



Traditional and medicinal uses of banana plant and utilization of its pseudo stem in food applications.

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Abstract: The banana is a well-known and commonly utilized fruit all throughout the world. It's commonly used as a breakfast snack or as a quick source of energy. In addition, the banana plant has historical and aesthetic significance in India. Bananas are a fruit with numerous health benefits. Various nutrients are available in each part, and their uses are evaluated using reliable sources, research, and literature. Bananas are high in potassium, vitamin A, vitamin C, vitamin E, minerals, fatty acids, flavonoids, saponin, essential and non-essential amino acids, tannins, glycosides, and steroid. Almost every part of this plant can be used, including the fruit, leaves, flower bud, trunk, and pseudo-stem. The trunk is referred to as a 'false stem.' Pseudo stem is primarily regarded as a trash and dumped in various locations, contributing to the greenhouse impact, soil erosion, and air pollution. It has, however, been utilized for a variety of purposes, including fibre, fertilizer, and paper, as well as handicrafts. However, the dietary applications of pseudo stem receive the most attention. The pseudo stem is high in nutrients and has a wide range of medicinal uses. Carbohydrates and dietary fibres can be found in the pseudo of the banana plant. It's also calorie-free and can be found in a variety of foods, including pseudo stem flour, pastries, candies, and fruit juice. The majority of the culinary items are enjoyed by children. Nutritionists and medics frequently advise people to include bananas in their regular diet plans

Index Terms - : Banana, antioxidant, ant diabetic, anticancer, pseudo stem , pseudo stem cookies, pseudo stem candies.

INTRODUCTION

Banana plants are cultivated forms of the genus *Musa*, which are divided into two subgroups: sweet plantains and bananas. The fruit, peels, leaves, roots, and pseudo stem of the banana plant have all been demonstrated to have different pharmacological effects. The inclusion of fatty acids, steryl esters, and sterols, in addition to oleic and linoleic acids, is linked to the existence of banana's various phyto-constituents. Banana pulp and peel extracts have been proven to contain fatty acids, steryl esters, and sterols. Bananas are also high in important phytonutrients, phenolic compounds, and vitamins. In addition to components like potassium and phosphorus, secondary metabolism produces a variety of bioactive chemicals with a variety of pharmacological effects. [1]

Scientific classification of banana

Kingdom : Plantae
Order : Zingiberales
Family : Musaceae
Genus : Musa

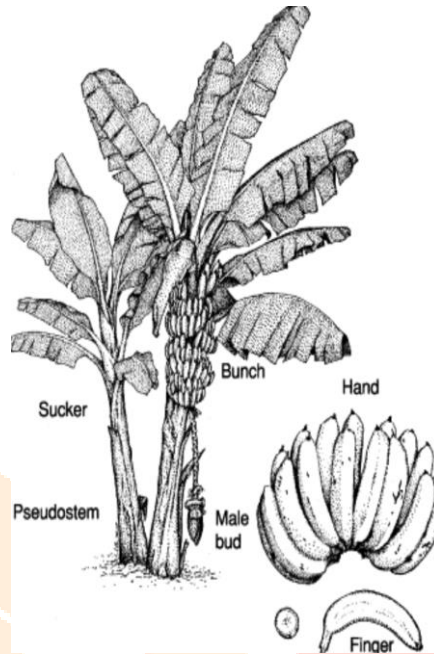


Fig 1: Banana plant and different parts of the plant [2]

Bananas aid calcium, nitrogen, and phosphorus retention in the body. Bananas can help with ulcers and other intestinal problems, as well as facilitate healing. Burns and wounds are also treated with the fruit. Make a paste out of a ripe banana and apply it to a burn or wound for rapid pain relief. Other health benefits of bananas include relief from constipation and diarrhea, arthritis treatment, and anemia treatment. Bananas, as one of the best sources of potassium, help to keep blood pressure and heart function in check. Bananas are also a great food for anyone looking to lose weight. They are a fantastic source of energy, while being high in calories (200 per banana) and carbohydrates (51 gm). A banana is a fruit. A banana eaten before an exercise can provide you the energy you need to finish a lengthier workout. [3]

According to the most recent Food and Agriculture Organization figures (FAOSTAT; 2019), India is the world's largest banana grower, producing 30,460,000 tonnes per year, followed by China and Indonesia [4].

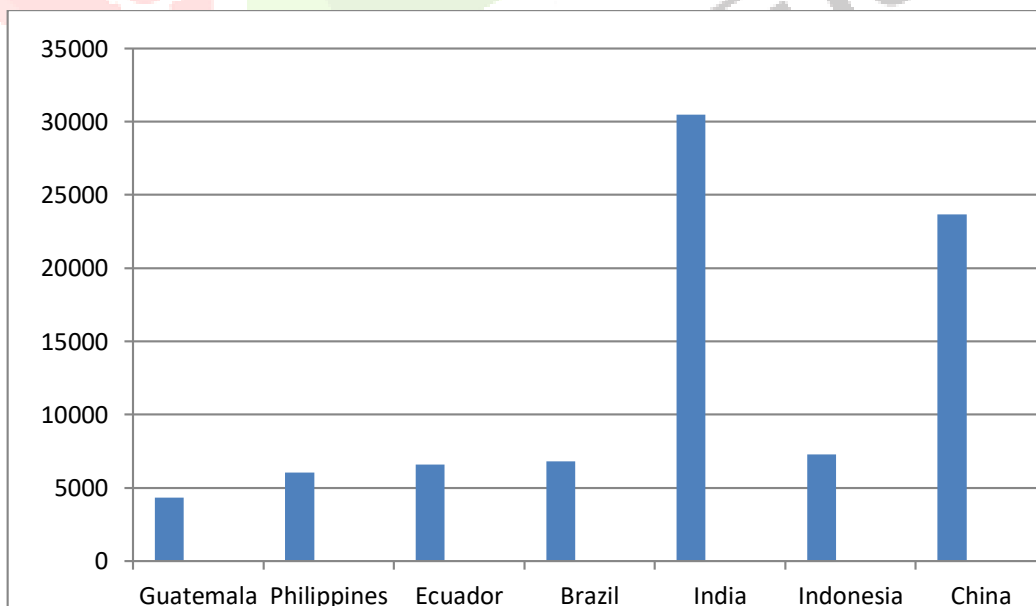


Fig 2: Top banana producing countries and their yield (thousand ton / year). Source: FAOSTAT, 2019[4]

MEDICINAL USES OF BANANA**1. Banana fruit**

There are two portions to a banana fruit: the peel and the pulp [5]. The edible component of the banana, banana pulp (BP), has a wealth of nutrients. BP has been studied in a variety of ways, from its usage as a food enrichment ingredient to the extraction and separation of several health-beneficial components such different types of starch, cellulose, and bioactive chemicals [6].

Table 1: Phytoconstituents in banana (in 100g banana) [7]

Energy	371 kJ(89 kcal)
Water	74.91g
Carbohydrates	22.84g
Sugars	12.23g
Dietary fibers	2.6g
Vitamins	
Pantothenic acids (B5)	0.334 mg (7%)
Pyridoxine	0.4 mg (31%)
Choline	9.8 mg (2%)
Vitamin C	8.7 mg (10%)
Minerals	
Magnesium	27 mg (8%)
Phosphorus	22 mg (3%)
Potassium	358 mg (8%)
Sodium	1 mg (0%)
Zinc	0.15 mg (2%)

Blood pressure

The American Heart Association Trusted Source (AHA) recommends that consumers reduce their sodium intake and increase their intake of potassium-rich foods. Potassium can assist in the control of blood pressure and the reduction of stress on the cardiovascular system. [8]

Rao N.M *et al* [9] investigated ripened and unripened 'Nendran', 'Rasthali', 'Poovan', 'Robusta', 'Bontha' and 'Safed Velchi' bananas for inhibition against angiotensin converting enzyme (ACE). The result was that inhibition of ACE by different ripened banana cultivars was much more than that of unripened banana cultivars.

Cancer

According to laboratory findings, lectin, a protein found in bananas, may aid in the prevention of leukemia cell growth. Lectin has anti-oxidant properties. Antioxidants aid in the removal of chemicals known as free radicals from the body. Cell damage can occur when too many free radicals accumulate, potentially leading to cancer. Researchers discovered in 2004 that youngsters who ate bananas, orange juice, or both had a decreased risk of acquiring leukemia. The authors of the study speculated that this could be related to the vitamin C concentration, which has antioxidant qualities as well. [8]

Zhang C X *et al* [10] studied the influence of banana fruit intake on breast cancer risk. The conclusion was that greater intake of banana was associated with reduced risk of breast cancer in women.

Diabetes

The American Diabetes Association recommends eating bananas and other fruit as they contain fiber. A study by Kaimal S *et al* [11] showed that ethanol extract of mature green fruits of *Musa AAA* (Chenkadali) has antioxidant and hypolipidaemic properties and may be used for treating diabetes mellitus Eating fiber can help lower blood sugar levels.

Heart health

Fiber, potassium, folate, and antioxidants like vitamin C are all found in bananas. All of them are beneficial to heart health. People who eat a high-fiber diet are less likely to develop cardiovascular disease than those who eat a low-fiber diet. Low-density lipoprotein (LDL), or "bad" cholesterol, was also lower in those who consumed more fibre. [8]

Digestive health

Bananas contain water and fiber, both of which promote regularity and encourage digestive health. One medium banana provides approximately 10% of a person's fiber needs for a day. Bananas are also part of an approach known as the BRAT diet which some doctors recommend for treating diarrhea. BRAT stands for bananas, rice, applesauce, and toast .Diarrhea can lead to a loss of water and electrolytes, such as potassium. Bananas can replace these nutrients .High fiber foods can trigger bloating, gas, and

stomach cramps in people with inflammatory bowel disease (IBD). However, bananas may improve symptoms. The Crohn's and Colitis Foundation of America recommend banana as a snack food in their diet plan. [8]

Neurological diseases

Heo H J *et al* [12] studied the effect of banana fruit extracts in protecting neuronal cells from oxidative stress induced neurotoxicity. Results of this study suggest banana reduces risk of oxidative stress induced neurodegenerative disease like Alzheimer's disease.

In nano medicine

Bankar A *et al* [13] used banana peel extract (BPE) as a simple, non-toxic, eco-friendly 'green material' to make gold nanoparticles. Further research revealed that BPE-mediated nanoparticles have effective antibacterial activity against majority of the examined fungal and bacterial cultures, including *Candida albicans* BX, *C. albicans* BH, *Shigella* sp., *Enterobacter aerogenes*, *Klebsiella* sp., and *Pseudomonas aeruginosa*. Ibrahim M M H [14] used banana peel extract to make silver nanoparticles that have antimicrobial action against pathogenic *B.Subtilis*, *S. Aureus*, *P.Aeruginosa*, *C.Albicanus*, and *E.Coli* bacteria.

2. Banana flower



Fig 3: banana flower [15]

The banana flower blooms at the end of a banana bunch. It's a leafy maroon cone with layered cream colored florets inside. Vitamins, flavonoids, and proteins abound in the banana bloom. Traditional medicine has utilized the flower to cure pneumonia, constipation, and ulcer problems. Antioxidant qualities of banana flower extracts help to avoid free radicals and manage cell and tissue damage. [16]

Lowers menstrual bleeding

Banana blossoms have been used to alleviate excessive blood loss during the menstrual cycle since ancient times. Blossom's capacity to regulate the progesterone hormone, which can minimize painful bleeding, is beneficial in reducing muscle cramps. It also contains magnesium, which can help with anxiety during that time. It is also thought to be beneficial to women with polycystic ovarian syndrome. [17]

Helpful in diabetes

Because banana blossoms are high in fibre and iron, which aid in the synthesis of red blood cells, it has been discovered that eating them regularly for roughly a month lowers blood sugar levels and raises haemoglobin levels in the body. [17]

Increase the milk production in lactating mothers

Intake of banana blossom boosts the milk production in lactating mothers. Therefore, it can be a blessing for new mothers who face problem nursing their new-borns. [17]

Helpful in ulcers

Ulcers are wounds that form on the linings of the intestines. Patients with ulcers are advised to increase their intake of vitamin C-rich foods, as vitamin C is thought to aid tissue repair and wound healing. Because the blooms are high in vitamin C, it can help with ulcer treatment by neutralizing stomach acids and reducing ulcer discomfort. [18]

Helpful in infection treatment

It was discovered during a study on the antimicrobial activity of ananda blossom extract that specific bioactive chemicals derived from banana blossoms had antibacterial action against the bacteria *Bacillus subtilis* (Mokbel and Hashinaga, 2005). The bioactive molecule malic acid discovered in blossom also had a greater antibacterial activity against *Bacillus subtilis*, *Bacillus cereus*, and *Escherichia coli*, according to the study. Furthermore, the flower extract aids in the healing of wounds, particularly in youngsters, as well as the prevention of *Plasmodium falciparum*, a malarial parasite, from growing and proliferating in the body.[19]

Good for gastrointestinal health

Banana blossom being a good source of both soluble and insoluble dietary fibre is very helpful for people suffering from irritable bowel syndrome (IBS) and diarrhea. [20]

3. Banana roots [21]

Toothache relief

The root of the banana actually helps in the alleviation of toothaches.

Asthma Relief

The banana root is considered to have antipyretic properties which are beneficial for disease of the respiratory system.

Pain and inflammation relief

The tannins in the banana root are considered to be very effective in relieving pain at the onset and site of the injury. It is also considered to be effective in treating brain inflammations.

4. Banana pseudo stem [22]

Managing cholesterol and blood pressure

It is high in vitamin B6 as well as iron, which raises haemoglobin levels. Banana stem is also high in potassium, which explains why it is excellent in lowering cholesterol and lowering blood pressure.

Weight loss

Banana stem has also been shown to help with weight loss. This is due to their high fibre content, which keeps you full for a long time.

Treat urinary tract infections

Banana stem juice is a diuretic that aids in the removal of toxins and the cleansing of the urinary tract.

Treating anemia

The stem of a banana is used to cure anemia. This is due to its high level of vitamin B6 and iron, both of which aid in the production of haemoglobin in the blood.

Good for diabetic patients

It has also got a low glycemic index and this is quite an important factor for any diabetic patient.

Helps in burning belly fat

It aids in the digestion and metabolism of the body. Banana stem juice or simply a cup of the stem, which is high in fibre, fills your stomach and keeps you satiated for longer.

As an analgesic

Suvarna et al [23] investigated the analgesic efficacy of aqueous and ethanolic extracts of *Musa sapientum* Linn stems using the hot plate method and tail immersion method, concluding that aqueous and ethanol extracts of *Musa sapientum* Linn stems have analgesic action. Possess analgesic potential that can be investigated further.

5. Banana leaf



Fig 4: banana leaf [15]

Sunscreen gel from banana leaves

Lignin is a class of complex organic polymers that form significant structural components in the support tissues of vascular plants and some algae, according to a study conducted by Dr. Deepak Wasule et al [24]. Lignin is very crucial in the creation of cell walls because it gives them stiffness and prevents them from rotting. Lignins are phenolic polymers that have been cross-linked. Because lignin is a natural sun protection agent. As a sunscreen, lignin can be found in green coffee, soy, and papaya, although banana leaves are said to have a high degree of lignin.

TRADITIONAL AND MEDICINAL USES OF BANANA**1. Hair care**

Bananas are good for your hair and scalp, according to a study by K Sampath et al [3]. They moisturize your skin and help to prevent and control dandruff while improving manageability and shine. Potassium, natural oils, carbohydrates, and vitamins are all abundant in bananas. These soften the hair and protect its natural suppleness, which helps to avoid split ends and breakage.

2. As a baby food

Bananas are the greatest solid meal for newborns to start with. A mashed ripe banana is a simple and nutritious infant meal. Vitamins A, B2, B6, C, E, Niacin, Folate, and Pantothenic Acid, as well as potassium, fibre, calcium, magnesium, phosphorus, selenium, iron, and vitamins A, B2, B6, C, E, Niacin, Folate, and Pantothenic Acid. Bananas are also relatively easy to digest and cause few adverse responses. Bananas are part of the BRAT (Banana, Rice, Applesauce, and Toast) diet, which is recommended by many doctors for children recuperating from gastrointestinal issues, notably diarrhoea. Recent study revealed evidence that eating more bananas and apple juice from concentrate may protect youngsters from wheezing. [25]

3. Plant based delicacies[25]**i. Koldil bhaji (fried banana flower)**

Banana blossom and banana heart are other names for the banana flower. Vitamins, essential and non-essential amino acids, and tannins abound. It can be found in a variety of Indian cuisines, including south Indian and Bengali dishes. Banana blossom is used by the Assamese tribal tribe in a simple and rustic style of cooking with few seasonings. Peeled banana blooms are chopped into little pieces. It is fried with potato cubes in a small amount of oil. The koldil is sometimes blended with pre-cooked dal and other spices and fried until it is perfectly cooked.

ii. Pitika kaskol

In real Assamese lunch scenes, mashed raw banana, or kaskol pitika as it is known locally, is a popular side dish. Along with the basic ingredient of raw bananas, the mashed combination frequently contains chilies, mustard oil, a few garlic pods, and chopped onions.

iii. Kolakhar

The commercial significance of 'kolakhar' among Assamese tribes is enormous. For the most part, banana trunks, rhizomes, and peels are utilized in the making of kolakhar. The plant portions are cut into bits and dried for several weeks in the sun. This is subsequently reduced to ashes, which are then removed using water. The ashes are then forced to pass through a bamboo sieve, where water is poured over them and allowed to flow down. Kolakhar is the name given to the filtrate obtained in this manner.

iv. Pitha Kol

It's an Assamese sweet delicacy created at home made from a banana it's steamed or deep-fried into fritters. Pithas are the archetypal sweet savoury from the Indian subcontinent. Assamese food is popular throughout the state. During the Bihu Festival, the Assamese community. The classic Kol Pitha is a steamed, encased, and stuffed pastry. Banana leaves wrapped around it Bananas are wrapped around the batter leaves and steamed them until they were done.

4. Improve emotional health

Bananas can help with a variety of emotional and physical ailments. They include tryptophan, an important amino acid that aids in the creation of serotonin, a neurotransmitter that helps people relax, boost their mood, and feel cheerful. This implies that bananas aid in the production of serotonin and so aid in the treatment of depression. [26]

5. Use of banana leaf for wrapping

Nunung et al [27] claim that *M. branchycarpa* is the most trustworthy food and cuisine wrapper based on the traditional practice of utilizing it. The bigger leaf breadth and higher number of fibres in the adaxial location support this.

6. Use of banana as a fibre

According to Desai et al [28], banana is a high-biomass crop that might be used as a raw material for fibre-based businesses such as paper, card board, tea bags, automobile interior fibre linings, high-quality dress fabrics, and currency notes.

7. Handicrafts from banana pseudo stem

Apart from woven and nonwoven fabrics and their products, NAU, Navsari, and CIRCOT, Mumbai, have also experimented with direct usage of fibre for the preparation of useful craft items. The fibbers were delivered to the Manav Kalyan Trust in Navsari [11] for the preparation of wall hangings, bags, dolls, idols, key chains, mobile phone covers, dining table mats, and other things. CIRCOT, Mumbai, made an effort at this utilizing both fibre and yarn. [28]



Fig 5: Handicrafts from banana pseudo stem [28]

UTILISATION OF BANANA PSEUDO STEM IN FOOD APPLICATIONS

The pseudo stem of a banana plant is the section that resembles a trunk. It is made up of overlapping leaf sheaths that are densely packed together. It's incredibly meaty, although it's primarily made up of water. It's extremely durable, and it'll hold a bunch weighing 50 kg or more. The false stem grows in height as the leaves appear one by one, reaching its maximum height when the inflorescence appears at the top of the plant. [29]



Fig 6: Pseudostem [29]

Because the plant is usually tall and strong, it is frequently mistaken for a tree. The banana plant's trunk, on the other hand, is a fake stem or pseudostem (Stover & Simmond, 1972). The pseudostem, which grows from a corm, is generally 5 to 7.6 meters tall (varies by species) (Nelson et al., 2006). The pseudostem is made up of a fragile core and multiple outer sheaths, as depicted in Figure 2.4. The juvenile inflorescence is carried by the fragile core (Fig 2.5) inside the pseudostem until it emerges at the top. As a result, the delicate core contains the majority of the pseudo stem's nutrients. [30], [31], and [32] are all numbers that can be used to make a number of different combinations.



Fig 7: Inner structure of banana pseudostem [31]

Nutritional value of banana pseudostem

The dietary fibre level of banana pseudostem is extremely high. In recent years, it has piqued the interest of food experts. The proximate composition of banana pseudostem was studied in order to see if it might be used in food rather than feed. [33] The proximate nutrient values from earlier studies were shown in the table below:

Table 2: Nutrient composition of banana pseudo stems [33]

Nutrients	Content (%)
Protein	2.5
Fat	3.4
Soluble dietary fibre	1.4
Insoluble dietary fibre	27.4
Starch	27.3
Ash	0.3
Moisture	15.1
Free sugar	3.4

1. Banana pseudo stem flour/banana powder

It can be used in a variety of dishes and has the potential to provide health benefits.

Powder can be used to fortify bakery items like bread, biscuits, and cookies, as well as dairy products like shrikhand, paneer, and cheese, with fibre, total carbs, and minerals.

The nutritional value of the banana pseudostem powder enriched with several dietary products and high fibre content is increased [34].

2. Pseudostem fruit juice

Banana pseudo stem juice has nutraceutical characteristics, making it a possible feedstock for healthy beverages. A bioprocess for nutritional enhancement of clarified banana pseudo stem juice with non-digestible glucooligosaccharides and practically calorie-free sugar, D-allulose, was developed by [35].

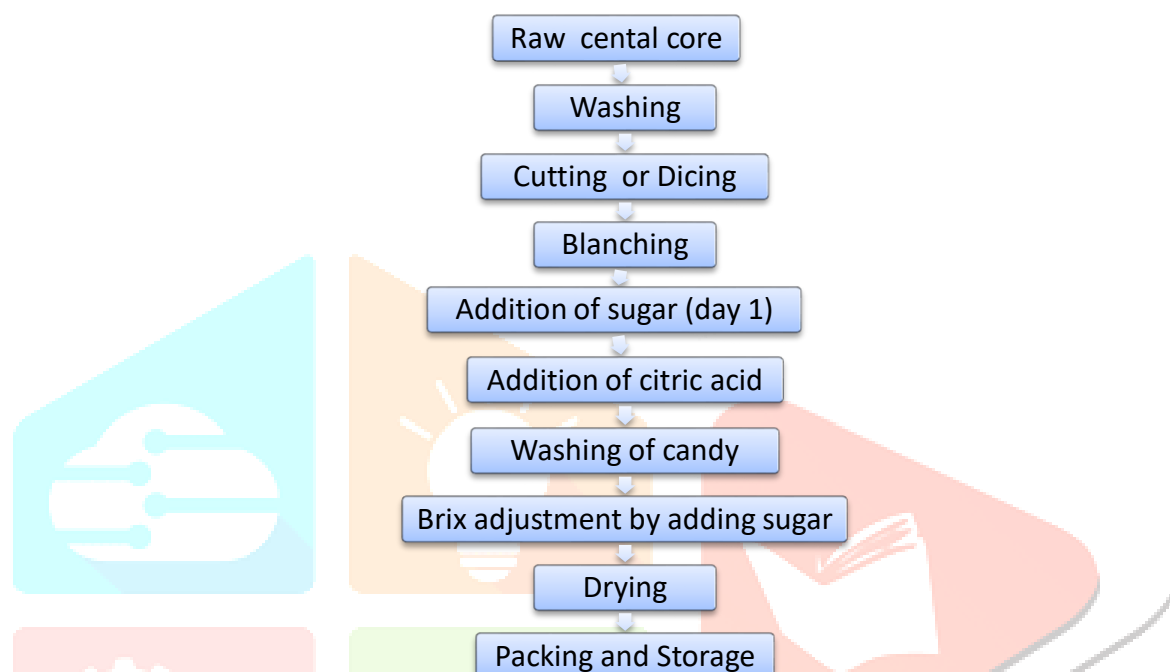
3. Pseudo stem candy

The most soft and tasty part of the pseudo stem is the central core. People, especially youngsters, prefer the central core after it has been processed into a candy because it is sweet and appetizing. [28]

Table 3: Nutritional content of candy prepared from pseudo stem[28]

Parameters	Unit	Content	Parameters	Unit	Content
Protein	%	4.1	Total dietary fibers	%	3.95
Carbohydrates	mg/100g	46.8	Vitamin B5	mg/100g	86.4
Calorific value	kcal/100g	390	Vitamin B3	mg/100g	34.1
Total sugars	%	85.4	Iron	mg/kg	643

Standardized process to prepare candy (according to Navsari Agriculture University, Navsari). [28]



4. Pseudo stem biscuits

To date, there have been few attempts to turn the pseudostem into edible baked shapes. As a result, including banana pseudostem into baked goods requires specific consideration. Biscuit or cookie preparations are quite popular among baked goods because of their ready-to-eat form, palatability, aroma, texture quality, and significantly longer shelf life [36].

Method of preparation

Biscuits were made using the method described by Kaur et al. [37] with minor modifications from the control (0 percent BPF containing wheat flour) and composite flour samples (BPF10, BPF20, and BPF30). Biscuit ingredients like as butter, sugar, salt, and sodium bicarbonate were also acquired at a nearby retailer (Malda, West Bengal, India). All four flour samples (150 g) were combined with butter (40 g), powdered sugar (35 g), salt (1 g), sodium bicarbonate (2 g), and distilled water in different batches (10 mL). The mixture was kneaded until it formed a nice, silky dough. Using a wooden rolling pin, the dough was rolled to a consistent thickness of roughly 0.7 cm on a fat rolling board. A cookie cutter was used to cut circular biscuits with a diameter of 4.5 cm, which were then placed on lightly greased trays and baked at 180°C for 15 minutes in a preheated convection oven (LG Electronics, India). All of the biscuits were kept in sealed containers after baking. [38]

DISCUSSION

Banana is an edible fruit that grows on a herbaceous flowering plant in the *Musa* genus and family Musaceae. Bananas can also be consumed as a cooked vegetable (and is then called plantains). *Musa acuminata* Colla and *Musa balbisiana* Colla are the two primary species of edible bananas, both of which are seedless (parthenocarpic). Bananas, a staple food in many nations, are one of the most popular fruits worldwide and a major agricultural food product in international trade. The banana flower is one of the banana plant's secondary crops, and it is considered a vegetable in many countries. Ivan suggested that the banana blossom may be utilized in traditional medicine to cure disorders like renal calculus and ulcers, and that its anti-hyperglycemic properties could be used in diabetes formulations. According to certain research, extracting the banana blossom using chloroform, water, and ethanol lowered blood sugar activity in rats with alloxan diabetes. The banana flower has traditionally been used to treat heart discomfort, asthma, diabetes, hypermenorrhea, dysmenorrhea, diarrhea, and gastrospasms. Furthermore, the banana flower extract contains anti-diabetic, anti-oxidant, and anti-malarial activities. The crude extract of the banana blossom has been shown in some studies to exhibit biological activity, such as regulating or changing oxidation resistance and lysosomal enzyme activity (Bhaskar & Salimath), as well as the potential to heal wounds [39]. Preliminary phytochemical screening of extracts of banana pseudo stem and antimicrobial activities revealed the presence of phenolic compounds, flavonoids, terpenoids, alkaloids, protein, tannins, saponins, cardiac glycosides that the pseudo stem of banana plant have pharmaceutical values and can be utilized in treatment of some ailments [40]. Even it has lot of food applications and can be utilized in making candies, biscuits, beverages etc.

CONCLUSION

Banana plants are widely regarded as one of the most useful plants on the planet. Almost every part of this plant can be used, including the fruit, peel, leaf, pseudo-stem, stalk, and inflorescence. Bananas are one of the most widely consumed fruits and a valuable commodity all over the world. However, once the banana fruit harvesting season is over, banana pseudo-stems are usually discarded as biomass waste. As a result, researchers have begun to extract the stem's fibres and other components and use them to create a variety of value-added products. A decorticator machine can extract the fibres from the banana pseudo-stem. Retting and degumming of the fibres are the next steps. Rope, cordage, fishing net, mat, packaging material, paper sheets, textile fabrics, bag, table cloth, handicrafts, absorbent, polymer/fiber composites, and other value-added products can be made from banana pseudo-stem fibres. Other components generated from the banana pseudo-stem can be employed as well. The central core can be used to make pickles, candy, and soft drinks, while the banana pseudo-stem sap (BPS) can be used as a mordant for colour fixation and organic liquid fertilizer, and the scutcher for compost and vermi-compost[40][41].

References

- [1] Afam I.O. Jdeani, Tonna A. Anyasi, 'Banana Nutrition', books.google .co.in
- [2] Macrea R, Robinson R K and Sadler M J (1993), *Encyclopedia of Food Science, Food Technology and Nutrition*, Academic Press
- [3] K. P. Sampath Kumar, Debjit Bhowmik, S. Duraivel, M. Umadevi, *Traditional and Medicinal Uses of Banana*, *Journal of Pharmacognosy and Phytochemistry*, Vol. 1 No. 3 2012; 51-53
- [4] FAOSTAT. (2019). *Crop production, statistics division*. Food and Agriculture Organization of the United Nations. <http://fao.org/faostat/en/#data/QC>
- [5] Singh B, Singh JP, Kaur A, Singh N (2016) Bioactive compounds in banana and their associated health benefits—a review. *Food Chem* 206:1–11. <https://doi.org/10.1016/j.foodchem.2016.03.033>
- [6] Amir Amini, Alaa El-Din Bekhit, Edward John Birch, 'Production, application and health effects of banana pulp and peel flour in the food industry,' *Journal of Food Science and Technology -Mysore-* February(2019), ResearchGate; 1,2,3
- [7] Jiwan S. Sidhu and Tasleem A. Zafar, 'Bioactive compounds in banana fruits and their health benefits', *Food Quality and Safety*, Oxford (2018); 1,186
- [8] Kathy.W. Warwick, R.D, CDE, 'Benefits and health risks of bananas', *Medical News Today*(2020) <https://www.medicalnewstoday.com>
- [9] Rao N M. Cysteine protease inhibitors from banana (*Musa paradisiaca*). *Current Science*. 1989; 58(23):1320-1322
- [10] Zhang C X *et al.* Greater fruit and vegetable intake is associated with lower risk of breast cancer in Chinese women. *Int J Cancer*. 2009; 125: 181-188.
- [11] Kaimal S *et al.* Hypolipidaemic and antioxidant effects of fruits of *Musa AAA* (Chenkadali) in alloxan induced diabetic rats. *Indian J Exp Biol*. 2010; 48(2):165-73
- [12] Heo H J *et al.* Effect of banana, orange and apple on oxidative stress induced neurotoxicity in PC 12 cells. *J Food Science*. 2008; 73(2):H28-H32.
- [13] Bankar A *et al.* Banana peel extract mediated synthesis of gold nanoparticles. *Colloids Surf B Biointerfaces*. 2010; 80(1): 45-50
- [14] Ibrahim M.M H. Green synthesis and characterization of silver nanoparticles using banana peel extract and their anti microbial activity against representative micro organisms *J. Radiation Research and App. Sci*. 2015; 30: 1-11.
- [15] 'Morphology of banana plant', promusa.org
- [16] Dr. Simi Paknikar, MD, Thalika Ravi, 'Medicinal Properties of Banana Plant', *Medindia*(2019)
- [17] Shilpi Singh, 'Banana blossom and understated food with high functional benefits', *International Journal of Current Research*(2017); 44517-44518

- [18] http://www.newvision.co.ug/new_vision/news/1436915/health-benefits-eating-banana-flower-empumumpu
- [19] Jahan M, Warsi MK, Khatoon F. Concentration influence on antimicrobial activity of banana blossom extract incorporated chitosan-polyethylene glycol (CS-PEG) blended film. *J Chem.Pharm.Res.*, 2010, 2(5):373-37
- [20] Jahan M, Warsi MK, Khatoon F. Concentration influence on antimicrobial activity of banana blossom extract incorporated chitosan-polyethylene glycol (CS-PEG) blended film. *J Chem.Pharm.Res.*, 2010, 2(5):373-37
- [21] Jebi, `Surprising Health benefits of Banana Roots, Tropics Australia. <https://islandjamaica.com>
- [22] Sheetal Decaria, MD, `11 Amazing Health Benefits of banana Pseudostem`
- [23] <https://www.ncbi.nlm.gov/pubmed/8044524>
- [24] <https://www.thehealthsite.com/fitness/add-more-fibre-to-your-meals-with-these-foods- kd0718>
a. <https://painassist.com>
- [25] Gore M A and Akolekar D. Banana leaf dressing for skin graft donor areas. *Burns* 2003; 29(5): 483-6
- [26] Dr Deepak Wasule, Ankita Kawale, Deepti Pandey, ` Determination of Banana Leaf Extract for Sunscreen Property`, (2018) *IJRTI*;75-80
- [27] Upasna Sarma, Viney Kumar Govila and Akanksha Yadav, ` The traditional and therapeutic use of banana and its plant based delicacies in ethnic Assamese cuisine and religious rituals from Northeast India`, *Journal of Ethnic Foods* (2020);4-5
- [28] N Jyothirmayi, N Mallikarjuna Rao, ` Banana Medicinal Uses`, *Journal of Medical Science & Technology*(2015);152-160
- [29] Nunung Harijati, Rodliyati Azrianingsih, Eva Affanti Prawaningtyas, `The Study of Anatomy and Fiber Banana Leaf as a Potensial Wrapping`, *American Journal of Plant Sciences*, 2013); 1461-1465.
- [30] C.S.Desai, V.P Usadadia , J.M Patel, V.R. Naik , S.L. Pawar, N.G. Savani, `Value Added Products from Banana Pseudostem`, *Navsari Agricultural University* (2016);1-2,17-76,82
- [31] IPGRI, INIBAB, CIRAD, 1996, `Description of banana (*Musa spp*) IPGRI. Rome, Italy INIBAP , Montpellier, France, CIRAD, France 55pp
- [32] Nelson.S.C, Ploetz R.C and Kepler. A.K. (2006) *Musa spp* (banana and plantains), ver. 2.2. In species Profile for Pacific Island Agroforestry. Permanent Agriculture Resources` (PAR), Hluoalooa, Hawaii
- [33] Jun Ma, ` Banana Pseudostem: properties nutritional composition and use as a food`, *The University of New South Wales*.2015;7
- [34] Stover.R.H & Simmonds, N.W. (1972). *Bananas* (3rd edn)
- [35] Bhaskar, J.J, Chilkunda, N.D & Salimath, P.V (2011) `Banana(*Musa spp* Var. *elakki bale*) flower and pseudostem : dietary fibre and associated antioxidant capacity`, *Journal of Agricultural and Food Chemistry*, 60(1),427- 432
- [36] R.L.Thorat & H.P Bobade , `Utilisation of banana pseudostem in food applications`, *International Journal of Agricultural Engineering*(Vol II) 2018;87,88
- [37] Manisha Sharma, Satya Naryan Patel, Rajender N Sangwan , Sudhir P Singh , `Biotransformation of banana pseudo stem extract into functional juice containing value added biomolecules of potential health benefits`, *Indian Journal of Experimental Biology*.(2017);453-460
- [38] Adeola AA, Ohizua ER (2018) Physical, chemical, and sensory properties of biscuits prepared from flour blends of unripe cooking banana, pigeon pea, and sweet potato. *Food Sci Nutr* 6:532–540. <https://doi.org/10.1002/fsn3.590>
- [39] Kaur M, Singh V, Kaur R (2017) Effect of partial replacement of wheat four with varying levels of flaxseed four on physicochemical, antioxidant and sensory characteristics of cookies. *Bioact Carbohydr Diet Fibre* 9:14–20
- [40] Rakhi Chakraborty, Sanjida Sabruna, Rumeli Roy, Sukanta Majumdar, Swarnendu Roy `Banana pseudostem substitution in wheat four biscuits enriches the nutritional and antioxidative properties with considerable acceptability`. (2021)
- [41] Azizah Mahmood, Nurziana Ngah and Muhammad Nor Omar, `Phytochemicals Constituent and Antioxidant Activities in *Musa x Paradisiaca* Flower; *European Journal of Scientific Research*`, EuroJournals Publishing, Page no.- 311 to 316.
- [42] C.T. Onyema, C.E. Ofori, V.C. Okudo and A.S. Ogbuagu, `Phytochemical and Antimicrobial Analysis of Banana Pseudo Stem (*Musa acuminata*)`, Department of Pure and Industrial Chemistry, Faculty of Physical Sciences, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria, Page no.- 1 to 8
- [43] Asmanto Subagyo and Achmad Chafidz, `Banana Pseudo-Stem Fiber: Preparation, Characteristics, and Applications`, <https://www.intechopen.com/chapters/64570>.