Value addition from Banana Fruit and Peel

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Abstract

Banana (*Musa* spp.) is a globally important fruit valued not only for its taste and nutrition but also for its diverse applications in food processing. Although widely consumed fresh, there is significant potential to transform both the fruit and its often-discarded peel into value-added products that improve shelf life, nutritional quality, and economic value. This article provides insights into processing of banana fruit into products like flour, chips, beverages and snacks, as well as the utilization of banana peel often discarded as waste, which is rich in dietary fiber, antioxidants and essential nutrients, making it suitable for use in bakery products, beverages, animal feed and biodegradable packaging. Valorizing both fruit and peel contributes to waste reduction, improves nutrition and supports sustainable economic opportunities for farmers and the food industries.

Introduction

Banana Fruit

Banana (*Musa* spp.) is one of the most widely cultivated and consumed fruits globally, prized for its sweet flavour, high nutritional value and year-round availability. Originating from the Indo-Malayan region, it is now grown across tropical and subtropical regions. India leads world production, contributing over 25%, with Tamil Nadu, Maharashtra, Gujarat, Andhra Pradesh and Karnataka as major producers (FAO, 2020).

Banana is rich in carbohydrates, dietary fibre, vitamins (C, B6, provitamin A) and minerals like potassium and magnesium and easily digestible, suitable for all age groups. Their low sodium and high potassium content also benefit heart health. Although most bananas are eaten fresh, there is great potential to process them into products like chips, flour, beverages, jams and other value-added items. However, only about 5% of bananas are currently processed, this means there is a big opportunity to reduce waste, increase farmers income and make better use of both the banana fruit and its peel in sustainable ways.

Banana peel: An underutilized Resource

Banana peel is the outer shell (cover) of the banana fruit. It accounts 40 per cent of the total weight of fresh banana and has been underutilized and discarded as waste which is considered as a potential source of phyto-chemicals and antioxidant.

Banana peels are rich in starch (3%), crude protein (6-9%), crude fat (3.8-11%), dietary fiber (43.2-49.7%) and essential amino acids. They also contain polyunsaturated fatty acids like linoleic acid, α-linolenic acid, and micronutrients such as K, P, Ca, and Mg (Hassan *et al.*, 2018). The peels are a good source of lignin, pectin, cellulose, hemi celluloses and galacturonic acid. Additionally, they have higher concentrations of micronutrients like Fe and Zn compared to the pulp, making them a potential feed material for cattle and poultry.

Banana peels from different varieties are used in the food industry based on their texture, composition and stage of ripening. Ripened *Musa acuminata* peels are soft and sweet, suitable for flour, bakery products and confectionery. The thick, fibrous peel of Saba (*Musa balbisiana* × *Musa acuminata*) is rich in starch and antioxidants, ideal for flour, snacks and fermented drinks. Semi-ripe *Musa acuminata* from the Philippines maintain firmness for use in jams and chutneys, while fully ripe *Musa cavendish* (Williams) peels, high in phenolics, are added to smoothies and baked goods. Nendran (*Musa paradisiaca*) has a firm, starchy peel perfect for chips, flour, and crispy snacks.

Banana peel offers many health benefits, including antioxidant and anti-inflammatory effects, digestive support, cardiovascular protection, blood sugar regulation and potential anti-cancer properties.

Value added products from Banana Fruit

Green Banana Flour

Green banana flour is a functional ingredient known for its high resistant starch content, which acts similarly to dietary fibre, supporting healthy digestion and promoting gut health (Nath *et al.*, 2018). The production involves peeling unripe bananas (either manually or mechanically), slicing into 5–10 mm pieces, and drying (sun-drying or mechanical drying) before grinding into powder. Pre-

steaming before peeling can ease processing and reduce browning. Applications include:

- Bakery Products – Substitution of 20–30% wheat flour in bread, cookies, and biscuits adds fibre, lowers gluten content, and increases mineral availability.
- RTE (Ready-to-Eat) Foods – Pancakes, muffins, noodles, pasta, energy bars and health mixes from the nutritional profile of banana flour.
- Ethnic Health Mix – Combining banana flour with ragi (finger millet) and jaggery or sugar to boost protein and micronutrient content.
- Vermicelli – Blending wheat and banana flour produces nutritious vermicelli with good consumer acceptance.

Banana Chips

Banana chips are a popular snack prepared mainly from unripe bananas, with several processing methods affecting their quality and shelf life:

- Fried Banana Chips – Sliced bananas deep-fried in oil; have a shelf life of 1–2 months.
- Dehydrated Chips – Slices are blanched to reduce enzymatic browning, then dried using hot air, vacuum, microwave or freeze drying.
- Vacuum Fried Chips – Fried under reduced pressure to lowers the oil absorption and preserves colour and allows chips to be made without peeling for extra fibre.
- Osmo-Vacuum Dried Chips – Combination of osmotic dehydration in sugar/salt solution followed by vacuum drying for attractive colour and flavour retention.

Fig 2: a). Fried Banana Chips, b). Dehydrated Chips, C). Vacuum Fried Chips and d). Osmo-Vacuum Dried Chips

Ripe Banana-Based Products

Ripe bananas are naturally sweet, aromatic and rich in potassium, magnesium, and bioactive compounds like phenolics and carotenoids (Singh *et al.,* 2015). Their softness and sugar content make them ideal for processed products ranging from beverages to desserts.

Fermented Products and Beverages

Fermentation improves flavour, shelf life and probiotic potential. Popular fermented banana products include:

- Banana Wine – Produced by fermenting ripe banana pulp with sugar and yeast; offers a unique aroma and taste.
- Banana Beer – Traditional in parts of Africa and Asia; prepared by fermenting banana juice with cereal adjuncts.
- Banana Vinegar – Produced from overripe bananas via acetic acid fermentation and used as a condiment.

Non-alcoholic beverages include

- Banana Juice and Smoothies – Fresh or pasteurised puree-based drinks, often fortified with vitamins or blended with other fruits.
- Banana Puree – A base for baby foods, bakery fillings, and ice creams.

Preserves and Sweet Products

Bananas can be transformed into shelf-stable sweet products through cooking, dehydration or concentration:

- Banana Jam – Prepared by boiling banana pulp with sugar and acid (pH 3.5); has a soft texture and characteristic flavour.
- Banana Jelly – Made from clarified banana extract it requires added pectin for gel formation.

- Banana Bar – The ripe pulp concentrated with sugar, dried to <20% moisture and cut into bars and have shelf life up to 7 months.
- Banana Fig –The ripe banana pieces dipped in honey and oven-dried; used as a raisin substitute in bakery and confectionery.

Banana-Based Snacks

- Banana Energy Bars – Combination of banana puree with cereals, nuts and seeds for nutrient-rich snacking.
- Banana Crisps – Thin slices baked or air-dried; healthier alternative to fried chips.

Condiments and Dairy-Based Products

- Banana Sauce - A spicy condiment prepared from ripe banana pulp mixed with onions, garlic, cloves, cardamom, cinnamon, salt, chilli powder, sugar and vinegar. The sauce is cooked

until thick, giving a tangy-sweet flavour and a long shelf life when bottled (Thilakam, 2016).

- Banana Yogurt - Fermenting banana puree with milk cultures produces a flavoured yogurt rich in probiotics and nutrients. It is both a preservation method and a value-added dairy product.

Canning and Long-Term Preservation

Bananas can be canned in syrup or juice to extend shelf life, facilitate transport and maintain quality over long storage periods. Canned bananas are used in bakery fillings, desserts and institutional catering.

Value added products from banana peel

Among the various forms of utilization, processing banana peels into a fine powder has gained significant attention for its versatility and ease of incorporation into diverse products.

Banana Peel Powder

Banana peel powder is a dehydrated, finely milled form of the peel that retains most of its nutritional and functional properties. The preparation involves washing, blanching, drying (sun or hot-air drying) and grinding. This powder is rich in dietary fiber, polyphenols and minerals, making it a functional ingredient in bakery items, smoothies, soups and dietary supplements. It enhances the nutritional profile of food products while acting as a natural colorant and preservative due to its antioxidant potential.

Banana peel powder has been successfully incorporated into a range of innovative products:

Banana Peel Powder Cookies

Cookies are made by mixing butter, powdered sugar, wheat flour, banana peel powder, milk powder, and baking powder into a soft dough. The dough is rolled out, cut into shapes, placed on trays, and baked at 120 °C for 5–6 minutes. The addition of banana peel powder increases fiber and antioxidants, making the cookies healthier.

Banana Peel Bread

Bread is made by replacing 10–20% of the wheat flour with banana peel powder. Flour, sugar, salt, and yeast are mixed, then warm water and a little oil or butter are added to make a dough. After rising, the dough is shaped, placed in tins, and baked at 180 °C for 25–30 minutes. This bread is richer in fiber and nutrients.

Banana Peel Noodles

Banana peel powder is mixed with salt and baking soda to make a dough, which is kneaded, rested, rolled out thin, and cut into strips. The noodles are steamed briefly, dried, and packed. They are a healthier option than regular noodles, with more fiber and bioactive compounds.

Banana Peel Pasta

Pasta is prepared by mixing wheat flour with banana peel powder. The dough is shaped into pasta forms and dried. This pasta is high in fiber, antioxidants, and can be stored for over a year if properly packaged.

Beverages

Banana peel can be used to make antioxidant-rich tea and smoothies fortified with fiber and potassium, enhancing health benefits without changing the taste.

Animal Feed

Dried banana peel is a cost-effective, nutritious feed for livestock, improving animal health while reducing waste and feed costs.

Functional Ingredients

Valuable compounds like pectin, phenolics, and natural pigments can be extracted from peels for use in food, pharmaceuticals, and as natural colorants.

Biodegradable Packaging

Banana peel fibers can be used to make eco-friendly bio-films that serve as sustainable alternatives to plastic packaging, promoting waste reduction and circular economy.

Ready to Cook products

- **Instant Banana Peel Soup Mix:** Banana peels are boiled, dried, and ground into powder, then mixed with onion powder, cornflour, spices, and herbs. To prepare, simply add the mix to boiling water for a quick, nutritious, fiber-rich soup.

- **Banana Peel Curry Mix:** Fresh banana peels are chopped, mixed with chili, garlic, cumin, turmeric, and curry leaves, then dried. The mix can be stored and later rehydrated to make a quick and healthy curry.
- **Banana Peel Sauce**: Banana peels are blended with coriander leaves, garlic, vinegar, chilies, and spices, then cooked into a tangy sauce. It can be used as a dip, spread, or as a base for savory dishes.

Conclusion

Banana fruit and peel together hold great promise for sustainable value addition. While the fruit's transformation into various products boosts nutrition and market value, the peel often discarded, serves as a rich source of nutrients and bioactive compounds with diverse industrial uses. Utilizing both fruit and peel reduces the waste, supports environmental sustainability and provides a new avenue for economic growth. Unlocking the full potential of bananas requires innovation and awareness to turn this abundant resource into a model of circular economy and health-focused food systems.

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