



REVIEW ARTICLE

Value added food products incorporating *Musa balbisiana*- a key to nutrition security

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ABSTRACT

Mindful eating has recently gained attention and people are more cautious than ever. Having the market flooded with various conventional food products with health hazardous chemicals and artificial flavours, people have started to opt for flavours as natural as possible. Banana is one of the most important fruit crops of India contributing 16% of the world total fruit production. Each and every part of banana a rich source of various bioactive compounds like total phenols, carotenoids, flavonoids etc. The Banana fruit is highly perishable and it is important to convert them to semi perishable value added food products by applying appropriate processing techniques to reduce the post-harvest losses. Various value added food products can be obtained by using banana. The aim of this review is to provide information about the food value of banana and value added food products developed from different parts of banana plant. As value addition of banana plays significant role in human nutrition, especially as a source of vitamins, minerals and dietary fiber, thus value addition of such fruits and vegetables by formulation of different value added products are an important source of nutritional security.

Keywords: Banana, product development, superfood, therapeutic properties, value addition

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INTRODUCTION

Banana plants are monocotyledonous perennial and one of the most important fruit crops of India contributing 16% of the world total fruit production. It is among the numerous fruit yielding plant which is as not only a healthy fruit but also all parts of the plant provide various medicinal values. The worldwide production of bananas in 2015 was 117.9 metric tonnes and Asia exports 4.5 million tonnes in 2019, representing an increase of 18 percent compared to 2018, when they stood at 3.8 million tonnes. (NHB 2014, FAOSTAT 2017, FAO 2019). The edible banana is indigenous to the warm moist part of Asia and probably originated somewhere in the mountainous regions of Assam, Myanmar (erstwhile Burma) Thailand, Vietnam (erstwhile Indochina). More than 85% of global banana production is produced by small-scale farmers, providing an important source of food and income. (NHB 2014)

Banana is a popular and everyone's favourite fruit all over the globe because of their taste texture, availability, versatility, and cost. Banana is a very good source of carbohydrates, dietary fibres, certain vitamins, essential minerals specially potassium

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and many health-promoting bioactive phytochemicals which reduces neurodegenerative disorders (Sidhu and Zafar, 2018) but it can also act as mineral inhibitors when in forms such as phenolic compounds, phytates and tannins (Anyasi et al., 2018).

It is a highly perishable fruit because of its high moisture content that leads to microbial contamination. The high levels of sugars, nutrients element and low pH value also make this particular fruit desirable to fungal decomposition. (Kuyu and Tola, 2018). This is why it is important to convert them to semi perishable value added food products by applying appropriate processing techniques and gentle handling to reduce the post-harvest losses. (Ahmed et al. 2013; Singh et al., 2018). Value added products are not only important sources of vitamins, minerals and fiber but also provide a wide array of bioactive components or phytochemicals. (USDA, 2011). Sustainable utilization of wastes and by-products from banana peel, rhizome, leaf etc for producing value-added products provides an opportunity for earning additional income for the dependent industrial sector as well as help in decreasing pollution by reducing environmental stress. (Ben-Othman et al., 2020).

NUTRACEUTICALS POTENTIAL OF BANANA FRUIT

Banana fruits are highly nutritious and easily digestible than many other fruits (Mohapatra et al., 2010). The wide consumption of banana is due to its sensory characteristics, particularly its attractive texture and flavor make banana popular by the consumers (Robinson and Sauco, 2010). Moreover, it has high caloric contribution leading to high demands mainly by developed countries which account for nearly 70% of world's consumption (FAO, 2012, Salvador-Figueroa, and Ov, 2016). The fruit is low in fat and high in dietary fiber, vitamin C, vitamin B6, and manganese making it an excellent source of nutrients (Vazquezshy et al., 2012). The presence of potassium and fiber in large amounts in bananas may help combat atherosclerosis, which can lead to heart attack and stroke and keep body fluids in balance (Kumar et al., 2012). Banana is an also an ideal weaning food for the children after six month of birth and as well as ideal for geriatric nutrition (Aurore et al., 2009). Whole banana plant is useful in food, feed, pharmaceutical, packaging, and many other industrial applications (Singh et al., 2018).

Each and every part of banana a rich source of various bioactive compounds like total phenols, carotenoids, flavanoids etc. Some phytosterols were also reported in banana, however there level was low due to these bioactive compounds, bananas have a higher antioxidant capacity than some berries, herbs and vegetables and this capacity increases during fruit maturity (Borges et al., 2014; Singh et al. 2016). Pereira and Maraschin (2015) reported that gallic acid, catechin, epicatechin, tannins and anthocyanins are the main phenolic compounds which is reported to be 7 mg/100 g fresh weight. These compounds impart astringent taste to the unripe banana. Arora et al., (2008) determined the beta carotene content in selected Indian banana varieties and reported karpooravalli banana cultivar had the highest beta carotene content (143.12 µg/100 g) among all the varieties.

THERAPEUTIC PROPERTY OF DIFFERENT PARTS OF BANANA

Banana is a rich source of antioxidant compounds and these compounds reduces risk of neurodegenerative disorders, retards ageing process and helps in lowering the incidence of degenerative diseases, such as heart disease. Folklore studies revealed that root extract (RE), shoot extract (SE), and inflorescence extract (IE) of *Musa Balbisiana* have high medicinal properties, and the root extract is used for the treatment of diabetes (Kalita et al., 2016). However, very less scientific study has been conducted till date regarding the scientific validation of this traditional claim. Various parts of the plant like Fruits, leaves, roots, and stalks from banana plant can also be used for the treatment of various diseases including diabetic, diarrhea, scabies, fevers, burns, pain and inflammations as all parts of the plant exhibit different pharmaceutical properties (Rai et al., 2009 and Hasan et al., 2014). Banana is suitable for consumption as it contains less fat, less sodium, and no cholesterol, making it particularly

recommendable for people with cardiovascular and kidney problems, arthritis, gout, or gastrointestinal ulcers. The plant is traditionally used in diarrhoea, dysentery, intestinal lesions in ulcerative colitis, diabetes, sprue, uremia, nephritis, gout, hypertension and cardiac disease (Imam et al., 2011, Sumathy 2011). Kumari et al. (2020) observed *Musa balbisiana* fruit pulp powder for its cardioprotective effect in cardiac hypertrophy and suggests that *Musa balbisiana* fruit powder supplementation can be useful for inhibition of inflammation and oxidative stress. Banana peel also has the antibacterial activity against periodontal pathogens as well as gram positive and gram negative bacteria (Kapadia et al., 2015 and Chabuck et al., 2013). *Musa balbisiana* Colla root extracts treated rat revealed a reduction in fasting blood glucose (62.5%), serum total cholesterol (36.2%), triglyceride (54.5%), and low-density lipoprotein (50.94%) after 15 days as compared to STZ treated animal (Kalita et al., 2016).

VALUE ADDITION OF BANANA

Banana undergoes less industrial processing compared to fruits such as potato, apple, orange, and tomato (Aurore et al., 2009). Different value added products like chips, snacks, powder etc. Helps to improve the market efficiency and income to the farmers as well as help to generate employment. (Singh et al., 2018).

Banana chips

Green bananas can be sliced and fried as chips. CFTRI, Mysore has developed the process technology of banana chips by using 'Dwarf Cavendish' and 'Nendran' varieties. The chips are produced by peeling followed by slicing and then dehydration. Banana chips may be osmotically dehydrated with brine solution and then dried in conventional air-dryer or microwave, radio frequency, infrared, vacuum or freeze-dryer to reduce the drying time and cost (Demirel and Turhan 2003; Jiang et al. 2010). Though freeze drying yields a good product, but it is not cost effective. The storage period can be greatly enhanced (up to 147 days) by storing the banana chips controlled conditions at about 25°C (Sagar and Kumar 2010)

Banana flour /powder

Drying is one of the best processing methods for any perishable food product. It is considered necessary to make the fruits available year round and different places where it is not available. Banana is dehydrated to remove moisture by different methods like microwave drying oven drying (Ganesapillai et al. 2011); spray drying, solar drying, freeze drying (Ezhilarasi et al. 2013) and ground to make banana flour or powder. The drying process also helps in handling and transporting due to its decreased weight. (Araya-Farias and Ratti, 2009). However, Anyasi et al., (2015) pretreated the banana pulp with organic acid to obtain unripe banana flour (UBF) and noticed that it enhances the physical and antioxidant properties of the banana flour. Liao and Hung (2015) studied the starch digestibility of green banana powder. Yan et al. (2016) determined the optimum ripeness stage to extract carotenoids from second grade banana peel for possible food applications. Banana puree is the main commercial processed banana product that is widely used all over the world (Pillay and Tenkouano, 2011)

Banana wine/beverage

Banana wine is an important alternative to utilize over ripe banana. Fermented alcoholic beverages can be made from ripe banana pulp juice ameliorated to 18°Brix was inoculated with 3% (V/V) Baker's yeast (*Saccharomyces cerevisiae*) and held at 30 ± 2°C for 14 days (Akubor et al., 2003, Ngwang 2015) as well as peel (DeMatos et al 2017). The highest aroma-producing yeast

isolated from banana fruit and peel showed that whole banana could be a good substrate for fermentation and distillation, (DeMatos et al., 2017)

The addition of organic green banana flour (GBF, 0%, 1%, 3%, or 5% w/v) on the quality parameters of fermented milk was investigated (21 days/5 °C) by Batista et al.,(2017) and found that at 3% addition of green banana flour, contributes to develop Synbiotic fermented milk with improved fatty acid and volatile profiles, as well as aroma and flavor acceptance.

Banana puree

Ripe banana fruits can be pulped for puree making which further used in a variety of products including ice cream, yogurt, cake, bread, nectar, and baby food. (Aurore et al. 2009). Banana pulp had potassium (584 mg/100 g), magnesium (58 mg/100 g), total sugar (5.2 g/100 g) and starch (1.8 g/100 g) contents. (Yap et al.,2017)

Banana baby food

Inadequate or inappropriate food intake is one of the leading factors of childhood malnutrition that leads to childhood morbidity and mortality. (Ibrahim et al., 2017) That is why wholesome, nutritionally adequate weaning diet is essential for achieving optimal growth in this crucial phase of life. (Matvienko-Sikar, 2018). Again childhood obesity is one of the leading due to excess added sugar consumption leads to poor health outcome in children. Banana is an excellent weaning food option for toddlers. A highly nutritious baby food has been formulated by using banana pulp flour to use as complementary feeding after supplementing it with other source of protein, mineral, vitamin and fat. (Ayo-Omogie et al., 2013)

Banana candy

Banana fruit candy made from banana pulp, jiggery and ginger are very popular in Southern part of India. However different types of candy was developed using banana stem as well through osmotic dehydration and sun drying process. (Mohiuddin et al., 2014, Desai et al., 2016)

Banana fig

Fully banana fruit can be made into figs by drying or dehydrating the extra moisture. There are very sweet in taste with sticky consistency. For this, the banana fruit is treated with 0.1% potassium metabisulphite solution and dried under the sun or oven dried at 50 °C. These figs may have a shelf life of about 3-4 months with appropriate packaging and ambient conditions. (Lal et al., 2017)

Banana jam/ jelly

Excellent quality of jam can be produced from ripen banana and they have sweet taste, fine flavour and texture (Aurore et al. 2009) . In the method for the preparation of jelly or jam fully ripe or over-ripe fruits are used. First the fruits hand-peeled and cut into definite small pieces or slices. The banana slices are boiled for 1 h in 60° Brix sugar syrup at the rate of 1 lb of banana slice to 1 pint of syrup (454.01 g to 0.5681). This is then strained and the clear solution is boiled until it sets. The Ph should be adjusted to 3.5. Sometimes pectin is also added to improve the set. (Singh et al 2018)

Banana sauce

Banana sauce is a ready-to-eat to sauce. The sauce has a strong banana taste and flavour and a dull yellow-red colour. The total soluble solid content varies from 39-40°Brix depending on the variety of bananas. It has a shelf-life of one year when stored in bottles. (Singh et al 2018)

Banana snack bars:

Value added cereal bars were developed by using banana peel flour, rice flakes and oat flour and on sensory acceptability of cereal bars, with subsequent evaluation of sensory profile of products identified as having high acceptability. The use of banana peel flour in the production of cereal bars is doable with different sensory profiles, which may favour the development of new products for different market niches. (Carvalho and Conti-Silva 2018).

Banana peel manure

Banana waste materials are rich source of nutrients and minerals like potassium, nitrogen and phosphorus. It is also rich source of starch (3%), crude protein (6-9%), crude fat (3.8-11%), total dietary fibre (43.2-49.7%), poly unsaturated fatty acids, essential amino acids and micronutrients. So peels could be good material for cattle and poultry feed. (Achinas et al., 2019)

Banana detergent

The banana foliage and pseudo stems are used as cattle feed during dry periods in some banana producing areas. Bananas are a good energy source but need to be supplemented with protein (Emaga, et al., 2008)

Banana plant leaves

The banana leaves are not eaten but may be used for wrapping food in cooking. These are also used for weaving eco friendly baskets, mats, cups etc (Mohapatra et al. 2010) In India and Asia, banana leaves are used like aluminium foil. The leaf makes an excellent platter and food served on these leaves tastes delicious. The leaves are not eaten but while steaming food some of the polyphenols are imparted to the food.

CONCLUSION

Different parts of banana have a long history of traditional uses ranging from folk medicine to culinary preparations in different parts of the world. It is an excellent source of antioxidant, has metal chelating power, acts as anti-diabetic, helps cures hypertension, helps to manage cholesterol etc. The Banana plants are used in preparing different functional food, wine, alcohol, biogas etc. The value addition of banana plays significant role in human nutrition, especially as a source of vitamins, minerals and dietary fiber, Now a days consumers opt for the food products, which are nutritious as well as convenient to use. More importance has been given to the products having natural flavour rather than chemical loaded artificial food flavoring substances. As the processing of the food in the forms which are preferred by the consumer, have long shelf life and involve low cost of production, studies need to be carried out to optimize the processing techniques to prevent oxidative damage on the bioactive

compounds and increase the shelf life of the food products. Thus, a systematic approach should be followed to develop and standardize the value added food products from banana that can be rewarding to the farmers, besides making available the nutrients to the Indian dietaries, thus meeting nutritional security of the population. Furthermore, bioactive constituents needs to be isolated and should be considered for further in vivo studies to confirm the claims and to explore the potential of development of components that may contribute in discovery and development of new drug and to be considered value added market oriented products.

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