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# Study on Development and Various Physicochemical Properties of Banana Flour

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## A B S T R A C T

The present investigation on the development of banana flour was carried out at Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalainagar during 2018-2020. The experiment was carried out in completely randomized design with four formulations and five replications. Banana flour was prepared with different varieties viz., $T_1$ – Poovan (AAB), $T_2$ – Nendran (AAB), $T_3$ – Karpuravalli (ABB), $T_4$ – Monthan (ABB). Among the formulations, flour prepared from Nendran ($T_2$) was evaluated as the best treatment when compared to the others with a flour yield of 45% and vitamin C content of 14.02 mg/100g. The maximum value of pH (5.74), protein content of 3.42% was recorded in Monthan flour ($T_4$). All the four formulations registered the shelf life of 6 months. The average sensory scores for taste, colour, flavor and overall acceptability of banana flour was highest in $T_2$ (Nendran) in all the three months of sensory analysis. The benefit cost ratio of 1.94 was calculated for production of 1 kg of flour.

***Key words*:** Banana flour, Poovan, Nendran, Karpuravalli, Monthan

In the tropics, banana is most widely cultivated and consumed. Banana is valued worldwide for its flavor, nutritive value and availability throughout the year. Fruit processing is a boon of science and technology with multiple benefits. For developing countries like India fruit processing has bright prospects. Banana is the major fruit of India having world largest production. However, a nominal 2% of it is processed. Hence, there is a tremendous scope for enhancing its processing. In fact, Banana processing can play a vital role in Indian economy [1]. Banana is highly perishable fruit crop and the shelf life is very short. Therefore, suitable measures have to be carried out in order to increase the storage life of banana, so there is urgent need to preserve this fruit for preparing value added products. Hence an investigation was conducted to develop banana flour and to analyze the properties of banana flour by using different varieties.

## MATERIALS AND METHODS

The present investigation on the development of banana flour was carried out at Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalainagar during 2018-2020. The experiment was carried out in completely randomized design with four formulations and five replications. Banana flour was prepared with different varieties viz., $T_1$ –Poovan (AAB), $T_2$ – Nendran (AAB), $T_3$ – Karpuravalli (ABB), $T_4$ – Monthan (ABB). Banana flour was prepared from mature green bananas. The unripe fruits of good size and quality were blanched and then peeled with a clean knife or manually. The peel rags were removed. The peeled fruits were then sliced into small pieces. Then the slices were dehydrated in a dehydrator at 60°C and they were finely powdered in a mixer or grinder to produce a good quality flour. The properties analyzed were pH, Titratable acidity (%), Vitamin C (mg/100g), Flour yield (%), Total sugar (%) and Protein content (%). Banana flour prepared with different varieties were subjected to sensory evaluation at monthly interval for a period of three months. A hedonic scale of 9 points was used to access the quality attributes viz., taste, colour, flavor and overall acceptability.

Prepared banana flour


Banana flour prepared from different varieties

## RESULTS AND DISCUSSION

The results revealed that the highest value for pH was recorded in treatment $T_4$ (5.74), followed by $T_2$ (5.45) and $T_3$

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(5.15). The lowest value for pH was recorded in $T_1$ (Poovan) (4.75). The lowest value for titratable acidity was recorded in treatment $T_4$ (Monthan) (0.17%), followed by $T_3$ (Karpuravalli) (0.21%) and $T_2$ (Nendran) (0.38%). The highest value for acidity was recorded in $T_1$ (0.51%). The highest value for vitamin C was recorded in treatment $T_2$ (14.02 mg/100g), followed by $T_1$ (12.98 mg/100g) and $T_3$ (11.92 mg/100g). The lowest value of vitamin C was recorded in $T_4$ (9.23 mg/100g). The highest value for flour yield % was noticed in $T_2$ (45.6%), followed by $T_3$ (30.8%) and $T_4$ (28.2%). The lowest value for flour yield % was noticed in treatment $T_1$ (25.1). The highest value for total sugar was recorded in treatment $T_1$ (3.58%), followed by $T_2$ (3.34%) and $T_3$ (3.11%). The lowest value for total sugar was recorded in $T_4$ (2.14%). The highest value for protein content was recorded in treatment $T_4$ (3.42%), followed by $T_1$ (3.26%) and $T_2$ (2.83%). The lowest value for protein content was recorded in $T_3$ (Karpuravalli) (2.19%) (Table 1).

Table 1 Effect of varietal difference on nutritional quality of banana flour

| Treatments | pH | Titratable acidity (%) | Vitamin C (mg/100g) | Flour yield % | Total sugar (%) | Protein (%) |
|---|---|---|---|---|---|---|
| $T_1$ (Poovan) | 4.75 | 0.51 | 12.98 | 25.1 | 3.58 | 3.26 |
| $T_2$ (Nendran) | 5.45 | 0.38 | 14.02 | 45.6 | 3.34 | 2.83 |
| $T_3$ (Karpuravalli) | 5.15 | 0.21 | 11.92 | 30.8 | 3.11 | 2.19 |
| $T_4$ (Monthan) | 5.74 | 0.17 | 9.23 | 28.2 | 2.14 | 3.42 |
| S. Ed. | 0.11 | 0.007 | 0.25 | 0.70 | 0.07 | 0.06 |
| C.D. (P=0.05) | 0.25 | 0.01 | 0.54 | 1.49 | 0.14 | 0.13 |

Banana flour prepared with different varieties were subjected to sensory evaluation at monthly interval for a period of three months. A hedonic scale of 9 points was used to access the quality attributes viz., taste, colour, flavor and overall acceptability. The scores obtained were presented in (Table 2-4).

Table 2 Sensory scoring for banana flour at 1st month of evaluation (October, 2019)

| Taste panel (TP) S | $T_1$ (Poovan) | | | | $T_2$ (Nendran) | | | | $T_3$ (Karpuravalli) | | | | $T_4$ (Monthan) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Taste | Colour | Flavour | Overall acceptancy | Taste | Colour | Flavour | Overall acceptancy | Taste | Colour | Flavour | Overall acceptancy | Taste | Colour | Flavour | Overall acceptancy |
| TP1 | 7 | 8 | 8 | 8 | 9 | 9 | 9 | 9 | 8 | 8 | 8 | 8 | 6 | 6 | 7 | 6 |
| TP2 | 8 | 8 | 8 | 8 | 8 | 9 | 9 | 8 | 8 | 9 | 8 | 8 | 8 | 7 | 8 | 7 |
| TP3 | 8 | 6 | 8 | 7 | 8 | 9 | 9 | 8 | 7 | 8 | 8 | 8 | 8 | 7 | 8 | 8 |
| TP4 | 8 | 8 | 7 | 8 | 8 | 7 | 8 | 8 | 7 | 8 | 7 | 7 | 9 | 8 | 8 | 8 |
| TP5 | 7 | 7 | 7 | 7 | 9 | 8 | 9 | 9 | 8 | 7 | 8 | 8 | 8 | 8 | 9 | 8 |
| TP6 | 6 | 7 | 6 | 7 | 9 | 8 | 9 | 9 | 7 | 8 | 8 | 7 | 9 | 9 | 7 | 8 |
| TP7 | 7 | 8 | 8 | 7 | 9 | 8 | 7 | 8 | 8 | 7 | 7 | 7 | 7 | 8 | 8 | 7 |
| TP8 | 6 | 7 | 7 | 6 | 8 | 8 | 8 | 8 | 8 | 8 | 6 | 8 | 8 | 8 | 8 | 8 |
| TP9 | 8 | 7 | 7 | 7 | 9 | 9 | 8 | 9 | 8 | 7 | 6 | 8 | 8 | 8 | 8 | 8 |
| TP10 | 8 | 6 | 8 | 7 | 8 | 8 | 8 | 8 | 6 | 7 | 7 | 7 | 8 | 7 | 7 | 7 |
| Grand total | 73 | 72 | 74 | 72 | 85 | 83 | 84 | 82 | 77 | 77 | 73 | 76 | 79 | 76 | 78 | 75 |
| Average | 7.3 | 7.2 | 7.4 | 7.2 | 8.5 | 8.3 | 8.4 | 8.2 | 7.7 | 7.7 | 7.3 | 7.6 | 7.9 | 7.6 | 7.8 | 7.5 |

Table 3 Sensory scoring for banana flour at 2nd month of evaluation (November, 2019)

| Taste panel (TP) S | $T_1$ (Poovan) | | | | $T_2$ (Nendran) | | | | $T_3$ (Karpuravalli) | | | | $T_4$ (Monthan) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Taste | Colour | Flavour | Overall acceptancy | Taste | Colour | Flavour | Overall acceptancy | Taste | Colour | Flavour | Overall acceptancy | Taste | Colour | Flavour | Overall acceptancy |
| TP1 | 8 | 8 | 8 | 8 | 9 | 9 | 7 | 9 | 8 | 8 | 7 | 8 | 6 | 6 | 7 | 6 |
| TP2 | 8 | 7 | 6 | 8 | 8 | 9 | 9 | 9 | 6 | 7 | 8 | 7 | 8 | 7 | 8 | 8 |
| TP3 | 8 | 6 | 8 | 7 | 8 | 8 | 9 | 8 | 7 | 8 | 8 | 8 | 8 | 7 | 6 | 7 |
| TP4 | 7 | 8 | 7 | 8 | 8 | 7 | 8 | 8 | 7 | 8 | 7 | 7 | 7 | 8 | 8 | 8 |
| TP5 | 8 | 7 | 6 | 7 | 9 | 8 | 8 | 8 | 8 | 7 | 6 | 7 | 8 | 8 | 9 | 8 |
| TP6 | 6 | 7 | 6 | 7 | 8 | 8 | 9 | 8 | 7 | 6 | 8 | 7 | 8 | 7 | 7 | 7 |
| TP7 | 7 | 8 | 8 | 7 | 9 | 8 | 7 | 8 | 7 | 7 | 7 | 7 | 7 | 8 | 7 | 7 |
| TP8 | 7 | 7 | 7 | 6 | 8 | 8 | 8 | 8 | 8 | 8 | 6 | 7 | 8 | 8 | 8 | 8 |
| TP9 | 7 | 8 | 7 | 7 | 8 | 7 | 8 | 8 | 8 | 7 | 6 | 7 | 7 | 7 | 6 | 7 |
| TP10 | 9 | 6 | 8 | 7 | 8 | 8 | 8 | 8 | 6 | 6 | 7 | 6 | 8 | 7 | 7 | 7 |
| Grand total | 71 | 72 | 69 | 72 | 83 | 80 | 81 | 82 | 74 | 72 | 70 | 71 | 75 | 73 | 73 | 73 |
| Average | 7.1 | 7.2 | 6.9 | 7.2 | 8.3 | 8.0 | 8.1 | 8.2 | 7.4 | 7.2 | 7.0 | 7.1 | 7.5 | 7.3 | 7.3 | 7.3 |

Table 4 Sensory scoring for banana flour at 3rd month of evaluation (December, 2019)

| Taste panel (TP) S | $T_1$ (Poovan) | | | | $T_2$ (Nendran) | | | | $T_3$ (Karpuravalli) | | | | $T_4$ (Monthan) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Taste | Colour | Flavour | Overall acceptancy | Taste | Colour | Flavour | Overall acceptancy | Taste | Colour | Flavour | Overall acceptancy | Taste | Colour | Flavour | Overall acceptancy |
| TP1 | 7 | 8 | 8 | 8 | 9 | 9 | 9 | 9 | 8 | 8 | 8 | 8 | 6 | 6 | 8 | 6 |
| TP2 | 8 | 8 | 8 | 8 | 8 | 9 | 9 | 8 | 6 | 7 | 8 | 7 | 8 | 7 | 8 | 8 |
| TP3 | 7 | 6 | 6 | 6 | 8 | 8 | 8 | 8 | 7 | 8 | 8 | 8 | 8 | 9 | 8 | 8 |
| TP4 | 8 | 8 | 7 | 8 | 8 | 7 | 8 | 8 | 7 | 8 | 7 | 7 | 8 | 8 | 8 | 8 |
| TP5 | 7 | 7 | 7 | 7 | 8 | 8 | 9 | 8 | 8 | 7 | 8 | 8 | 8 | 8 | 7 | 8 |
| TP6 | 6 | 7 | 6 | 6 | 9 | 8 | 7 | 8 | 7 | 8 | 6 | 7 | 8 | 8 | 8 | 8 |
| TP7 | 7 | 8 | 7 | 7 | 9 | 8 | 7 | 8 | 8 | 7 | 7 | 7 | 7 | 8 | 8 | 8 |
| TP8 | 6 | 6 | 7 | 6 | 8 | 8 | 8 | 8 | 8 | 8 | 6 | 7 | 7 | 8 | 8 | 8 |
| TP9 | 8 | 7 | 7 | 7 | 8 | 7 | 8 | 8 | 7 | 7 | 6 | 7 | 8 | 8 | 8 | 8 |
| TP10 | 7 | 6 | 8 | 7 | 8 | 8 | 8 | 8 | 6 | 7 | 7 | 7 | 8 | 6 | 6 | 7 |
| Grand total | 71 | 73 | 71 | 70 | 83 | 80 | 81 | 81 | 74 | 75 | 71 | 73 | 76 | 76 | 77 | 77 |
| Average | 7.1 | 7.3 | 7.1 | 7.0 | 8.3 | 8.0 | 8.1 | 8.1 | 7.4 | 7.5 | 7.1 | 7.3 | 7.6 | 7.6 | 7.7 | 7.7 |

The average score for taste (8.5), colour (8.3), flavor (8.4) and overall acceptability (8.2) were highest in the treatment $T_2$ in the first month of sensory evaluation. The scores were highest in this treatment during all the three months of sensory evaluation. The treatment $T_4$ obtained the second-best score for sensory characters taste (7.9), colour (7.6), flavor (7.8) and overall acceptability (7.5).

The lowest sensory scores were given for treatment $T_1$ regarding taste (7.3), colour (7.2), flavor (7.4) and overall acceptability (7.2) during first month of sensory analysis. The scores were lowest in this treatment during all the three months of sensory evaluation. The sensory characters of the banana flour did not vary to a huge extent during the three months of sensory analysis irrespective of the treatments.

The presence of various oxo-acids like malic, oxalic and citric acids contribute to the acidity of flour. The pH of flour varied between the varieties [2]. The lowest value for pH was recorded in poovan banana flour. High pH content of poovan banana when compared to other banana was reported by [3]. The highest value for pH was recorded in monthan banana flour.

The presence of various oxo-acids like malic, oxalic and citric acids contribute to the acidity of flour. The titratable acidity significantly varied between the banana flour. The lowest titratable acidity was recorded in Monthan banana flour. The highest value of titratable acidity was recorded in poovan flour. The values of titratable acidity vary between banana varieties as reported by [4]. The acidity of Poovan banana is high when compared to other bananas [5].

Vitamin C content of the banana reduced during processing of banana flour as reported by [6]. Heavy loss in vitamin C occur during processing of most fruits. The highest vitamin C content was seen in Nendran banana flour. The lowest value for vitamin C content was seen in monthan banana flour because of the varietal influence.

The highest flour yield % was seen in Nendran flour and lowest recovery was seen in flour prepared from Poovan banana. The flour yield may vary according to the variety and physiological characters as described by [6].

The highest total sugar was seen in Poovan banana flour as this might be due to high sugar content in the fresh banana as reported by [7]. The total sugar content varies according to the stage of maturity of the fruit [8]. The lowest sugar content was seen in Monthan banana as reported by [9].

The protein content varied among the banana flour prepared from different varieties. The difference in protein content was primarily influenced by the inherent behavior among the dessert and plantain bananas as reported by [10]. The highest value for protein content was seen in Poovan banana. The lowest value of protein content was seen in Karpuravalli banana.

There is no much difference in organoleptic quality of the banana flour during storage. The Nendran flour received the best scores for organoleptic evaluation during the storage period. The lowest scores for organoleptic quality was given for Poovan banana flour. The flour from Nendran banana was slightly better when compared to other varieties used.

With regard to the shelf life, all the four formulations were in good condition during the 6 months of the observation of shelf life under the refrigerated condition. The more shelf life of banana flour might be due to the lower moisture content as it might prevent the growth of microbes.

Benefit cost ratio obtained through production of banana flour found to be 1.94. As this BCR provides the person who engages in value addition with considerable returns, processing of banana into banana flour can be used for commercial exploitation.

## CONCLUSION

It is concluded that. Nendran banana flour recorded the best flour yield percent and highest value of vitamin C content. The organoleptic scores were highest in banana flour prepared with Nendran banana. Though the various parameters vary among the banana flour with difference in varieties, flour prepared with Nendran is regarded as the best. This was mainly due to its flour yield percent which could increase the BCR and acceptability by the panelists. Shelf life of banana flour was also found good during the 6 months of assessment. Hence value addition of banana by processing into banana flour may be commercialized for income generation.

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