

Banana inflorescence and their potential health benefits as future food

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Abstract

Banana scientifically known as *Musa* sp. is a famous tropical fruit majorly cultivated in India with a production of 29 million tonnes. One of the underrated parts of the banana plant is the edible flower (banana inflorescence/ blossom) which can be utilized in several ways for nutritional and therapeutic purposes as it is known to have potential antioxidant, anti-carcinogenic, and anti-diabetic properties. The present paper primarily focuses on the health benefits of banana inflorescence and the bioactive components responsible for its properties. Secondly, the paper describes different traditional dishes of banana blossom made in India highlighting the regionality, ingredients used, and preparation procedures with a view to popularize these ethnic delicacies and functionality of banana blossom among other parts of the world. In India, several different dishes and pickles are prepared with the blossoms. They are used as functional foods and are mentioned in detail in this paper.

Keywords: banana inflorescence; edible flower; traditional Indian cuisine; Health benefits; Anti diabetic properties; biochemical properties

Introduction

Banana, scientifically known as *Musa* sp. (Musaceae), is an accustomed tropical fruit. Banana is a vital food source all over the world. It is perhaps the world's most cultivated and oldest crop (Yusoff, 2008). The banana plants approximately hold harvested area of 10 million hectares globally (FAOSTAT, 2011). It is known to be cultivated in about 130 countries across tropical and subtropical regions over the world. From its Southwestern Pacific home, the banana species came to India by about 600 BC and later spread along the tropical regions. Over 300 varieties of banana are developed in various countries. Furthermore, most of the species have been growing in Asian, Caribbean, Indo-Malaysian, Australian tropics, Latin America, and African countries. The most consumed species of bananas are *M. acuminata*, *M. cavendishii*, *M. paradisiaca*, and *M. sapientum* (Mohapatra *et al.*, 2010). India is the major producer of

this tropical fruit; the production is about 29 million tons (FAO, 2011). India, Ecuador, Brazil, and China together account for around 50% of banana production with an annual global total production of approximately 145 million tons (Radha and Mathew, 2007).

By-products of most agricultural products are generally discarded or used for nonedible purposes like packaging. As the world is moving toward sustainability in various aspects, researchers around the world are looking into the nutritional and health benefits of by-products and redundant parts to reduce wastage from agricultural produce. In this aspect, the banana tree is the ultimate when it comes to a zero-wastage policy! Most of the parts of the banana tree are utilized in several ways. The most evident is the banana fruit, which is consumed daily by majority of the population. The banana fruit is deemed as the most significant source of energy. Consumption of 100 g of banana provides about 1.10 g protein, 89.00 Kcal of energy, 1.00 mg

sodium, 8.00 mg calcium, 385.00 mg potassium, 121.80 g carbohydrates, 0.40 mg iron, 30.00 mg magnesium, 0.11 mg copper, 11.70 mg vitamin C, 610.00 µg niacin, 40.00 µg thiamine, and 23.00 µg folic acid (Aurore *et al.*, 2009). This present review focuses on the traditional usage of banana's edible inflorescence in Ethnic dishes of India and the health benefits of the flower. The banana blossom as in Figure 1A is also known as a banana flower or banana inflorescence and is an edible flower that can be consumed in several ways. There is very limited and scattered information and literature available on trusted websites about Banana Inflorescence. Hence, a review of the various biological activities of banana inflorescence leading to health benefits is essential. Banana's edible flower is used in treating menorrhagia (Ghani, 2003). The South Asians use

banana flowers as a vegetable. They use it in raw form or steamed with a side of dips. They also use them in soups, curries, and fried foods. The flavor of this edible flower is similar to that of artichoke where both the fleshy part of the bracts and the core part are edible. A detailed description of the properties of bioactive components present in banana inflorescence leading to health enhancement and the traditional recipes of dishes made from this inflorescence is given in the latter part of this review.

Chemistry of banana blossom

As per the literature survey of banana blossom, it is a potential source of carbohydrates with other



Figure 1. (A) Banana Blossom (B) Banana Flower Curry (Mochar Ghonto); (C) Banana Flower Poriyal; (D) Banana Flower fritters (VazhaipooVadai); (E) Banana Flower Chutney/sauce (Vazhaipoo thogayal).

micronutrients. Apart from nutritional properties, the phytochemical (bioactive) compounds of the inflorescence are gaining importance because of their potential health-promoting properties (Lau *et al.*, 2020). The exceptional nutrient content of the banana flower paves way for many health-promoting properties. The nutritional value of the banana flower has been mentioned in Table 1.

Biological activities of banana blossom

The data on various biological activities of several edible flowers have shown potential health-promoting benefits for humans. The banana blossom has also demonstrated biological activities that might be symbolic of its potential health-enhancing properties named in Figure 2. Many outcomes of the research have majorly indicated a positive effect of the antioxidant and anti-diabetic properties of banana blossom. These properties are available for human consumption upon incorporation into foods. The latter part of this paper discusses the ethnic delicacies prepared using banana inflorescence in various parts of India. The banana blossom also depicted properties like anti-carcinogenic, anti-microbial, cardio-protective activities, and anti-inflammatory due to the presence of certain bioactive components present in the inflorescence, discussed in the next section (Lau *et al.*, 2020). This nutritional content of banana blossom holds different roles when it comes to tackling different health issues and infections. According to the literature review, some of the most exceptional health benefits that can be obtained because of the consumption of banana flower food products are described below.

Antioxidant properties

Several studies depict that the relationship between the concentration of polyphenols and flavanols has an

antioxidant effect in epidemiological studies (Arun *et al.*, 2017; Bhaskar *et al.*, 2012). Most of the research outcomes are inclined toward reducing the risk of diabetic issues, cancer, oxidative stress, and various cardiovascular diseases (Lau *et al.*, 2020). The phenolic content present in an inflorescence may be dependent on the species of Banana. The *Musa spp.* in a study showed significant phenolic and flavonoid content which may contribute to the maintenance of health among the local people that consume their traditional banana inflorescence-based dish (Sonowal *et al.*, 2016). The antioxidant properties of the banana inflorescence are due to the extracts of methanol present in it that reduces free radical activity (Arun *et al.*, 2017). Consumption of banana's edible flower also helps to treat other health conditions such as aging (premature) and cancer. Value-added health supplements can be made from the edible flower due to its antioxidant property (Bhaskar *et al.*, 2012).

Anti-diabetic properties

Studies on the anti-diabetic activities of the banana blossom thus far have included both in vitro and in vivo methods. Blood sugar levels can be reduced with a calculated intake of banana flowers (Bhaskar *et al.*, 2011a). Also, this intake increases the total hemoglobin level in the body. In a study, the total phenolics were identified and profiled using HPLC where in Ehrlich ascites tumor cells, the extracts revealed varying degrees of glucose uptake stimulatory effect (Bhaskar *et al.*, 2011a). The literature to learn about the antidiabetic properties of banana blossom depicted that oral administration at a certain amount showed a significant antihyperglycemic effect in rats (Jawla *et al.*, 2012). Bioactive compounds like umbelliferone, lupeol were also isolated in studies of many researchers and used for the anti-diabetic activity study and results showed that these compounds inhibited the activity of various sugars, glycated proteins, and advanced glycation end products (Bhaskar *et al.*, 2011b; Ramu *et al.*, 2014). However, when it comes to the anti-microbial activity of the banana blossom, their hypoglycemic effects have not been proven clinically yet. There is a large scope for research on this property of banana blossom.

3.3. Cytotoxic and apoptosis inducing properties

Several studies aimed at finding and determining the anti-cancer effect of banana blossom extracts upon various human cancer cells. Two human colorectal cancer cells, HT29 (IC₅₀: 5.25–20 µg/mL) and HCT116 (IC₅₀: 39.89 µg/mL), were predominantly sensitive to the alcoholic extracts of the banana blossom when compared with other cancer cells—HeLa and the human breast

Table 1. Nutritional content of banana flower.

Nutritional properties	Quantity
Energy (kCal)	51.00
Proteins (g)	1.60
Fats (g)	0.60
Carbohydrates (g)	9.90
Fiber (mg)	5.70
Calcium (mg)	56.00
Phosphorus (mg)	73.30
Iron (mg)	56.40
Copper (mg)	13.00

Source: Khare (2007).

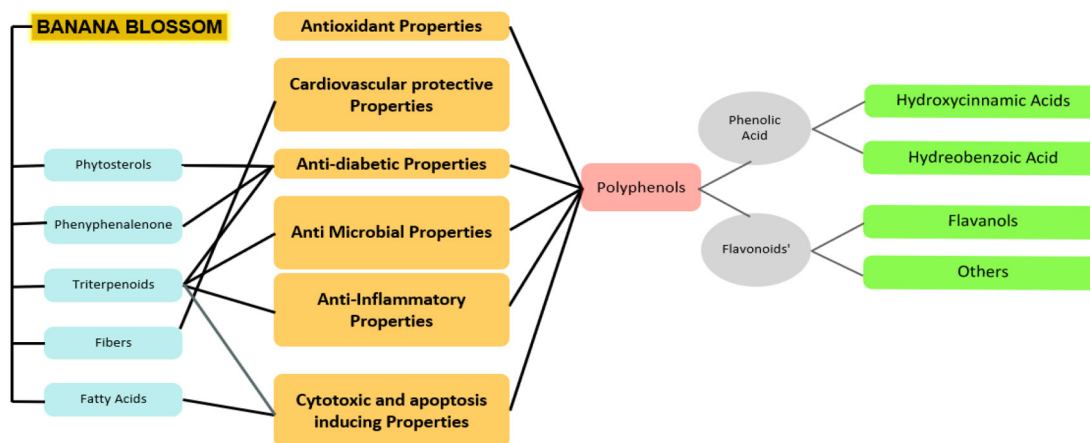


Figure 2. Biological activity of bio-active compounds in banana blossom.

cancer cell line and MCF7 (Arun *et al.*, 2018; Revadigar *et al.*, 2017; Timsina and Nadumane, 2014). The metabolic pathway of the banana blossom extracts and their mode of action have not been significantly understood. The literature available indicated that the total phenolics, flavonols extracted induction of apoptosis causes cell death (Lau *et al.*, 2020). The presence of polyphenols such as gallic acid, syringic acid, catechol, and ferulic acid in the extracts depicted the apoptotic activity of *M. paradisiaca*'s methanol-based extract (Arun *et al.*, 2018). Considerably, two sterols—stigmasterol (7.33%) and β -sitosterol (5.23%) were noted to be ample in banana blossom (Revadigar *et al.*, 2017).

Antimicrobial properties

In warding off infections, the ethanol-based extracts' property to inhibit the growth of pathogenic bacteria makes the banana blossom capable of treating infections, and it helps in healing wounds. Some of them are *B. subtilis*, *B. cereus*, and *E. coli*. According to a recent study, the extracts of banana flower can inhibit the *Plasmodium falciparum* (malarial parasite) growth in vitro, while these claims are yet to be proven (Jawla *et al.*, 2012; Padam *et al.*, 2012; Ramu *et al.*, 2015; Tin *et al.*, 2015).

Anti-inflammatory properties

The property to prevent/reduce swelling or inflammations in different parts and organs in the human body is called anti-inflammatory property. The banana blossom showed this property in Nisha and Mini's study. The study stated that gallic acid, quercetin, and epicatechin were detected by high-pressure liquid chromatography and ESI mass spectrometry. These compounds were identified as responsible for the anti-inflammatory activity upon suppression of activities of COX-2 and 5-LOX

monocytes (Nisha and Mini, 2013). This property of Banana inflorescence has great potential to act as a natural immune builder if focused under food value addition, fortification with its immune-enhancing bioactive components.

Traditional dishes from banana inflorescence in India

Several dishes are prepared from banana blossom in the eastern (West Bengal, Assam, Tripura) and southern parts of India (Kerala and Tamil Nadu) (Figure 1B–E). One such dish is *Banana Flower Cutlet* or *fritters* (*Mochar Chop/Vazhaipoo Vadai*). This is a traditional and highly consumed Bengali and Tamilian snack where banana flower and potatoes are the base ingredients. Its origin is in the northeastern Indian state of West Bengal. Another ethnic banana blossom curry with its origin in West Bengal is *Banana Flower Curry* (*Mochar Ghonto*). It is a dry curry and is often served with steamed rice. In "Mochar Ghonto," banana flowers are cooked along with potatoes and several aromatic spices giving it a delicious taste. *Banana Flower Poriyal* (*Vazhaipoo Podimas*) originated in Tamil Nadu, South India. It is a traditional dish made from a combination of banana flowers and yoghurt and is a perfect accompaniment for an Indian lunch for diabetic individuals as well. *Banana flower chutney* (*Vazhaipoo Thogayal* or *Thuvaiyal*) basically originated in Tamil Nadu and Kerala. It is usually consumed by mixing with rice along with a dash of either gingelly oil or ghee. These traditional dishes can be given as super foods for the future generation (Sharma *et al.*, 2020).

Conclusion and future scope

The utilization of banana blossom or inflorescence can add positively to the agricultural produce waste

management apart from being a healthy, nutritious, and traditional alternative food like the ones described in this paper. With further incorporation of food technology principles into these existing products made from the edible banana flower, the preparatory methods can be optimized. These traditional Indian foods can be popularized in the palatability and sensory aspects to preserve the regional culture along with increased commercialization of the edible banana inflorescence. Different preservation methods can be introduced to make the local cuisine a global cuisine with enormous health benefits.

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Competing Interests

The authors declare that there is no competing interest.

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