Analysis of Physico-chemical and Functional Properties of Banana Flower

Damini Soni and Gargi Saxena

Research Journal of Agricultural Sciences
An International Journal

P- ISSN: 0976-1675
E- ISSN: 2249-4538

Volume: 12
Issue: 06

Res. Jr. of Agril. Sci. (2021) 12: 2020–2023

CARAS

Res. Jr. of Agril. Sci. (Nov-Dec 2021) 12(6): 2020–2023
www.rjas.org

Full Length Research Article

Analysis of Physico-chemical and Functional Properties of Banana Flower

Damini Soni*[1] and Gargi Saxena[2]

Received: 26 Jul 2021 | Revised accepted: 16 Oct 2021 | Published online: 11 Nov 2021

A B S T R A C T

Banana flower is a banana male bud which is the by-product of banana plant. It is a large dark maroon color flower grown from the end of bunch of bananas. In the present research work, the flower was studied for its proximate composition and functional properties. Moisture, ash, total fiber, fat, carbohydrate, Iron, phosphorous, calcium and vitamin C of the flower were analyzed and it was found that the flower is a good source of fiber and can be used to develop fiber rich food products. The flower was also assessed for its antioxidant and phytochemical properties as, it is a rich source of a class of bioactive compounds i.e., alkaloids, flavonoids, tannins and phenolic compounds and hence the flower is known to possess various bioactivities such as antioxidant, antimicrobial, antivirus and anti-cancer. The functional properties of the flower were also analyzed which included bulk density, oil and water holding capacity, swelling power and solubility. The bulk density of the flower was found to be low which showed that banana flower powder can be incorporated in various food products to enhance the antioxidant profile and fiber content.

***Key words*:** Banana flower, By product, Fiber rich, Antioxidants, Anticancer

Banana is a leading crop in world agriculture and trade with expanding global import demand and rapid increasing production and volume in recent decade. Global average banana production raised from 69 million tonnes in 2000-2002 to 116 million tonnes in 2017-2019, at an approximate value of 31 billion USD. Asia is expected to remain the leading global producing region at volume share of 51.8%, with India projected to reach 35.5 million tonnes and per capita consumption of 23.5kgs in 2029 [1]. Looking at the production rate it can be estimated that the production of banana flower or blossom which is the byproduct of banana will be more as compared to the production of banana. Banana flower is an underutilized byproduct which can be consumed by humans.

Banana flower is a banana male bud which is a leafy maroon colored cone at the end of banana's bunch with cream-colored florets layered inside [2]. Blossom is an edible flower rich in many nutrients and anti-oxidants which can give several health benefits but it is mostly discarded as waste during cultivation of banana [3]. The extract of banana blossom possesses antioxidant properties which helps to prevent tissue damage caused due to increase in amount of toxins produced in our body [4]. The flower is rich in vitamins, essential and non-essential amino acids and tannins [5].

Fig 1 Flower of *Musa paradisiaca*

Nutritional profile of banana flower

Banana flower has tremendous nutritional value and is consumed as food additive in many Asian countries such as Sri lanka, Indonesia, Thailand and Myanmar [6]. The flower is found to be a rich source of fiber and some biologically active compounds like vitamin C, tannins, myoinositol, phosphates and alpha tocopherol [7]. The bracts of banana flower are good source of carbohydrates, proteins and minerals [8]. The flower in Thailand is usually

* **Damini Soni**
✉ daminisoni1013@gmail.com
[1-2] Department of Home Science, IIS (Deemed to be University), Jaipur - 302 020, Rajasthan, India

considered as a vegetable which has a potential to be regarded as functional food due to its high nutritional content, being an excellent source of fiber, protein, vitamin A, C and E including minerals like phosphorous, Iron, Zinc and Potassium [9]. According to Tasnim *et al*. [2] blossoms are good source of high-quality protein, dietary fiber, vitamins, minerals including Iron, copper, magnesium and also rich in flavonoids specially quercetin. Sugars being the bio-available source of energy, flower is found to be rich in sugars like maltose, sucrose, arabinose, glucose and fructose. Classes of phytochemical which include amount of tannins, saponins, flavonoids are also reported in banana bracts [10].

Health benefits of flower

Musa species are widely known for their medicinal properties to mankind. Heart pain, menstrual cramps, diabetes, endocrine problems and asthma can be treated from the flowers of banana also weak body and infantile malnutrition can be suppressed using the blossoms of banana [11]. Blossoms are found to cure stomach and throat ulcers, redness/itching of eyes, nervous disabilities, breathing and blood flow problems. They have also been reported to boost immune system and reduce the growth of cancer cells together due to their antioxidant properties can reduce the risk of chronic diseases like cardiovascular and diabetes [12]. Suman *et al*. [13] conducted a comparative study on anti-cancer effects of anthocyanins derived from banana flower bracts against human colon (HT-29) and cervical cancer cells (HeLa cells). The study showed that anthocyanins of banana bracts are potential anti-cancerous compounds. Banana flower extract is used for ameliorating urinary disturbance and have been reported to suppress Benign Prostatic Hyperplasia by Regulating the Inflammatory Response and Inducing G1 Cell-cycle Arrest [14]. The flower due to rich in anti-oxidants and fiber is known to stabilize the blood sugar levels; helps fight anemia and menstrual problems in women. Also, it is believed to inhibit the growth of pathogenic bacteria and malarial bacterial growth [15].

Consumption of banana flower

The flowers of banana are been consumed in many countries including Indonesia, Thailand, Myanmar. It is considered as vegetable and is cooked in variety of dishes in India, Sri Lanka and South East Asian countries [4]. It is exclusively included in south Indian cuisines and Bengali recipes, the Assamese community use it in a rustic and a simple way with fewer spices to make *koldil bhaji* and *koldil mangxho* [5]. The extract of banana blossom has also been used to prepare banana tea in United States [16]. Blossom is also consumed in Bangladesh as vegetable and as salad with rice and wheat bread in different countries of Asia [2].

MATERIALS AND METHODS

The study was conducted in the Research laboratory of the Department of Home Science, IIS (deemed to be University), Jaipur, Rajasthan.

Procurement of banana flower

Banana flower was procured from the local Bengali market located at C-scheme area of Jaipur city in Rajasthan. After procurement of banana flower, it was weighed using digital weighing balance. The outer bracts of the flower was weighed and discarded as it was the inedible part of the flower. The inner bracts were weighed as they were edible.

Processing of the flower

To prevent darkening, the flowers were immersed in various concentrations of citric acid and salt solution for varied period of time. The pre-treated flowers were dried in hot air oven for 4 hours at 50 degrees and later ground to fine powder [9].

Physicochemical analysis of the flower

The Moisture, ash, protein, fiber, fat, carbohydrate, iron, phosphorous, vitamin C, calcium, antioxidant activity and phytochemical content of the flower were analyzed. The estimations were done in triplicates.

- *Moisture content*

Oven drying method was used for the estimation of moisture content [17]. 5gm of flower sample was kept in petri-plate at 60°C for 4-5 hours for drying.

- *Ash content*

Dry ashing method was used for the estimation of ash content [17]. Three gram of sample was taken for ashing. Two concordant readings were taken.

- *Protein content*

Nitrogen content was estimated using Micro-Kjeldahl method (KELPLUS) which includes digestion, distillation and titration [17]. The nitrogen content was then multiplied by the conversion factor 6.25 to get the protein content.

- *Crude Fiber content*

Acid-alkali wash method was used for the estimation of Crude fiber content [17]. Five grams of moisture and fat free sample was taken for the estimation of fiber.

- *Fat content*

Soxhlet method was used for the estimation of fat content [17] where di-ethyl ether was used as solvent.

- *Carbohydrate*

Carbohydrate content was assessed using difference method where moisture, protein, fat, ash and crude fiber were subtracted from 100.

- *Iron and phosphorous content*

Estimation of Iron content present in banana flower was done using Wong's method. Colorimeter set to 570 nm was used for taking the optical density of the samples [18]. Titrimetric method was used for the estimation of phosphorous where Ammonium molybdate solution was taken for the estimation [19].

- *Calcium content*

Calcium estimation was performed using titration method against potassium permanganate [20].

- *Vitamin C*

Vitamin C was estimated using metaphosphoric acid by titration method where readings were taken in triplicates [20].

- *Anti-oxidant activity*

Antioxidant activity of the banana flower was estimated using DPPH where Trolox was used for the preparation of standard solution [21].

- *Phytochemicals*

Total Phenols and total flavonoids were estimated in banana flower where quercetin and Gallic acid were taken as standards respectively [22].

Functional properties of banana flower

Banana blossom was analyzed for its functional properties which included assessment of Bulk density [23] water and oil holding capacity [24], solubility index and swelling power [25].

- *Bulk density*

10gm of dried sample was taken in 100ml measuring cylinder and was tapped to a constant volume and bulk density (g/cm^3) was calculated.

- *Water holding capacity*

One gram sample was mixed with 10ml of distilled water and allowed to stand at room temperature for 30 min. Centrifugation was done at 3000rpm for 25min. Water was discarded and weight of the vial was taken using which water holding capacity is calculated.

- *Oil holding capacity*

One gram of sample was mixed with 10ml of vegetable oil in pre weighed centrifuge tube. Tube was stirred for 1 min and is allowed to stand at room temperature for 30 min. Centrifugation was done at 3000rpm for 25 min. Separated oil was removed using pipette after which the weight of the tube was taken and oil holding capacity was calculated.

- *Solubility*

One gram of sample was weighed in pre weighed centrifuge tube and was mixed with 10 ml distilled water. The tube was heated at 80° for 30 min and then was removed from bath. Later it was kept for drying at room temperature and centrifuged at 2200rpm for 15 min. The supernatant was discarded and dried residue was weighed to determine the solubility.

- *Swelling power*

Weight of the swollen sample was taken which was obtained from decanting the supernatant and weighing it.

RESULTS AND DISCUSSION

Banana flower is a nutritionally rich edible byproduct of banana which can be consumed as vegetable. The flower is rich in fiber and various bioactive compounds. Present study was done to assess nutritional composition and functional properties of banana flower, so that it can be incorporated in the diet in various forms for better health.

Physicochemical properties of banana flower

The physicochemical composition of Banana flower was assessed. Moisture content was reported to be 71.516 g/100g. Sheng [7] also reported slightly high moisture content of 89.42 g/100g in banana flower. The ash content of the flower was estimated to be 3.58 g/100g which was close to the value of 3.5% as reported by Elaveniya [26]. Fiber content was found to be 12.38 g/100g which indicated flowers can be consumed as dietary fiber supplements. The fat content of the flower was estimated to be 4.501 g/100 which was close to 6.54% as assessed by Liyanage [22]. Protein content of banana flower was found to be 5.639 g/100g. According to a study by Florent *et al*. [27], flower has a good protein quality and high levels of unsaturated fatty acids especially linoleic and gamma-linolenic acids. Carbohydrate content of the flower was calculated to be 2.64 g/100g. Iron and phosphorous content of the banana flower were found to be negligible. Calcium content of banana flower was estimated to be 60.2 mg/100g. As per the study conducted by Sheng *et al*. [7], banana flower was found to have 56 mg/100g of calcium. Antioxidant activity of the flower was estimated using DPPH methods and was found to be 11.44 mg/TAE/100g which shows that the flower is a good source of antioxidants. Vitamin C content of banana flower was found to be 38 mg/100mg. The total phenol content was estimated and was expressed as gallic acid equivalents which was 96.155mg GAE/100g and total flavonoids was 137.585mg QUE/100g, which was expressed as quercetin equivalents.

Table 1 Nutritional composition of banana flower

Proximate parameter	Amount (g/100g)
Moisture	71.516 ± 1.007
Ash	3.58 ± 0.531
Fiber	12.379 ± 0.951
Fat	4.502 ± 0.555
Protein	5.639 ± 0.292
Carbohydrate	2.64 ± 0.726
Mineral (mg/100g)	
Iron	-
Phosphorous	-
Calcium	60.2mg
Antioxidant activity	
DPPH	11.44 mg/TAE/100g
Vitamin C	38mg
Phytochemicals	
Total phenols	96.155mg GAE/100g
Total flavonoids	137.585mg QUE/100g

Functional properties of banana flower

Functional properties of the banana flower are represented in (Table 2). Bulk density of banana flower was found to be 0.606g/cm^3. Bulk density is the measure of heaviness of powder which determines the ease of packaging and transportation, also low bulk density of a powder states its good quality for development of different products. The sample was also estimated for oil and water holding capacity which was found to be 0.178 g/g and 0.89 g/g respectively. The oil and water holding capacity of the powder were found to be low. The swelling power of banana flower was analyzed to be 0.91 (g/g). According to some researches solubility is an indicator of its quality [26]. High solubility suggested that it is digestible and can be considered for the development of food products.

Table 2 Functional properties of banana flower

Functional parameter	Value
Bulk density (g/cm^3)	0.60
Oil holding capacity (g/g)	0.17
Water holding capacity (g/g)	0.89
Swelling power (g/g)	0.91
Solubility (%)	9.92

CONCLUSION

The banana flower is an underutilized byproduct of Banana plant but possess a good proximate profile as reported in the present study. The flower is found to be good in dietary fiber which is an important nutrient as it relieves constipation, lowers the cholesterol level, helps in weight reduction, helps in controlling blood sugar levels and maintains good bowel health by acting as prebiotics. Besides, the high dietary fiber content, it possesses good antioxidant profile also, so, from the present study it is concluded that banana flower can be incorporated in the diet

for better health. The low bulk density of the banana flower indicates that it can be used for the development of various food products and beverages. On the other side, the oil and water holding capacity of the powder was found to be low which may be due to less availability of polar amino acids thus the powder was found to be less suitable for the development of bakery products. Swelling power and solubility of the powder were found to be appropriate which suggested that it can be used for product development and indicated that the quality of powder is good. Banana flower, besides being nutritionally rich it has good functional properties and hence can be in corporate in various dishes prepared both at home and commercially for better health of the community.

LITERATURE CITED

1. Anonymous. 2020. Food and Agriculture Organization of United States, Banana Market Review, February 2020.
2. Tasnim T, Das PC, Begum AA, Nupur AH, Mazumder MAR. 2020. Nutritional, textural and sensory quality of plain cake enriched with rice rinsed water treated banana blossom flour. *Journal of Agriculture and Food Research* 2: 100071.
3. Thaweesang S. 2019. Antioxidant activity and total phenolic compounds of fresh and blanching banana blossom (*Musa* ABB CV. Kluai "Namwa") in Thailand. *In*: *IOP Conference Series: Materials Science and Engineering* 639(1): 012047. IOP Publishing.
4. Sharmila YDP. 2015. Development and evaluation of banana blossom incorporated dark chocolate. Mother Teresa Women University, Kodaikanal, India.
5. Sarma U, Govila VK, Yadav A. 2020. 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* 7(1): 1-7.
6. Wickra Marachchi KS, Ranamukhaarachchi SL. 2005. Preservation of fiber-rich banana blossom as a dehydrated vegetable. *Science Asia* 31: 265-271.
7. Sheng ZW, Ma Wei-Hong, Jin, Zhi-Qiang, Bi Yang, Sun Zhi-Gao, Dou Hua-Ting, Gao Jin-He, Li Jing-Yang, Han Li-Na. 2010. Investigation of dietary fiber, protein, vitamin E and other nutritional compounds of banana flower of two cultivars grown in China. *African Journal of Biotechnology* 9(25): 3888-3895.
8. Kakimori MTA, Debiage RR, Gonçalves FMF, Da Silva RMG, Yoshihara E, de Mello-Peixoto ECT. 2019. Anthelmintic and antioxidant potential of banana bracts (*Musa paradisiaca*) extract in ruminants. *Acta Veterinaria Brasilica* 13(1).
9. Singh S. 2017. Banana blossom-an understate food with high functional benefits. *International Journal of Current Research* 9(1): 44516-44519.
10. Ramu R, Shirahatti PS, Anilakumar KR, Nayakavadi S, Zameer F, Dhananjaya BL, Prasad MN. 2017. Assessment of nutritional quality and global antioxidant response of banana (*Musa* sp. CV. Nanjangud Rasa Bale) pseudostem and flower. *Pharmacognosy Research* 9(1): 74.
11. Singh B, Singh JP, Kaur A, Singh N. 2016. Bioactive compounds in banana and their associated health benefits – a review. *Food Chemistry* 206: 1-11.
12. Komal K. 2019. Development and nutritional evaluation of banana blossom incorporated sev. *International Journal of Basic and Applied Research* 9(8): 28-34.
13. Suman R, Kalaimathi K, Palanichamy S, Sowmiya R, Vaganan MM, Ravi I, Uma S. 2018. Anti-cancerous activities of anthocyanins of banana cv. Nendran (*Musa* sp.) flower bracts against human colon and cervical cancer cell lines. *International Journal of Current Microbiology and Applied Science* 7(12): 2786-2793.
14. Liu LC, Lin YH, Lin YC, Ho CT, Hung CM, Way TD, Bau DT. 2018. Banana flower extract suppresses benign prostatic hyperplasia by regulating the inflammatory response and inducing G1 cell-cycle arrest. *In vivo* 32(6): 1373-1379.
15. Ambrose DC, Sumithra V, Vijay K, Vinodhini K. 2018. Techniques to improve the shelf life of freshly harvested banana blossoms. *Current Agriculture Research Journal* 6(2): 141-149.
16. Ashikawa JK. 2001. U.S. Patent No. 6,180,160. Washington, DC: U.S. Patent and Trademark Office.
17. AOAC. 2019). *Official Methods of Analysis*. 18th Edition. Association of Official Agricultural Chemist. Washington. DC.
18. Raghuramulu N, Nair MK, Kalyansundaram S. 2003. *A Manual of Laboratory Techniques*. National Institute of Nutrition, ICMR, Hyderabad, India.
19. Ranganna S. 2010. *Handbook of Analysis and Quality Control for Fruit and Vegetable Products.* Tata McGrew-Hill Publication, New Delhi.
20. AOAC. 2019. *Official Methods of Analysis*, 21st Edition. Association of Official Agricultural Chemist. Washington. DC.
21. Tadhani MB, Patel VH, Subhash R. 2007. In vitro antioxidant activities of *Stevia rebaudiana* leaves and callus. *Journal of Food Composition and Analysis* 20(3/4): 323-329.
22. Singleton VL, Orthofer R, Lamuela-Raventos RM. 1999. Analysis of total phenols and other oxidation substrates and antioxidants by means of Folin-Ciocalteau reagent. *Methods Enzymology* 299: 152-178.
23. Okaka JC, Potter NN. 1977. Functional and storage properties of cow pea-wheat flour blends in bread making. *Journal of Food Science* 42: 828-833.
24. Rosario RD, Flores DM. 1981. Functional properties of flour types on mung bean flours. *Science Food Agriculture* 32: 172-180.
25. Okaka JC, Potter NN. 1979. Physico-chemical and functional properties of cowpea powders processed to reduce beany flavor. *Journal of Food Science* 44(4): 1235-1240.
26. Elaveniya E, Jayamuthunagai J. 2014. Functional, physicochemical and anti-oxidant properties of dehydrated banana blossom powder and its incorporation in biscuits. *International Journal of Chemical Technology and Research* 6(9): 4446-4454.
27. Florent A, Loh AM, Thomas H. 2015. Nutritive value of three varieties of banana and plantain blossoms from Cameroon. *Journal of Agricultural Sciences* 5(2): 52-61.