REVIEW ARTICLE

Nutritional potential and multiple uses of banana peel: A review

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Globally, interest in investigating waste management is growing as more people become concerned about pollution and its different causes. Banana peel flour has Jess protein and fat calories and more dietary fibre and total carbs. The chemical constitution of BPF determines its possible uses, and the Resistant Starch (RS) and dietary fibre found in banana peels serve as key structural and functional elements. Utilizing the garbage is essential for overcoming these toxic gases and making it feasible to use the waste. After the fruit is harvested, the banana plant is useless, but it plays an important role in the production of biofuel, cellulose, citric acid, lactic acid, amylase, bio-film, papers, bio-plastic, and bio-electricity in the agroindustry, among other things. Peels are also utilized a bio-sorbent to clean water by removing nitrites from drinking water as well as for anti-fungal and antibiotic purposes. The value of banana peels in several domains is covered in the current review.

Key Words: *Banana; Peels; Benefits; Waste; Management*

INTRODUCTION

Organic waste from fruits and vegetables is continually rising, which poses a concern for waste management and environmental damage. However the majority of research relies on treating trash to produce bioactive molecules, implying further treatment that produces extra waste. Banana peels have a variety of uses, including composting, ethanol production from water purification, cellulose production, lactase production, and use as fertilizer. Despite the fact that banana peel has several beneficial applications, it is nonetheless regarded as vegetable waste [1]. The phenolic, flavonoid, and tannin components were extracted using water, 80% methanol, 80% ethanol and 80% acetone. Peel extracts' chemical make-up and biological activities were both examined. According to analysis, the amounts of moisture, protein, crude fat and total carbs were, respectively, 88.10, 13.42, 7.57, 10.44 and 68.31 g/100 g DW. Banana peel has a high amount of potassium (9.39% of dry weight), followed by magnesium, calcium, sodium, and phosphorus (0.71, 0.44, 0.18, and 0.09% of DW), in that order. Iron, manganese, zinc and copper all had microelement contents that were respectively 96.50, 35.01, 27.95 and 3.37 ppm. The greatest levels of total phenolic, flavonoid, and tannin were found in the methanolic extract (80%), with corresponding concentrations of 17.89, 21.0, and 24.21 mg/g DW [2]. The unused banana peel weighs around 40% of the total mass of a fresh banana. Banana peels production, ripening phase impacts on dietary fiber constituents and pectin in banana skins and the chemical properties of banana peel as modified by the ripening stages and cultivars of bananas are just a few of the investigations that have been conducted to explore peels [3]. Studies have shown that *Musa sapientum* (Musaceae), medications and the financial strain of medical spending are the primary factors that pose significant hypoglycemic, anti-ulcer reagent and further approaches that have antioxidant and anti-inflammatory effects barriers for cancer patients [2].

LITERATURE REVIEW

Nutritional factors

Gadgihalli et al., [1] stated that the evaluation of the characteristics of concrete including powdered dry banana peel as an additive. Concrete admixtures are substances added to plastics (fresh) mixed or curing conditions (ASTMC 496) in addition to cement, water and aggregates. By adding banana peel powder as an additive, concrete's flexural strength has improved, but its compressive strength has grown far less. It is obvious that utilizing dried banana peel powder as an additive has lowered the exothermal reaction in concrete based on the decreased transmission temperature % and temperature reduction duration [1]. Khawas et al., [4] concluded that the study of the culinary bananas (Musa ABB) peel's morphology, functioning, and modem method at distinct developmental stages. The abundantly accessible agricultural waste known as culinary banana peel hasn't been able to attract a lot of interest in respect of its possible use. It deserves to be used properly and/or better apart from being a rich source of nutrients and useful ingredients. This study's objective was always to investigate this food-waste at various stages of growth in arrange to pinpoint the vital chemicals at each phase of development. In contrast to constituents, which rose with maturity and decreased at extra ripe stage, phenolics, flavonoids and radical scavenging activity were maximal at early development phase. According to x-ray diffractograms, the peel's starch of the C-type and is crystalline in nature. The peel produced high cellulose content at the edible maturity phase 4 that might be employed as a reinforcing material in high performance biocomposites. Fourier transform infrared characterization supported the existence of several functional groups revealing the complexity of the culinary banana peel. Scanning electron microscopy images showed that the peel's microstructure substantially changed at the overripe stage, and that starch and other components began to degrade. Therefore, in this context, the culinary banana peel has the potential to be used as a biopolymer for use in industry and will increase the value of this crucial but underused crop for the local economy [4].

According to the Ehiowemwenguan et al., [5] founded that banana peels phytoconstituents and antimicrobial analyses. The both ethanolic and aqueous extracts of bananas (*Musa sapientum*) peels *in vitro* antibacterial efficacy was examined on both grampositive and gramnegative bacteria. According to phytochemical findings, ethanol is a superior solvent for removing the bioactive substances found in banana peels, such as tannins, flavonoids, volatile oil, alkaloids, saponins, glycosides and saponins. *Musa sapientum* peels existence of opiates and flavonoids may be explained by the fact that traditional healers have used them to cure bacterial illnesses such colds, flus, fevers and venereal disorders. As a result, peel extracts the ability to treat infections brought on by *E. coli*, *K .pneumoniae*, *Salmonella typhi* and *S.aureus*. The extracts from this medicinal peel can also be used to treat infections including micrococcus species and *Pseudomonas aeruginosa* induced encephalopathy, microbial endocarditis and bronchopneumonia. Therefore, it is acceptable for conventional medical professionals to utilize banana peel [5].

Giri et al., [6] concluded that dietary consumption of bananas in food (*Musa acuminata*) peel flour influences rohu, *Labeo rohita* proliferation, protective effects, cytokines reactions and illness sensitivity. The effects of Banana Peel Flour (BPF) on *Labeo rohita's* growth and immune system were assessed in order to explore the viability of *Musa acuminate* (banana peels) as a feeding supplement. The fish (average weight: 15.3 g) were fed diets with five different concentrations of BPF for 60 days:0% (base diet), B1:1%, B3:3%, B5:5% and B7:7%. The B5 group had a greater ultimate weight gain

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and a certain development rate (P 0.05%). These findings imply that dietary banana peel flour at S% might improve *L. rohita's* ability to proliferate and fortify its defenses [6].

Okorie et al., [7] stated that the thrash metal and nutritional content of banana (*Musa paradisiaca*) peels, the peel samples under investigation include larger quantities of K than Na, which is regarded as a competitive edge. This is due to the association between consumption of foods with a greater K to Na ratio and the prevalence of hypertension. Many biological activities, including bone development, energy synthesis, cell communication, and acid-base balance management, depend on phosphorus. According to the statement, unripe plantain peels had greater Zn concentrations than ripe plant peels, early peels, and ripe banana peels. That study's key discovery is how much Fe is present in unripe plant skin. The development of glucose and the correct operation of the immune system both depend on iron, a necessary constituent of hemoglobin [7].

Product developed from banana peel

According to the Andreanyta et al., [8] research the in order to strengthen bread, bananas and pomegranate peel flour is used. According to this study, serotonin was expressed more strongly in the colon in diabetes individuals. This discovery is consistent with a prior study, which shown that it may be a catalyst for diabetes problems *via* platelet activation and the decrease of muscle cells in the artery wall. Also, it was shown in this study that there was no discernible difference in serotonin expression in the pancreas under normal and diabetic circumstances; hence, diabetes did not reduce serotonin synthesis. The pancreas of diabetic rats and the regular group both had a high serotonin concentration, and the regular pancreas stimulates the release of insulin. Banana peel flakes included in the usual meal for three weeks may have an antidepressant effect, mostly *via* lowering the blood sugar of hypoglycemic effect. According to our knowledge, a likely mechanism for lowering blood glucose was suggested: prevention of intestinal glucose uptake. The system may no longer be required more insulin to maintain glucose homeostasis as a result. Serotonin expression accordingly reduced as plasma and blood glucose levels rose in diabetics pancreatic tissues. It may be concluded that flakes of banana peels act as an antidepressant's outcome in the diabetics rats model, which could happen *via* the method of phytochemical substances regulating blood sugar levels. Antioxidants, tryptophan, a precursor to serotonin and dietary fiber are among the substances that help the gut-brain axis operate normally [8].

Saifullah et al., [3] concluded in their study that the use of banana peel as a useful component in noodles. The banana peel flour created in this study had a brownish color and discernible black patches all over the flour samples. It also tasted like bananas. The Banana Peel (BP) noodles developed in this research were thought to be distinct from the usual industry-made noodles. The flat size of the BP noodles was created to make evaluating their texture easier. The BP noodles had a pronounced banana scent and were dark brown in color. The noodles had a thickness that varied from 1.8 to 2.2 mm, were 15 cm long and had a breadth of 8 millimeter. The noodles were made were creamy and had a yellowish hue. The same manner a typical consumer could prepare noodles at home was used to prepare the noodles. Although the pH of yellow noodles typically ranges from 9 to 11, which leads in the yellow color, the noodle's pre-cooking pH was 8.0, that was constant with the furthermore of alkaline salt. With comparison to reference white bread, it was investigated how quickly noodles *in-vitro* carbohydrate digestion occurred. For the various noodles, curves for the combined digestion and dialysis process. All of the samples analyzed, the percentage of hydrolysis steadily rose throughout the first 120 minutes of the process. After then, the hydrolysis gradually increased until it hit a plateau. Noodles in the control group were broken down more quickly than those in the BP group. Calculated HIs and associated GIs from the hydrolysis curves. Compared to the control, BP noodles had a lower GI. This might be explained by the peels high content of dietary fiber, including pectin polysaccharides and hemi-cellulose. In comparison to control noodles, BP noodles showed a greater elasticity value, equivalent tensile strength and a lower projected glycemic index. The modified product proposed in this research may promote usage of waste products from banana agro industries and widen the selection of low glycemic index food items [3].

According to the Arun et al., [9] study the plantain peel: a possible cause of dietary fiber with antioxidants for making useful cookies. Nendran Peel Flour (NPF) is an excellent source of fiber and antioxidants. By substituting NPF at a level of 10% for wheat flour, acceptable cookies may be made. The addition of NPF enhanced the cookies' antioxidant potential and fiber content. Finding novel dietary fiber sources with particular bioactive components that might provide traditionally marketed goods new, beneficial characteristics is of growing interest. NPF might be included as an appropriate cause of dietary fiber with related bio-active compounds and utilized to make a wide range of food items, such as cakes, biscuits, and other baked goods. The value addition of BPF as in type of a healthy food product component can bring about significant socioeconomic change the area later functional foods are an efficient approach to provide favourable agents intended to lower illness risk [9].

Lesetja et al., [10] stated that the bio-active components, antioxidant activity and physical feature of wheat-prickly pear and banana cookies. The concentrations of total phenolic compounds, flavonoids and crude fiber was higher in the flour and biscuit sample that had been supplemented with BPF and PPF by-products than in the control samples. An increase in these bioactive compounds in biscuits and flours made with BPF and PPF showed an enhancement of their total antioxidant activity and, as a result, their functional dietary qualities. Furthermore, the oil and water holding capacities of composited flours improved while the bulk density and high viscosity of flour that was combined with BPF and PPP remained unaltered. The flours physical characteristics and biscuits revealed inconsistent outcomes. BPF and PPF were used to produce variable coloured composite flours and biscuits. The biscuits' diameter and spread ratio grew as their height reduced [10].

Garsa [11] study's banana peel flour has medicinal uses and is substituted for wheat flour in the industry to calculate dietary fiber. The flour made from banana peels that are rich in minerals and dietary fiber. In order to create functional meals, fortify at levels 5, 10, 15 and 20% from BPF, these bioactive components were utilized. Different biscuit mixes were used to analyses the color, physical properties, texture characteristics and sensory qualities. The panellists approved of the various blends made with banana peel flour at levels of 5, 10 and 15%, but the combination with 20% banana peel flour proved unacceptable, which may have resulted from its dark color and high dietary fiber content [11].

Banana peel waste packaging and other uses

Agustina et al., [12] stated that the natural wrapping paper with additive essential oils. The finer fibers may be found in banana peel waste than in wood products with high levels of cellulose (6065%), hemicellulose (68%) and lignin (5-10%). Banana peels have far more cellulose than softwood, which is the typical raw material for paper. Furthermore, the lignin content in banana peels (5-10%) makes the cellulose extraction process simpler. In order to lessen the reliance on hardwood as the basic material for wrapped paper, the banana peel may be utilized as a raw material for papermaking. By raising the economic worth of the trash, using banana peel trash enhances waste reduction efforts. Essential oils, such as, lemon oil, lime oil, cinnamon oil and clove oil, are used as preservatives and fragrance agents at a rate of 2% or 3% respectively [12].

According to the Sharif Hossain [13] study founded that banana peel bio-mass based on hemicellulose is used to prepare nanoparticles as a device in nano-biotechnology by creating additional raw material resources; as well as other advancements. The economics of the paper, pulp, etc, sectors may also be significantly improved by advancements in the use of garbage. By acetylating cellulose, a thermoplastic substance is created (cellulose acetate). The whiskers (monocrystals) are formed after acidic therapy and the removal of the amorphous components of glucose micro fibrils, and they are utilized to create nano composites. This study resulted in the finding that the entire banana plant has several industrial uses, including feed, food, medicine, packaging, or many more. Fruits are a great source of minerals like k and Fe and antioxidants. Pseudostem, a byproduct of fruit harvesting, has the potential to be exploited as a source of cellulose for high-value cellulose based goods like paper and fiber [13].

Babu et al., [14] concluded in the research that using banana peels as biosorbents to remove nitrates from fluids. The country's groundwater supply is generally drinkable and suited for a variety of uses. The most frequently found contaminants, like arsenic, fluoride and iron, are geogenic (occurring as a result of genuine sources, primarily through rock-water interaction), while adulterant like heavy metals, nitrates, phosphates, etc. are the result of a variety of human activities. The research indicates the viability of using

banana peel as a bio sorbent to remove nitrate from drinking fluid (H20). It was investigated how various factors, such as contact duration, adsorbent size fraction, adsorbent dose, and nitrate solution, affected the process. When used as an adsorptive to treat 100 ml of dirty water with a 200 mg/l nitrate concentration for 0.5 hours, 0.05 g of banana peel powder was used with a 106 ml volume fraction, the extraction efficiency was nearer to 80% [14].

DISCUSSION

Over the world, banana peel is dumped as an agricultural waste since it is worthless and complicates waste management. Due to its nitrogen and phosphorus content, this biodegradable peel could harm the environment. Banana peels, however, can also be considered a readily available, inexpensive, and environmentally friendly biomaterial. The greatest way to protect the ecosystem, grow sources, and recover money from trash is to extract the banana peel. Banana peel flour has the potential to provide novel products with standardized composition for a variety of commercial and home purposes, much like its cousin, pulp flour. Around 40% of the heaviness of fresh bananas is made up of the skin, which is underused. The entire banana plant has several industrial uses, including feed, medicine, packaging, food, and many more. Fruits are a great source of minerals like K and Fe and antioxidants. Once the fruit is harvested, pseudostem is a waste product that has the potential to be developed as a source of cellulose for high-value cellulose-based goods like paper, fiber, etc. Research is still needed in the pertinent therapeutic applications and waste usage of action. There may be dire repercussions from this review [15].

CONCLUSION

According to the findings of this study, the entire banana plant has several industrial uses, including those in food, feed, medicine, packaging, and a wide range of other industries. Fruits are packed with antioxidants and minerals like Fe. Fruits are a great source of minerals like K and Fe and antioxidants. The pseudostem is a solid waste that may be adopt as a source of glucose for high-value glucose-based products like fiber, paper, etc. after the fruit has been picked. In the areas of useful therapeutic applications and waste utilization of action, further study is required. This might have severe consequences.

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