example is mango peel. By aligning ourselves with the maintainable food development, it is feasible to supplant the poisonous engineered halfway color in material enterprises. By diazotization of mango side-effects, the normal azo color could be removed. This demonstrates mango waste could be a decent wellspring of regular color to substitute oil based engineered color.

Animal feed: Mango by-products can be utilized as animal feed and could mostly swap energy focuses of diet for ruminants. Physicochemical characteristics of the by-product uncovered that they have high sugar content, so they are suitable particularly to ruminants. Because of the chemical composition of mango peel, favourable volatile fatty acid and in vitro digestibility, mango peel have promising potential for utilisation as animal feed or feed additives.

Conclusion

It can be concluded that mango peel contains various valuable components like polyphenol, carotenoids, and dietary fibre. Peel extract possess various bioactive compounds and was found to be rich in soluble dietary fibre. It exhibited antioxidant properties and protected against DNA damage and its usage is highly beneficial not only for the human body but also for industries, as the utilization of different parts other than the fruit gives rise to prime benefits to the food industry as well as consumers. Besides that, it is also beneficial for the environment as it is easily available and reduced the percentages of waste generated by

the fruit industry, making it an economical raw material. So, advancing examination and creative drives to foster new options of handling of mango peel is vital. The research ought to emphasize on the use of suitable innovation to balance out and safeguard the nourishing, nutraceutical, and functional properties of mango peels. Additionally, the exploration needs to pay attention on the extraction strategies that give high return and are well disposed to the climate. This will also reduce the problem of food security which is very common in underdeveloped countries.

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1

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