Extension Folder : 34

G20
भारत 2023 INDIA
वसुधैव कुटुम्बकम्
ONE EARTH • ONE FAMILY • ONE FUTURE

BANANA PRODUCTS
for new business horizons

P. Suresh Kumar
D. Amelia Keran
K. N. Shiva
C. Sivananth
K. Kamaraju
S. Uma

भाकृअनुप
ICAR

ICAR - National Research Centre for Banana
(An ISO 9001 : 2015 Certified Institute)
Sardar Patel Outstanding ICAR Institute
Thogamalai Road, Thayanur Post, Tiruchirappalli - 620 102.
Tamil Nadu, India.

NATIONAL RESEARCH CENTRE FOR BANANA
TIRUCHIRAPALLI

Bananas are incredibly healthy, convenient, delicious, and one of the most inexpensive fresh fruits, containing many essential minerals like potassium, magnesium and vitamins like A, B along with fair amount of resistant starch and fiber. Therefore, it benefits in weight loss, digestion and heart health. The banana industry is an important part of the global industrial agro business. In addition to banana export and domestic fresh consumption, processing of banana into different products could mean additional income for banana farmers and new business opportunities for entrepreneurs. Considering the importance, ICAR-NRCB has developed more than 40 immune boosting, market driven, remarkable technologies and products with higher commercial entrepreneurial opportunities. Some of the most innovative products with better market potential are described.

Minimally processed ready to cook banana products (unripe-fruit, flower, central core stem & rhizome/ corm)

Convenient foods are gaining popularity with the change in lifestyle, demography, emergence of quick service restaurants (QSR) and working women. Minimal processing of unripe plantain slices, its inflorescence (flower), inner central core stem and rhizome has tremendous domestic and export market opportunities. Pre-treatment of the above parts with preservatives like potassium metabisulphite (KMS, 0.05%) and/ or citric acid (0.05%) has the possibility to enhance the shelf life of the products up to 10 days when packed in HDPE bags and store under refrigerated condition (7±1°C). Natural products like garlic extract could also be used. Other than domestic market, this has higher opportunity to be exported to satiate the requirements of ethnic population. Minimally processed banana slices could be an better option for making evening snacks like bhajji.

Low-fat banana chips (Microwave/ Vacuum)

Banana based snack industry is expected to witness a stellar growth from Rs.500 to 5000 crores in near future due to change in food habits and consumption pattern. Endowed with unique flavour, banana chips are gaining attention in domestic and international markets. Consumer inclination towards healthy foods, provides opportunities for making low fat chips in market shelves with the added advantages. Surface treatment of unripe banana slices (Nendran/ Popoulu) with hydrocolloids can render less oil absorption during deep frying and reduce oil percentage by 25%. Similarly, microwave and vacuum frying technologies facilitate less oil absorption to banana slices. HDPE pack with nitrogen flushing maintains the chips nutritive and sensory attributes intact and enhances shelf life up to 60 days.

Nutrient Dense Banana grits

Grits are a popular dish widely consumed across different parts of the world. They're generally made from dried and ground cereals like oats, wheat or maize. They are often cooked in different liquids like water or milk until the mix reaches a thick, creamy, porridge-like consistency. It's ease of preparation and long storage life makes it a comfortable and convenient product for preparation. Development of grits from unripe banana opens a new vista of opportunity with improved resistant starch and Pro vitamin A content.

Banana grits can be used for making a great variety of dishes. They bear resemblance to *Rava* and broken wheat too. Banana grits are also similar to corn grits or "*polenta*" (Italian Dish). The lack of gluten in grits means they could be consumed by those who are sensitive to gluten. Use of low heat during its preparation aids in slow release of starch, which creates a decadent, silky texture. Frequent constant whisking throughout the cooking process, will prevent lumps from forming and after cooking they have a smooth, creamy, and deeply flavourful taste. This can be a better choice than cereal grits that lack resistant starch and for health-conscious people. Banana grits can also be used for the preparation like "*Upma*" or "*Kheer*".

Low-Fat set Fruit Yoghurt

Yoghurt is a fermented dairy product with high protein and calcium contents. It is also rich source of carbohydrates, fat, vitamins and phosphorus. It has nutraceutical effects such as enhancing digestion owing to the presence of probiotic cultures like *Lactobacillus* and *Bifidobacterium*. There is increased consumer demand for dairy products with added fruits due to their functional properties. The incorporation of probiotic cells into banana matrices in the form of puree could possibly help the cell survival.

In addition, ripe banana has been known as a natural source of prebiotic substances such as oligo- and polysaccharides. Its matrix is also a predominant source of sugars namely sucrose, glucose, and fructose, which are suitable for fermentation by microorganisms. Commercial yoghurts are available in a wide range of fat contents. Consumers need for low fat yoghurts with better sensory qualities than conventional yoghurts can be met by using banana puree or powder. Addition of banana starch can also act as a thickening agent in the preparation of low-fat set fruit yoghurt.

Functional green banana flour-based smart foods

Utilization of green banana and plantain for its flour is of interest as a possible resource to make healthy functional products with its higher resistant starch and low glycemic index. By simple dehydration of raw banana slices in hot air oven / solar drier and pulverizing it, can yield green banana flour with higher resistant starch, fiber and minerals. It acts as a gluten free replacement to wheat flours which can be promoted by certain dieting trends such as paleo, and by some recent nutritional research on banana flour. With a texture similar to lighter wheat flours, it has a mild banana flavor when eaten raw and an earthy flavor when cooked, requiring 25 percent less volume than wheat flours. Green banana flour could be considered as an ideal supplement in the products such as pasta, bread, spaghetti, cookies, noodles and health foods. Being a grain-free source of complex carbohydrates, it is a good choice for those seeking to lose weight as it helps to regulate appetite and prevent overeating.

As it is loaded with resistant starch and prebiotic fibre that promotes gut health while whittling down belly fat. Resistant starch present in green banana flour"resists" the process of easy breaking down into sugars. This may help lower blood sugar levels. Additionally, it may help to feel more satiated, lowers pH levels and helps to reduce cell damage. Banana flour could be used in variety of industrial applications with its better thermal characteristics like lesser cooking time than the other flours. A combination of malted maize, milk solids, soybean and roasted groundnut flour along with unripe green banana flour can be a recommendable healthy food. Similar way, it is suitable for blending with other flours and paves way in the form of health mix and soup mix. This can also be blended with most of the traditional recipes like murukku, roti etc., During Covid period, the utilization of green banana flour in Karnataka revolutionized with its multiple use under *"Ba ka hu"* movement.

Banana starch and modified starch

Starch, a white powder, without out any taste or odour becomes household name and not new to anyone today. With the growing demand, new sources are being explored for starch extraction and utility. Unripe green bananas are found to be an excellent reserve material, contains up to 80–90% starch (dwb). Banana starch has a great potential due to its digestion and techno-functional pre-biotic properties. They have application in processed foods with higher resistant starch.

Being a non-conventional source, it has numerous uses as an ingredient in food systems and other industrial applications. It is unique both nutritionally and functionally, and its further modification can definitely be considered as a fortunate thing to the starch starving sectors like food, pharma and bio-polymer industries.

Dehydrated ripe banana (Banana Fig)

The emerging trend among consumers to select protein and fiber enriched snacks is fuelling the demand for dry fruits market. Dehydrated ripe banana or banana fig are leathery and dry product with a competing potential in global market. In order to obtain high quality dehydrated banana, an efficient, safe, and controllable drying method for commercial scale is required. Several drying methods can be a viable commercial option for the production of dried banana, including hot air drying (HAD), Solar drying (SD) and solar dryer with Phase changing material (PCM) or hybrid drying sheds.

Traditional bananas like Karpooravalli, Elakki (Neypoovan), Nendran with higher sugar content are suitable for making banana figs. Honey dip, and green tea extract coating can further improve its market value. This can be a multi dense food with lesser weight. Best wholesome dry fruit for defence personnel and school children to impart immediate energy. This dehydrated, easily available product can also be a better carrier for fortification of minerals like iron and vitamins.

Ripe banana fruit powder

The demand for "tropical fruits" has grown so much in recent years that there is enormous scope for exploring and developing new products. Fruit based sugars are gaining attention due to nutraceutical benefits. Fruit powders, also known as dehydrated fruit pulp powder or dehydrated fruit powder, can have multifaceted utility in the food industry. It is a process that is characterized by the transformation of a liquid in a heated medium, in a continuous operation, turning it into a solid state in the form of powder by drying. The natural matrices of ripe banana powder contain a high amount of simple carbohydrates and bioactive compounds with potential pre-biotic beneficial effects. Preserving the characteristics of fruit-based products (such as colour, flavour, odour and nutritional quality) is of interest to manufacturers and the consumer.

Therefore, the choice of the appropriate drying method and operating conditions is pivotal for achieving this goal. **With intense taste and indulgent natural flavours and flavours ripe banana fruit powder is a very good choice for making healthy pudding, fudge, pan cake and bakery filling along with all-purpose flour.** It can be used as a ready-to-sprinkle powder on other foods or as a functional ingredient in juices, purees, milk or tea. It can also be suggested for compaction into **tablet forms for nutraceutical.** The prominent antioxidants in fruit sugar can facilitates the decrease in oxidative stress by scavenging the free radicals. In addition, it has better prebiotic activity and opens up new vista of opportunities for using it to promote selective growth of beneficial organisms and to make prebiotic rich **synbiotic foods.**

Encapsulated food products can also be made using dehydrated ripe banana powder. With growing demand for fruit powders, which are extensively used as replacement of artificial flavours and colours, sales are expected to multiply in the coming years. Use of natural fruit powder retains the inherent characteristics of the food. Future Market Insights (FMI) has forecast the demand for fruit powder to increase at 7.4% CAGR between 2021 and 2031. Fruit powder is extensively used in coffee drinks & protein shakes, and tomato paste in a pasta sauce, juice and plant-based beverages. Backed by the rising demand for organic ingredients, leading food brands are adopting fruit powder as a natural functional ingredient.

Clarified banana RTS & blended beverages

The overwhelming demand for fresh and nutritious beverages is increasing the demand for clarified juice concentrates extensively. The growing popularity of healthy and tasty drinks among a substantial chunk of the populace will bring immense growth prospects for the clarified juice market. Ripe bananas are a perfect choice for the preparation of clarified banana RTS owing to their rich sugar content. The addition of hydrolytic enzymes like pectinase and cellulase can aid in the production of clear and clarified banana juice.

Fruit juices fortified with functional ingredients offer new product opportunities to companies that can develop and market functional fruit juice products by understanding consumer preferences, so as to meet consumer expectations. Further addition of omega-3 fatty acids, bioactive compounds, vitamins, and probiotic bacteria are some of the functional ingredients that offer immense product opportunities for the juice industry. Berverages like squash, nectar, cordials, fizzy drinks could also be prepared with incorporated bioactive substances.

Basil seed suspended banana ready to serve (RTS) beverage with no added sugar

Fruit beverages have gained popularity recently and provided an alternative substitute to aerated/carbonated beverages. Sweet basil seeds (*Ocimum basilicum)* are considered to be a rich source of dietary fiber. The importance of dietary fiber on human health for functional beverages can be satisfied by basil seed suspended banana ready to serve (RTS) beverage. The complication in suspending basil seeds is that, due to density differences with fruit juice, it is common tendency for seeds to either settle at the bottom or to float at the top. This was overcome with clarification of juice, homogenization and proper suspension of hydrocolloids. With proper marketing and publicity this product can rule the retail market shelves which are previously filled only with fruit flavoured basil/chia seed suspended beverage with added sugars. This product has shelf life of more than 90 days under chilled condition. This could be a better thirst quencher than the carbonated products available in the market. Blended banana juice using strawberry, raspberry, guava, beetroot and apple could also be prepared.

Banana wine and vinegar

Fruit juices are fermented to produce wine, an alcoholic beverage. *Saccharomyces cerevisiae* yeast converts the sugar in the fruit juices into alcohol and organic acids, that later react to form aldehydes, esters and other chemical compounds which also help to preserve the wine. As an alternative to full-strength wine, tropical fruit wines with a reduced alcohol content (4-6%) offer a number of potential social and health benefits for consumers. Considering the immense health benefits of banana, the aerobic fermentation of its enzymatic clarified juice with *Saccharomyces cerevisiae* has the ability to yield banana wine with medium alcohol content and high phenolic content.

Vinegar was used as a condiment for conservation by the Babylonians & Egyptians around 2000 BC. Apple cider vinegar may be the most well-known type of fruit vinegar, but banana can also be a competitive product for making fruit vinegar. Vinegar can impart a yielding flavour when added in different global cuisines. It also has many health benefits on top of its potent flavour. Banana vinegar can be a better choice than synthetic vinegar with immense nutrient like potassium, magnesium and bioactive properties.

Low-sodium banana stem central core and flower pickle

Increased promotional activities by the manufacturers have increased the popularity of cross-cultural cuisine. The use of pickling as a culinary technique helps to preserve the shelf-life of a food product through anaerobic fermentation that is done in brine or through vinegar immersion. Pickling is one of the more cost-effective ways to preserve food. Eating low-sodium pickle is the great way to add more essential minerals & vitamins into the diet and improving digestion and maintain blood pressure.

Banana inflorescence and central core stem with rich bioactive properties can be utilized for the development of pickles (Thokku). Even the industrial players who are ruling the retail market shelves with variety of pickles have not tried these pickles from banana parts. The usage of sea salt alternative salts with low sodium content at definite proportions without compromising on sensory properties adds additional market value and consumer preference to these products. MSME sector could utilize the opportunity with these products to maximize their profit and sustainability.

Banana stem candy

Candy and sugar have been linked in our brain for celebrations. Candied products are easy to preserve. Banana stem is a good choice for being candied. Central core is a by-product obtained from banana pseudostem during the process of fibre extraction. It is rich in digestible fibres, Iron, Vitamins B3 and B5. Soaking and boiling of banana stem in sugar solution and ginger extract makes it sweet and soft. Further drying, gives the product a firm texture.

After processing of central core into candy, it becomes delicious and palatable and liked by people, especially children. This is an unique product for the consumers as well as for processors. Being a preserved product, it has better self-life without the need of being refrigerated. Besides, its use-by date is really long. These items can also find good marketable value in future.

Central core stem juice

India shares 20 % of the world banana production, and generates>80 million tons (MT) of pseudostem biomass, which is more than double the quantity of bunch harvested (30 MT). Banana central core stem is used in various ayurvedic and siddha formulations to cure kidney related disorders, worms in intestine, diseases related to mental health, burn injuries and wounds. The phenol, flavonoids and antioxidant activities are known to be higher in it. Central core stem of banana contains up to 92-94% of moisture. Hence a simple extraction or mechanical crushing can give maximum yield of banana stem juice.

Banana central core stem juice could be potentially utilized as an effective source of antioxidant, anti-inflammatory, anti-urolithiatic and antitumor agent. Diverse portfolio of products from different demography can be made to maximise its business potential, Other than conventional markets pharmacy, ayurvedha can also be tapped to make the product more popular with its immune boosting capabilities.

Dietary fibre from banana central stem

Dietary fibre is mainly a carbohydrate, which pass relatively unchanged through human stomach and intestines. The major role of fibre is to keep the digestive system healthy. The importance of food fibres has led to the development of a large and potential market for fibre-rich products and ingredients. In recent years, there is a trend to find new sources of dietary fibre that can be used in the food industry. Banana central core stem is a rich source of dietary fibre that creates a feeling of satiation. Dietary fibres are used in a variety of industries, including pharmaceuticals, food and beverage. Consumers are incorporating dietary fibres into their regular meals, which fuels market expansion. Its possibilities for food fortification are currently being exploited by a growing number of food product manufacturers. High digestive tolerance, fibre enrichment, remarkable stability, and ease of formulation in a wide range of applications makes dietary fibre as the best component in smart food markets. Fibre in foods can change their consistency, texture, rheological behaviour and sensory characteristic of the end products. The emergence of novel sources of fibres, have been offering new opportunities in their use in food industry. Addition of banana central core stem dietary fibre in breakfast cereals, bread, cookies, cakes, Ice cream, yoghurt, beverages and meat products are some of possible industrial applications.

Pectin from banana peel

Pectin is a naturally occurring carbohydrate in fruit especially the rigid portion of fruit contains more pectin. Pectin is an approved food additive (INS 440) capable of forming gels with sugar /acid and therefore is being used as a gelling agent. Pectin has shown to improve cholesterol metabolism and supports normal blood pressure. New applications of pectin in functional foods, pharmaceuticals and biomedical continue to emerge, making pectin extraction and commercialisation an attractive investment. Exploring the opportunities to use banana peel for the extraction of pectin would be a most sustainable and profitable alternative way of adding value to the industrial waste, besides fulfilling the demands of the pectin industry. Better quality pectin can be extracted from banana peel with higher methoxy content and emulsifying activities.

Fibre from banana pseudo-stem

Banana fibre is a multicellular fibre belongs to stems/bast fibre, like jute consisting of xylem and phloem, sclerenchyma and parenchyma cells arranged in a particular fashion. The principal constituent of fibre is a native α-Cellulose intermingled with hemicellulose (polysaccharides) and even lignin to some degree. Compared to other fibres, banana fibre is relatively shorter in length, but finer. Its fineness is closer to kenaf and jute which are used for decortication purposes. Banana pseudostem can yield 1-1.5% of fibre. All varieties of banana trees abound in fibers. Out of the 14-18 sheaths available in a stem, the outermost 4-6 sheaths yield course fiber, the inner 3-5 sheath yield soft lustrous fiber and the rest middle sheath yield soft fibers. From one hectare, pseudostem yield 500-700 g fibre, 30-35 tonnes of scutcher / baggase, 12000-15000 litres of sap and 4-6 tonnes of central core stem.

These fibres are subsequently spun into different fabrics depending upon the end user applications. Traditionally, this fibre has been used for handicrafts, ropes, doormats as well as in textile sector. Very recently, banana fibre and other plants fibres have attracted much interest in polymer composite materials as it has a potential to use as an effective reinforcing component.

Scuture waste could be used for preparing vermicompost. Sap can be used as liquid fertilizers/mordant dye. Banana fibre has excellent characteristics like good mechanical strength, stiffness, low density, non-abrasive, high disposability, renewability and they are considered to be eco- friendly over synthetic fibres. Paper board, tissue paper can be prepared out of banana pseudostem. Banana fibres can be used as natural absorbent, bio – remediation agent for bacteria and can also be used for mushroom production. They could also used in making quality paper cards, tea bags, string thread, high quality fabric material, paper for currency notes and good rope for tying purpose.

Cellulose and its products from banana fibre

Cellulose is a polymer of β-glucose that are held together by hydrogen bonds to form microfibril. Banana cellulose provides advantages such as low density, appropriate stiffness, mechanical properties, high disposability and renewability. Additionally, they are recyclable and biodegradable. They can be used in the textile industry. Similar to cotton, linen, and other natural fibres which could be used directly or processed to make rayon like viscose fibre.

Micro/ nano crystalline cellulose and powdered cellulose are used as drug fillers and as food thickeners, emulsifiers, and stabilizers. Personal hygiene products, non-woven fabrics could also be made using banana fibre and its derivatives. It can also be used in composites and epoxy industries. Regenerated modified fibers and its derivatives has diverse engineering, packaging and pharmaceutical applications.

स्वच्छ भारत
एक कदम स्वच्छता की ओर

PM FME

हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद
Agrisearch with a human touch

Sponsors

PPVFRA
NABARD
एपीडा
APEDA
राष्ट्रीय बागवानी बोर्ड
NATIONAL HORTICULTURE BOARD

Contact Details

Director
ICAR- National Research Centre for Banana
Thogamalai road, Tiruchirappalli -620 102, Tamil Nadu, India
Phone : 0431 2618125, Email - director.nrcb@icar.gov.in,Web - https://nrcb.icar.gov.in