



Composition and Pharmacological Benefits of Banana Blossom: A Brief Review

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ABSTRACT

One of the earliest crops cultivated in emerging nations like India is the banana. Their nutritional and pharmacological profiles are good. Every part of the banana plant has a different medical purpose. The banana plant is regarded as a gift from nature to humanity because of its many nutritional, medicinal, pharmacological and physiological advantages. It is the antioxidant powerhouse that includes phytonutrients, phenolics and polyphenols. The minerals potassium, iron, zinc, phosphorus and the vitamins C, B2, B6, B5, E and A are abundant in banana flowers. Bananas and its components also include significant concentrations of phytochemicals such as quercetin, lectin, alkaloids, dopamine, flavonoids and tannins. Because of its many uses and potential, bananas and their by-products- leaves, fibers, peels and fruits are used in both the food and non-food industries to make a variety of goods, including ice cream, chocolates, pickles, jam, jellies, candies, pasta, breads, ropes, clothes and mats. In most parts of the world, it is still one of the underappreciated meals while having such effective qualities. Thus, the focus of this paper is on the value of bananas and the ability of banana blossoms to improve people's health in a variety of ways. It also emphasizes the necessity to raise public knowledge of bananas because they are beneficial in a number of ways.

Key words: Antioxidants, Banana blossom, Medicinal, Pharmacological, Phytochemicals, Therapeutic.

A fruit that is consumed most frequently throughout the world due to its taste, flavor and health advantages is the banana. It is a mercenary fruit of numerous sub-tropical and tropical countries, India being the tremendous manufacturer (Kiribhanga *et al.*, 2022; Bridgit *et al.*, 2023). Generally speaking, it developed in South East Asia and India (tropical humid environments). It is currently grown in tropical regions around the equator, 30 degrees north and 30 degrees south, all over the world (Singh, 2017). The banana, commonly known as the Apple of Paradise, is a special type of fruit plant. The banana plant is a perennial herb that blooms. Nearly every component of this crop including the flowers, stems, leaves and fruits, has nutritional, medicinal and therapeutic qualities. It is an important consumable plant crop of sustenance and farmers can ensure year-round production and income (Meghwal *et al.*, 2024). The extensive value of the portions of crops that belong to or are connected to the Musaceae family includes flowers, stems, fruits, leaves and so on. There are 42 species and 2 genera (Ensete and Musa) in the family Musaceae; 10 species are in Ensete and 32 are in Musa. Currently, 1200 banana species and variants are categorized (Awedem *et al.*, 2015). Many species including *Musa sapientum*, *Musa aurantiaca* G. Mann ex Baker, *Musa oranta*, *Musa nagensium* Prain, *Musa flaviflora*, *Musa acuminata* Colla, *Musa itinerans* Cheesman, *Musa cheesmani* N.W. Simmonds, *Musa balbisiana* Colla and *Musa sikkimensis* Kurz are found in India Pushpaveni *et al.* (2013) A musa plant has several different parts including roots, fruits, flowers and others as depicted in Fig 1. Each component has a unique purpose, nutritional worth and bioactive properties (Deb *et al.*, 2018).

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Fruits

In essence, fruit is the ripened reproductive organ of a seed plant. Banana fruit is a food component of all plants and trees. Nutrients such as minerals (calcium, potassium, iron, magnesium, copper, boron) and vitamins A (carotene), B1, B2, B3, C and D are rich in it. It also contains a healthy amount of carbs, proteins, fat and calories. Numerous bioactive substances and phytonutrients are present in large quantities including fatty acids, glycosides, phenolics, saponins, carotenoids, tannins, flavonoids and alkaloids (Bennett *et al.*, 2010; Islam *et al.*, 2015). It is used to treat a variety of illnesses including hypertension [when consumed in ripe form Mutheea *et al.* (2011)], diabetes [when consumed in ripe form or when prepared with different vegetables Mahouachi *et al.* (2014)] and anaemia [when consumed in ripe form Okon *et al.* (2013)]. According to Kumar *et al.* (2012), it also lowers cholesterol and heartburn and increases immunity and energy in the treatment of Alzheimer's disease.

Sap

A plant's vascular system circulates a sap, which is essentially a watery solution of sugars, salts and minerals. Banana sap is used to treat sick fever (Morilla *et al.*, 2014). According to Pothavorn *et al.* (2015), they contain flavonoids (myricetin, kaempferol, quercetin and apigenin), hydrocinnamic acid, dopamine, caffeoylquinic acid and N-acetylserotonin in an ethanol extract.

Peels

A fruit's peel is essentially its rind. Banana peels are used in the water treatment process to eliminate nitrites from potable water. It is also utilized in the manufacturing of organic fertilizers, cosmetics, biofuel, pulp and paper, bio sorbents and biotechnology processes. According to Anal *et al.* (2014), it contains phytochemicals such as tannins, phenolics, glycosides, terpenoids, flavonoids and saponins. It also possesses antifungal and antibacterial qualities. The methanol extract has triterpenes, steroids, palmitic acid, alkaloids, sesamin, epi-sesamin, oleic acid, linoleic acid, phenols and pyrogallol; the acetone extract has anthocyanins, dopamine, catecholamines and phenolics (Mordi *et al.*, 2016; Nimah, 2014).

Roots

A plant's roots are essentially its subsurface organs. Banana roots are used to treat genital sores, piles, HIV/AIDS and other sexually transmitted illnesses (STDs), as well as to induce labor, prevent conception and treat snake bites. When making herbal medicines or tonics, it serves as an anthelmintic medication (De Wet *et al.*, 2012; Uddin *et al.*, 2011). Anigorufone is present in the root's methanol extract (Mathew *et al.*, 2017).

Leaves

In plants, leaves serve as the primary organ for transpiration and photosynthesis. Banana leaves are used to serve food in a traditional and religious manner. According to Meenashree *et al.* (2014), these are used to treat asthma and wheezing, as well as blistering skin and wounds. The leaves include alkaloids, cinnamic acid and ferulic acid in powdered methanol extract (Mathew *et al.*, 2017; Mahouachi *et al.*, 2014), as well as phenolics and tannic acid from methanol, ethanol, petroleum ether and acetone extracts (Prasanta *et al.*, 2013).

Stems

In essence, stems are extended structures that hold up plants. Banana stems are a great source of dietary fiber, which makes them useful in the textile and apparel industries. It is used to alleviate kidney stones and cure respiratory conditions including TB. It can be used in many different industries, including the paper, agro, biomedical, pharmaceutical and bioengineering sectors. It can also be applied in bio-plastic, bio-film and bio-electricity domains. The main components of the pseudo-stem or heart of the stem were hydrogen, carbon and nitrogen (Meenashree *et al.*, 2014).

Banana blooms

In general, banana blossoms are angiosperm plants' reproductive organs, particularly those with colourful or ostentatious elements. A cluster of folded leaves on a fully grown stalk extends into an oval-shaped, dark purple bud known as a blossom or flower. Banana blossoms have two main parts:

- Exterior sheath like substance varying red and purple colours are called as Bract.
- Interior tiny tubular- toothed white blossoms arranged besides floral stacks are called Florets.

In addition to banana blossoms, the stem is also auto-cultivated. Following the harvesting process, banana plant by products such as flowers and fruits from stems are typically thrown away (Pushpaveni *et al.*, 2013). According to Sumathy *et al.* (2011), tannins, phenols, flavonoids, glycosides, saponins and steroids are present in the methanol extract of banana blossoms.

Bract

A bract is essentially a modified leaf or a leaf-like portion that sits beneath and shields an inflorescence, or the section of a plant that blooms. Typically, banana bracts range in color from brilliant red to dark violet, but occasionally, the top caps and outer surfaces may be yellow and the inside surfaces may be pale yellow. It has an abrupt peak and a narrow, oval form that tapers dramatically towards the end (Mathew *et al.*, 2017). According to Debabandya *et al.* (2015), bracts rise in 3 to 10 days and scatter quickly, raising fruits that mature in bunches. One bract uplifts at a time throughout this process. These are typically used to treat blood pressure disorders and feed cattle (De Wet *et al.*, 2016). Additionally, it contains a variety of bioactive substances, including flavonoids in the ethyl acetate extract, cycloglycosides and alkaloids in the petroleum ether extract (Roobha *et al.*, 2011). Additionally, it contains substances such as steroids, glycosides, terpenoids, flavonoids, tannins, alkaloids, phenols, saponins and coumarins in methanol extract and phenols and coumarins in aqueous extracts (Gunavathy *et al.*, 2014).

Flowers or florets

In several Asian countries, such as Malaysia, banana blossoms are a staple in various dishes. The stigma is

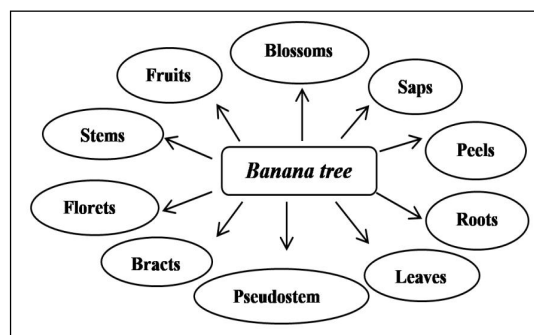


Fig 1: Different parts of banana tree.

orange or rich yellow in hue, while the male flowers are often creamy white. Male flowers are occasionally more numerous, with around 20 florets arranged in two rows per bract found in the upper hands, while female flowers range in number from 1 to 10 and are accommodated in two rows per bract in the basal blooms. With free tepals that are semi-transparent and half the length of a compound, the tepal (an undifferentiated component of the perianth that cannot be recognized as a sepal or petal) is about 2.5 cm in length and is yellow, light purple, or white in color with yellow or white lobes and tip. Its ovaries are hairless or have few microscopic hairs around the base and can be purple, yellow or bright green in color. The male bud, or partially opened flower, has an egg to helix shape during the progressive blooming phase. The male reproductive organ of the flower, the stamen and the perianth, which are the outer parts of the flower and are made up of the calyx (the curls of the flower's sepals collectively forming the outer floral envelope) and corolla (the curls of the petals collectively forming the inner floral envelope), all have the same length. The stamen's anther, which contains pollen, typically turns pink before the flower dehisces (Mathew *et al.*, 2017). Banana blossoms are utilized by people in South and Southeast Asia in a variety of dishes, including curries, soups, fried meals and raw or steaming dips. The blooms' flavor is similar to that of artichokes.

Nutritional profile

They have a superior nutritional profile, which eventually aids in regulating plasma glucose levels and may enhance or reinforce exercise performance (Netshiheni *et al.*, 2019). Bananas naturally contain a variety of oligosaccharides, or sugars such as xylose, glucose, fructose, mannose and galactose, which serve as excellent prebiotics for the growth of beneficial bacteria in the colon (Debabandya *et al.*, 2010). Bioactive substances with possible antioxidant properties, such as flavonoids and phenols (Soni and Saxena, 2021), can relieve the symptoms of diabetes, asthma, ulcers, heart pain and diarrhea (Sumathy *et al.*, 2011). Numerous minerals, including sodium, calcium, iron, potassium, phosphorus, zinc and magnesium are abundant in blossoms (Sheng *et al.*, 2017; Elaveniya *et al.*, 2014). Bananas are a great source of fiber, magnesium, selenium, potassium, calcium, iron, phosphorus and vitamins C, A, E, Folate, B5, B2 and B6 (Kumar *et al.*, 2012). Additionally, banana plants contain a variety of carotenoids and phytosterols that can be used to cure a variety of illnesses (Kumari, 2023). Nutritional composition as given in Table 1 (Ranjha *et al.*, 2022).

Therapeutic potential of banana blossoms

Anticancer potential

A generic medication to treat cervical cancer was made using the ethanol extract of banana blossoms⁵⁰. Chemical studies identify putative active ingredients responsible for apoptosis and cytotoxic inducing activities in banana blossom extract (Lau *et al.*, 2020). In addition, existence of polyphenols including syringic acid, catechol, gallic acid

and ferulic acid in the extract is linked to the methanol extract's ability to induce apoptosis (Arun *et al.*, 2018).

Antidiabetic potential

Banana blossom extract has pharmacologically progressive components that show promise as an antidiabetic agent. Research on the atoxic characteristics of blossom extract has been conducted in acute oral toxicity and in diabetic rats treated with blossom extracts, levels of urea, blood glucose, creatinine, uric acid and glycosylated haemoglobin were significantly reduced. Comparing *Musa paradisiaca* flower extracts to glyclazide, a well-known hypoglycaemic medication, demonstrates their powerful hypoglycaemic effect (Shanmuga *et al.*, 2011). Banana flowers include a number of chemical components that may have the ability to act as diabetic agents, including epicatechin, quercetin, gallic acid, phenolic acid and total phenols (Sheng *et al.*, 2017; Nisha and Mini, 2013; Bhaskar *et al.*, 2011).

Antioxidant potential

The Baxijiao variety of banana is utilized as a suitable food additive and nutritional supplement because of its high amount of antioxidants, particularly flavonoids and polyphenols (De Wet *et al.*, 2016). Banana blossoms were also discovered to include other antioxidants, including total phenolics, umbelliferone, tannins and lupeol, which reduce the incidence of diabetes and cardiovascular diseases (Padam *et al.*, 2012; Bhaskar *et al.*, 2012; Sasipriya *et al.*, 2014; Ramu *et al.*, 2014). This plant's antioxidant potential is mostly due to its ability to scavenge free radicals, prevent peroxidation and have chelating properties. According to Thaiphaniit and Anprung (2010) the pulp's ethanol extracts demonstrated antioxidant activity by scavenging DPPH and ABTS radicals with increased activity at the mature stage.

Antimicrobial potential

With minimum inhibitory concentrations (MIC) ranging from 1.56 to 12.5 mg/mL and an inhibition zone of 12 to 22 mm, the methanol extract of banana blossoms exhibits excellent

Table 1: Nutritional composition of banana.

Proximate (%)	Banana
Fibre	16
Protein	3.50
Moisture	77.19
Carbohydrates	22.12
Fats	0.75
Vitamins (mg/100 g)	
Vit. K	0.59
Vit. B1	0.04
Vit. C	10.27
Vit. E	0.12
Vit. B2	0.09
Minerals (mg/100 g)	
Potassium	18.50
Zinc	7.84
Iron	10.59

antimicrobial potential, resisting multiple pathogens such as *Proteus mirabilis*, *Aspergillus niger*, *Salmonella* sp., *Staphylococcus aureus*, *Micrococcus* sp., *Bacillus subtilis*, *Candida albicans* and *Escherichia coli* (Sumathy *et al.*, 2011).

Immuno-modulatory potential

In human tumor cells growing in cases of non-small cell lung carcinoma, the natural non-steroidal anti-inflammatory drug produced from banana blossoms showed anti-inflammatory properties. Pharmacological evidence supported the extract's potential to modulate immunity in Wistar albino rats. Neutrophils are probably drawn to the inflammatory site faster by the methanol extract, which in turn functions as a strong immunostimulant under dose-dependent conditions. By increasing the phagocytic potential of macrophages, methanol extracts promote the excretion of foreign particles from the environment (Singhal and Ratra, 2013).

Medicinal benefits

Infections

Banana flower ethanol extract may be useful in healing wounds and preventing infection since it inhibits the growth of germs and pathogens such as *Escherichia coli*, *Bacillus subtilis* and *Bacillus cereus*. The development of *Plasmodium falciparum*, the malarial parasite, may be inhibited by ethyl acetate extract (Kumar *et al.*, 2012).

Menstrual bleeding

Eating fried banana blossoms with yogurt are regarded as an excellent way to treat excessive menstrual bleeding. This is because it raises the body's progesterone hormone levels, which reduce bleeding, associated with menorrhagia (Singh *et al.*, 2015).

Losing weight

Bananas are the best fruit to lose weight since they are rich in satiety due to their natural sugar content. It aids in weight loss because of its low calorie count, low fat content, high potassium and water content and low calorie value (Kumar *et al.*, 2012).

Cardiovascular protection

Bananas, which are high in potassium, aid in preserving normal blood pressure and cardiac function. A high potassium concentration improves bone health by forbidding the loss of calcium in the urine and reduces the risk of atherosclerosis and hypertension (Liyanage *et al.*, 2016).

Diarrhoea

Pectin, a soluble polymer found in bananas, helps regulate bowel movements and ward off constipation. In cases of diarrhea, it could be helpful (Kumar *et al.*, 2012).

Stomach ulcer

Utilized as an antacid, bananas shield the stomach from harm and ulcers. A combination of milk and bananas may reduce acid production. Protease inhibitors and thick

mucus from the stomach's acid are present. The purpose of these retarders is to assist get rid of the bacteria that trigger stomach ulcers (Soni and Saxena, 2021).

Lowered chances of high blood pressure

Potassium, a crucial mineral for sustaining healthy blood pressure and heart function, is rich in bananas. The body uses potassium to keep its fluid and electrolyte balances in check. Scientists propose that natural ingredients found in bananas are similar to medications used to treat hypertension (Soni and Saxena, 2021).

Promotes normal bowel activity

A sufficient quantity of indigestible fibers such as cellulose, hemicellulose and α -glucagans, found in bananas, can help relieve constipation, diarrhea and loose stools. They improve colon function, allowing the body to absorb more water and promote regular bowel motions. It's beneficial because pectin, which is water-absorbent, may be produced in large quantities. Because they are high in fructooligosaccharide, a prebiotic, bananas support probiotics, or beneficial bacteria, in the colon. These probiotics supply digestive enzymes and vitamins that improve the body's ability to absorb nutrition and combat infections (Soni and Saxena, 2021).

Protection against neurodegenerative diseases (Alzheimer's disease)

Researchers have shown that because banana extract includes antioxidants and phytochemicals such as phenols, it may protect cells against neurotoxication. Consequently, they might be essential in reducing the risk of neurodegenerative illnesses like Alzheimer's by shielding cells from oxidative stress (Kumar *et al.*, 2012).

Precise food for baby

When introducing meals to babies, bananas are an excellent option because they are packed with nutrients that are vital for healthy growth and development. Babies can quickly adjust to them because they are soft, mushy, easily digestive and rarely non-allergic in nature. For newborns recovering from gastrointestinal disorders, most physicians advise a BRAT (bananas, rice, apple sauce, toast) diet (Kumar *et al.*, 2012).

Kidney health

Because bananas have a large level of potassium, they can aid to improve and enhance kidney function. Consuming potassium in moderation reduces the risk of renal stones and regulates the excretion of calcium in the urine (Liyanage *et al.*, 2016).

Energy booster

The three hereditary sugars fructose, glucose and sucrose found in bananas give off a significant, long-lasting energy boost. The potassium content in bananas aids in proper muscular function and prevents cramping during exercise (Kumar *et al.*, 2012).

Immunity booster

Bananas contain 25% of the recommended daily allowance (RDA) of the B6 vitamin, which is necessary for the synthesis of red blood cells (RBCs) and antibodies, aids in the metabolism and utilisation of fat, boosts immunity and aids in the treatment of septic illnesses. Bananas' 15% RDA (Recommended Dietary Allowance) vitamin C concentration serves as a potent antioxidant (Soni and Saxena, 2021).

Depression

A recent MIND (National Association for Mental Health) study found that eating bananas makes depressed patients feel better. Tryptophan, a type of protein, is the cause of this satiety potential. It transforms into serotonin in the body, which elevates mood, induces feelings of relaxation and makes you happy. By controlling blood glucose levels, the B6 vitamin found in bananas helps improve mood. The high vitamin B content helps to soothe the neurological system and the nerves (Govindaraj *et al.*, 2022).

Pharmacological actions shown by banana blossom

The pharmacological properties of banana blossom are listed in Table 2.

Industrial application

In agriculture, the antifungal and antibacterial qualities of banana peels and pulp are used to treat germs and fungus.

Banana leaf is used by the local communities to make building materials and umbrellas. Worldwide, banana fibers are used in the weaving of mats, clothes, ropes and papers. The tannins found in mature banana peels are used as tanning agents during the leather-making and processing processes. These days, banana by-products serve a variety of functions and are utilized as gelling and thickening ingredients in cuisine. These find application as fertilizers, pollutant adsorbent, feeds, food additives, renewable fuel sources and other organic chemical sources. There are many different food products on the market that can be consumed, including banana flour, puree/paste, breads, pasta, cakes, yogurt, cookies, drinks, chocolate and its products pickles, sweets and ice cream (Kumari *et al.*, 2023; Mohiuddin *et al.*, 2014).

Limitations

Banana blossom comes with the little tedious cleaning or disinfecting procedure. It is not freshly available in all parts of the world. To overcome this, canned blossoms are available in some parts of the globe. In some parts it may be expensive and some people might not be capable to purchase it. Only limited food products incorporated with banana blossom are available in the market. Owing to its mild flavour its best served with combination of food items.

Future trends and applications

Utilization of banana and its by-products especially blossom is still not properly done owing to its outstanding

Table 2: Pharmacological properties in banana blossom.

Phytochemical	Pharmacological property	Citation
Glycoside	Curing cardiac arrhythmias and congestive heart failure	Sumathy <i>et al.</i> (2011)
Alkaloid	Pain killer	Philip <i>et al.</i> (2015)
Dopamine	Potent vasoconstrictor	Pothavorn <i>et al.</i> (2015)
Phytosterol	Lowering plasma cholesterol	Vilela <i>et al.</i> (2014)
Saponin	Curing epilepsy, unbounded salivation, chlorosis and migraines	Sumathy <i>et al.</i> (2011)
Tannins	Antioxidant activity	Sumathy <i>et al.</i> (2011)
Anigorufone	Leishmanicidal	Mathew <i>et al.</i> (2017)
Chlorogenic acid (Caffeoylquinic)	Antioxidant	Pothavorn <i>et al.</i> (2015)
Omega 3 acid and Omega 6 acid	Lowered chances of cardiovascular diseases, cancer, Osteoporosis and immune disorders	Vilela <i>et al.</i> (2014)
2, 3- dihydro- 3, 5-di hydroxyl 6-methyl- 4H-pyran-4-one	Anti-inflammatory, anti-proliferative and antioxidant	Dhanalakshmi <i>et al.</i> (2014)
Flavonoids	Anti-inflammatory, Anti-ulcerogenic, hepatoprotective, anti-allergenic, anti-thrombic and anti-carcinogenic	Philip <i>et al.</i> (2015)
Trans β - carotene	Antioxidant, antineoplastic and chemo preventive	Sumathy <i>et al.</i> (2011)
Lectin	Immunopotency, mitogenic activity, anti-cancer	Mathew <i>et al.</i> (2017)
Apigenin	Prohibits various type of cancer cells lines by enhancing apoptosis and cell cycle arrest	Mathew <i>et al.</i> (2017)
Kaempferol	Anti-inflammatory	Pothavorn <i>et al.</i> (2015)
Quercetin	Anti-venom, helpful in powering capillaries and blocking bleeding	Pothavorn <i>et al.</i> (2015)
α - tocopherol	Cancer, neurological disorders, age related Macular degeneration, cardiovascular disease, inflammatory diseases and cataract	Vilela <i>et al.</i> (2014)

nutritional, medicinal and pharmacological properties. Yet more emphasis on research on by-products of banana plant could be done so that it could be explored in field of food and nutrition. It can lead to the production of many beneficial food products which could be useful to many consumers. In addition, research on toxicological issues should also be addressed to attend the needs of this growing market. Future perspectives open new research directions to identify specific bioactive compounds and their mechanisms of action present in banana blossom. Various researches have analysed the potentials of banana blossom but many other aspects are yet to be explored.

CONCLUSION

Numerous studies have demonstrated the scientific validity of bananas and their by-products, particularly their blossoms, for their high nutritional profile and therapeutic potential. The bioactive potency of banana blossoms was definitely determined in the current work and this information is useful in assessing health. The banana and its by-products, including pseudostem, peels, leaves and blooms, are regarded as useful raw materials for the food and non-food sectors. Because of its potential, it can therefore be regarded as a superfood.

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Conflict of interest

The authors declare that they have no competing interest.

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