



## Development of breakfast cereal using banana blossom bracts and determination of its nutritive value and acceptability

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### Abstract

Banana flower, also known as banana blossom or heart or bud, is the splendid looking male, sterile flower of the banana plant. In this study, the outer bracts of the banana flower was incorporated to prepare a breakfast cereal. A Standard breakfast cereal (A1) was prepared using whole wheat flour. Banana blossom bracts incorporated breakfast cereal had two variation, A2 – 60g and A3 – 80g of banana blossom bracts paste. Proximate composition such as moisture, ash, carbohydrates, protein, dietary fiber, calcium and iron were analyzed. As banana blossom bracts are a good source of antioxidants, they were analyzed for its antioxidant activity, vitamin A and vitamin C of all the three samples. Sensory analysis was conducted for the samples by analyzing the parameters such as color, appearance, flavor, texture, taste and overall acceptability. Both the variations A2 and A3 were found to be rich in dietary fiber (41.2% & 63.7%, respectively) and antioxidant activity (14.7% & 20.6%, respectively) along with other chemical compositions including proximate, minerals and anthocyanin content. The results revealed that the variations A3 followed by A2 was rich in dietary fiber and antioxidant activity and can be used as a functional ingredient to formulate different products to achieve low- calorie and high fiber products. The banana blossom bracts are rich in anthocyanin content and can be used to extract natural color dyes commercially in large scale industries.

**Keywords:** banana flower, banana blossom, antioxidants, breakfast cereal, dietary fiber

### Introduction

The role of breakfast cereals in a balanced diet has been recognized for many years. Dietary guidelines note that the high nutrient density of breakfast cereals (especially those that are whole grain or high in cereal FIBER) makes them an important source of key nutrients. The group of Breakfast Cereal comprises many different cereal products and can be divided roughly into cooked cereals, like porridge type breakfasts, and ready-to-eat cereals (RTEC) or “cold” breakfast cereals like cornflakes and muesli (Marion G. Priebe and Jolene R. McMonagle.; 2016). Today, breakfast cereals are still based on natural grains – wheat, maize, rice, barley, oats and rye. It is made from either flour or whole grains, they contain all of the basic nutrients that we need to start the day: carbohydrates, protein, fat, minerals, vitamins and FIBER. The first meal of the day is the most important because it supplies the body and brain with the necessary nutrients after a night’s sleep. Scientific studies have established the importance of nutrients breakfast cereal consumption has played a vital role.

The banana flower is a component in the inflorescence of the banana plant. The male and female flowers of the plant are both present but come out of the plant separately. The female flowers are the first to come out which then develops into fruits. The genus is native throughout the Indo-Malaysian region, in tropical and subtropical areas from Sri Lanka and eastern India, across south China and Southeast Asia to the southwest Pacific and northern Australia, but it is widely cultivated in all tropical regions of the world (Kennedy, 2009). It is long pointed, deep crimson yellow or

pink coloured and consists of tightly packed leaves or bracts that wrap around rows of thin stemmed male flowers. Easy availability of banana blossom throughout the year, high nutritive value and low market price has made it unique commodity (Midhila Mahendran and C. Nirmala, 2014). Along with the fruit wastage, there is an immense wastage of this by-product also. These are usually discarded in water bodies, leading to increased biological oxygen demand (BOD) and thus disturbing aquatic life. The inner bract of banana flower is cooked in a variety of dishes in Asian countries such as curry, deep fried outlet whereas the coloured outer bracts are generally disposed as residue after harvesting of banana flower (Leonard, 2006).

About 300 kg of coloured bracts per hectare are disposed as residues during harvesting of banana and is an excellent source of anthocyanin.

The composition of fibre, its organizational structure, physicochemical and surface properties, and associated bioactive (oligosaccharides and bound phenolics) compounds are mainly responsible for the physiological benefits of Dietary FIBER (Macagnana *et al.* 2016) [7]. Besides, polyphenols associated with Dietary FIBER is also responsible for beneficial effects, especially in the prevention and management of chronic and degenerative diseases (Aruna *et al.* 2017).

The main objective of this study is to formulate a healthy alternative baked breakfast cereal using the outer bracts of the banana flower to implement the utilization of the under-utilized bracts which has an abundant source of nutritional components.

**Materials and Method**

**Sample pre-preparation**

The outer bracts of the banana blossom was removed carefully, cut into pieces and weighed approximately 250g, which was washed and blanched for 3 to 5 minutes at 75C.

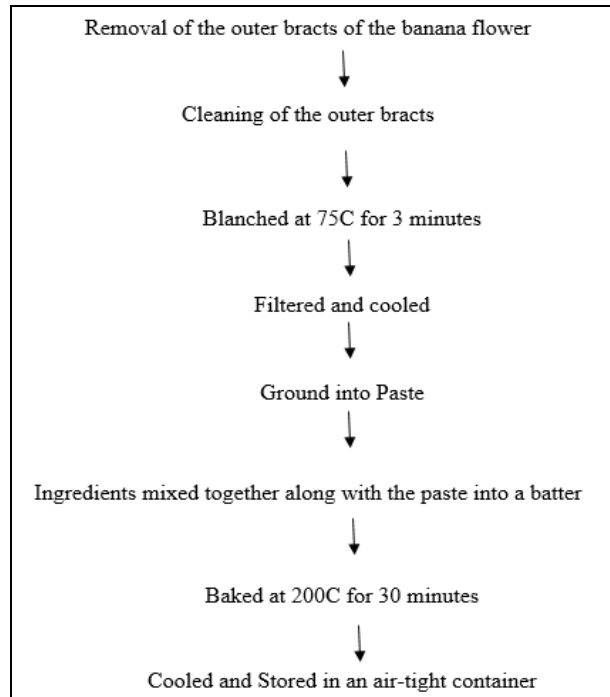
The bracts were cooled for some time and ground into a paste. The paste was added in different proportions for the formulation of the product.

**Formulation of the Product**

**Table 1:** Formulation of the product of the control and the variations

	Wheat Flour	Bracts Paste	Unrefined Sugar	Baking Powder	Vanilla Essence
A1 (control)	100g	-	30g	¼ tsp	¼ tsp
A2	40g	60g	30g	¼ tsp	¼ tsp
A3	20g	80g	30g	¼ tsp	¼ tsp

**Process Flowchart**



**Fig 1:** Process flowchart of the control and the variations

**Experimental Procedure**

**Nutrient analysis**

The nutrient analysis was carried out for the standards and variations using standardized protocols.

The parameters analyzed include moisture, total ash, protein, total carbohydrates, Calcium, Iron, antioxidant activity, Dietary FIBER, Vitamin A, Vitamin C and Anthocyanin content.

**Sensory analysis**

Samples were analyzed for its sensory characteristics like colour, flavour, taste, appearance, texture, mouthfeel and overall acceptability using 9-point hedonic scale (9- like extremely to 1- dislike extremely).

**Results and discussion**

**Proximate analysis**

**Table 2:** Result for proximate analysis of the control and the variation samples

Analysis (100g)	A1 (standard)	A2 (variation 1)	A3 (variation 2)
Moisture (%)	9.774±0.05	9.513±0.08	9.403±0.1
Ash (g)	0.125±0.01	0.357±0.1	0.369±0.1
Total carbohydrates (g/100g)	97.9±0.2	83.83±0.04	76.63±0.03
Protein (g)	10.74±0.05	7.85±0.07	7.99±0.08
Insoluble dietary FIBER	-	37.876±0.1	59.868±0.2
Soluble dietary FIBER	1.9±0.02	3.376±0.07	3.868±0.04
Total dietary FIBER (g)	1.9±0.2	41.252±0.5	63.736±0.5
Calcium (mg/100g)	132.52±0.3	509.31±0.4	685.08±0.5
Iron (mg/100g)	2.7±0.1	18.89±0.5	34.29±0.3
Betacarotene (mg/100g)	0.845±0.07	1.735±0.07	2.57±0.03
Vitamin C (mg/100g)	7.46±0.2	9.94±0.3	12.42±0.3
Antioxidant activity (µ/ml)	0.180±0.05	14.718±0.04	20.624±0.04
IC50 (µM)	12.32±0.02	131.436±0.05	175.24±0.05
Anthocyanin pigment (mg/100g)	0.0125±0.03	14.0141±0.02	18.0158±0.04

A1- control; A2- variation 1 (60g); A3 – variation 2 (80g)

**Sensory analysis**

The breakfast cereal prepared with banana blossom bracts was analysed with hot milk and the plain samples without the milk which was evaluated for sensory attributes (appearance, colour, texture, flavour and overall

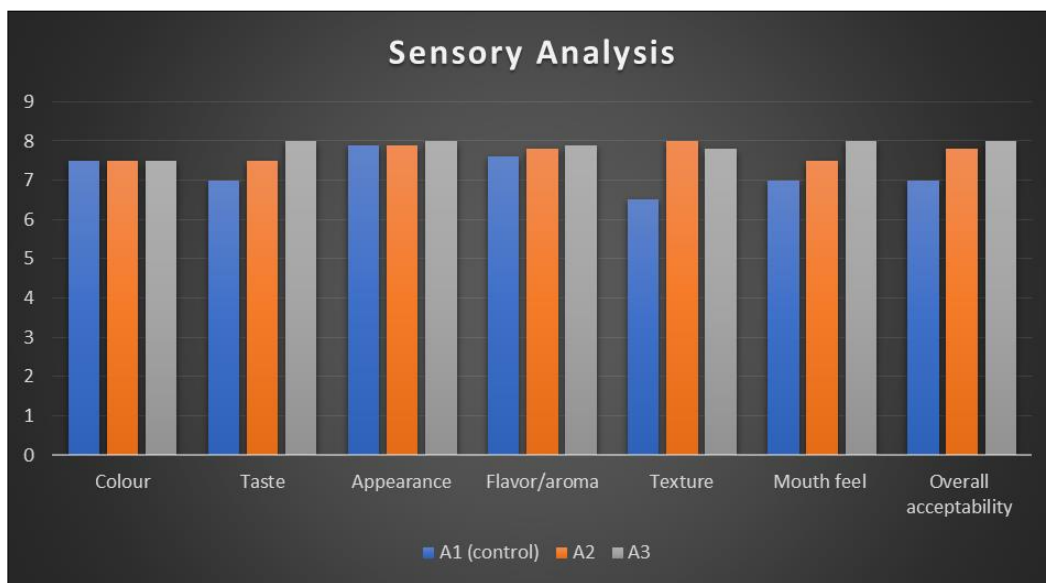
acceptability) through a panel of semi-trained panelists using 9-point hedonic scale. This was done by a team of 25 untrained panelists who represented the common consumer most likely to use the product.

**Table 3:** Results for the sensory analysis of the control and the variation samples

Analysis	A1 (Standard)	A2 (variation 1)	A3 (variation 2)
Colour	7.5±0.3	7.5±0.4	7.5±0.1
Appearance	7.9±0.3	7.9±0.2	8±0.1
Flavour/aroma	7.6±0.3	7.8±0.1	7.9±0.1
Texture	6.5±0.1	8±0.05	7.8±0.05
Overall acceptability	7±0.1	7.8±0.2	8±0.3

In terms of the sensory evaluation and overall acceptability of the breakfast cereal of the control A1 scored averagely 7.8 and the breakfast cereal prepared with 60 % of outer bracts paste A2 scored 7.8 whereas breakfast cereal prepared with 80 % of outer bracts paste A3 scored 7.9.

There was no significant difference between the control and the variations (p>0.05). The overall acceptability of the experimental samples was within acceptable range and satisfactorily acceptable. However, A3 was most preferred by the panelists.



**Fig 2:** Sensory attributes for Control and variations

**Conclusion**

It is evident that blossom bracts incorporated breakfast cereal, prepared by baking and analyzed with or without milk had good acceptability with nutritional benefits. The variation 2 with 80% blossom bracts paste scored the highest in dietary fiber, antioxidant activity and anthocyanin content. Thus, overall acceptability score for the breakfast cereal sample A3 (variation 2) was found to be most acceptable with respect to all sensory parameter studies. The preferable product was sample A3 (variation 2) followed by A2 (variation 1). The banana blossom bracts can be used as a functional ingredient to formulate different products to achieve low- calorie and high fiber products. The banana blossom bracts are rich in anthocyanin content and can be used to extract natural color dyes commercially in large scale industries.

**Scope for Future Study**

- The preparation of the outer bracts paste of the banana flower can be reconstituted into powder form by sun-drying method to avoid loss of nutrition.
- Further research can be done to find out the presence of toxins and anti-nutritive properties in the blossom

bracts

- This product can be recommended for further improvement and industrial largescale production.

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