Value-added Processing of Bananas and Plantain

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Summary

Plantains and banana offer multipurpose processing options and are a great source of starch and energy. A wide range of products can be made from the unripe and ripe fruits, particularly puree for beverages and syrups, flour for baking and fried and dried slices for chips. Both ripe and unripe bananas and plantains are typically peeled and sliced before processing. Sun drying is the most widespread technique where climate conditions permit, but oven drying is also practices. Banana and plantain products are increasingly manufactured at an industrial scale. Most production is made from green bananas and plantains because ripe bananas are often damaged during transport. Banana flour is produced from unripe fruit, and banana powder from ripe fruit, and both products have rapidly expanding markets due to their nutritional and medicinal benefits.

Technical Description

A wide variety of food products may be processed from both ripe and unripe fruits of banana and plantain. Green banana and plantain are peeled, cut or chopped, dried and ground to produce a useful baking flour. This flour contains up to 80% starch that may be extracted into purer forms used in cosmetics. Cut green banana are fried into savory snacks. Ripe bananas are peeled for fresh fruit consumption and industrial processing. Pulped banana produces a puree for use in drinking beverages and dairy products such as ice cream and yoghurt. Sliced banana is dried and ground into banana powder or fried into sweet snacks. Banana and plantain is rich in dietary fiber, potassium, phosphorus, calcium, vitamins A and C, crude fat, carotenoids and other nutritious compounds. Traditional flour processing results in a brownish color that is unattractive for baking, but blanching or soaking in sodium metabisulfite or organic acids counteracts this problem.

Uses

Flour from unripe plantain and banana can be incorporated into pasta, noodles, infant foods, and bakery products as partial substitute for wheat, or for making gluten-free food products. Expertise and testing are needed to align the specific cultivars and growing conditions with final product. For instance, the green unripe French plantain Red Essong is best as a flour for the baking industry since it doesn’t alter the color of finished products unlike for the False Horn Mbouroukou 3 and PITA hybrids. Untreated flour of the plantain hybrid PITA 27 can be used in food products where high thickening is required,

whereas treated flours from False Horn Mbouroukou 3 and hybrid PITA 14 are better suited for foods that require less thickening.

Composition

The highest levels of amylose, water-holding capacity , and oil-holding capacity are recorded in unripe flours and the highest content of resistant starch in acid-treated flour. The highest level of total phenolic, carotenoid contents, and browning index is obtained in flour after pre-blanching. Crude protein content in flour from green dessert and plantain measures between 3.4% and 4.9%. The amylose and amylopectin content of plantain flours varies largely between varieties from 23% to 43%. Crude fat content ranges from 0.17 to 0.61% in green plantain flours whereas EAHB have no or very low fat content. Hybrid plantain and banana from the ABB group contain more than 40% resistant starch whereas this is lower for true plantains from the AAB group and East-African Highland Banana Cavendish and Gros Michel banana from the AAA group. Plantain flours have a low available starch content which form an issue for achieving dietary requirements of digestible carbohydrates.

Means of application

The flour of unripe plantain and banana is prepared by cutting the peeled fruit into slices and air drying for 1-3 days before milling. Before peeling, it is critical that the bunch or fingers are thoroughly washed to remove the sand and impurities. Peeling can be done by hand or with an industrial scale automated machine. At industrial scale the fruit is usually made into a smooth mash by wet milling that is dewatered using a press filter and flash dryer. Dried chips or press cake is then milled and sieved to obtain a fine high-quality flour. This process requires 8–10 kg of raw green bananas to produce 1 kg of dried banana flour. Banana puree is prepared from ripe bananas after washing and peeling. Bananas are blanched with steam or boiling water to a temperature of 93°C, requiring about 15 minutes. Blanched bananas are then cooled and passed through a blender. There are two different methods for making banana chips. One of these is to deep fry thin slices of banana in hot oil, in the same way as potato chips or crisps. The other is to dry slices of banana, either in the sun or using a solar or artificial dryer.

Agroecologies	Highlands, Humid forest, Moist savanna.
Regions	Africa South of Sahara.
Developed in Countries	Benin, Burkina Faso, Burundi, Cameroon, Democratic Republic of the Congo, Ethiopia, Ghana, Guinea, Ivory Coast, Kenya, Malawi, Nigeria, Rwanda, Sierra Leone, Somalia, Tanzania, Togo, Uganda, Zambia.

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Solution Forms	Equipment.
Solution Applications	Post-harvest handling, Value addition.
Agricultural Commodities	Banana/Plantain.
Target Beneficiaries	Small-scale farmers, Commercial farmers, Agro-manufacturers.

Commercialization

Commercialization Category

Commercially available

Startup Requirements

The following steps are needed for enterprise development around banana and plantain flour milling and blending, and widespread replication thereof: 1) Raise awareness with farmers, agri-food companies and investors on the economic benefits of the technology, 2) Formulate appropriate product standards, packaging sizes and prices based on consumer demand, 3) Identify profitable, durable and equitable strategies for taking flour products to local, regional and international markets, 4) Establish reliable supply of high quality fruit to processing plants through nucleus farming or sub-contracting, 5) Set up equipment and production lines that make efficient use of energy and labor, and 6) Train operators and workers on safety and quality adherence throughout the manufacturing process.

Production Costs

Banana flour production machinery with adjustible mesh size that can process 100 kg per hour is available in China for US $15,000. Larger equipment with a capacity of producing 5 ton flour per hour cost about $300,000. Equipment for the automatic production of fried banana chips costs netween $10,000 and $60,000 depending upon throughput capacity. This equipment processes between 100 to 500 kg per hour and include a banana peeler, banana slicer, a gas powered continuous fryer, a vibrating de-oiler, a flavoring station and automatic weighing and packing. Commercial presses for producing banana pulp cost about US $1,500, are made of stainless steel and have a

pulping capacity of 0.5 ton per hour. larger machines able to pulp 2.5 tons per hour cost about $4,000 in China.

Customer Segmentation

Flour milling and blending systems for banana and plantain are applicable to industrial processors and food manufacturers, and may be modified to suit the needs of more localized community-based operations. It also requires that consumers accept the products resulting from blended flours.

Potential Profitability

Both banana flour and powder are internationally marketed as gluten-free alternatives to wheat-based flours. Banana flour has excellent cooking characteristics that allow it to replace wheat even in cooked products such as pasta. The banana powder market rapidly expanding owing to its recognized medicinal and nutritional characteristics. This market is segmented into food, pharmaceutical, animal feed, and cosmetics applications. Banana flours are rich in resistant starch which helps diabetes patients improve insulin sensitivity and maintain blood sugar levels. The presence of potassium in banana flour provides multiple health benefits which is a vital factor contributing to its market growth. Globally, the market for banana is estimated at US $63 Million in 2020, and forecasted to grow annually with 4.4% by 2026.

Licensing Requirements

The establishment of commercially operated processing agribusinesses involves the acquision of several businesses licenses and is subject to regulatory health inspection.

Innovation as Public Good

Cottage-style techniques for production of banana and plantain flour are a Public Good, whereas the building and operating procedures for industrial systems remain intellectual property of manufacturers.

Solution Images

Banana flour has a growing demand as a wheat substitute

Food stuffs prepared from different plantain varieties of Nigeria

Steps of industrial flour production from plantain (Credit: Kaifeng Sida)

Institutions