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The Effect of Banana Cultivar and Maturity Stage on Flour Production

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ABSTRACT: Banana flour has been recognized as functional ingredient, owing to its healthy nutritional pattern. Nevertheless, unripe and ripe banana flours show different characteristics and scarce information is available about changes undergone during banana ripening. The experiment was carried out during 2021-22 at the College of Horticulture, Mudigere, under laboratory conditions. The experiment was laid out in Factorial Completely Randomized Design (FCRD) with two factors *viz.*, C- Cultivars of banana (C_1 - Ney Poovan, C_2 - Nendran, C_3 - Mysore baale, C_4 - Grand naine C_5 - Rajapuri), M- Maturity stage (M_1 - Unripe stage, M_2 - Ripe stage) and their interaction (C×M) in 3 replications. The main objective was to evaluate banana cultivars and the stage of harvest for flour production. Powder recovery (%) was found to be maximum in C_2M_1 (Nendran at the unripe stage; 25.87%), drying duration was minimum (2 hrs. 55 min) in C_1M_1 (Ney Poovan at the unripe stage) and the highest overall organoleptic evaluation score was noticed in C_2M_1 (4.65). Based on Powder recovery (%) and organoleptic evaluation, it was proved that C_2M_1 is best suited for flour production.

Keywords: Cultivars, maturity stage, powder recovery percentage, drying duration.

INTRODUCTION

Almost all parts of the banana plant are used in different aspects and a whole banana plant is useful in food, feed, pharmaceuticals, packaging and many other industrial applications. The ancient Egyptians used banana leaves, fruits and flowering sheaths as a wound dressing, often mashing the fruit and applying it as a poultice over rashes, infected scratches, grazes and burns, covered by either the skin or the leaf which was warmed in hot water (Garasangi *et al.,* 2018). Banana flowers are used as a vegetable in South Asian and South East Asian cuisine, either raw or steamed with dip or cooked as soups, curries and fried foods. Both the fleshy part of the bracts and the heart are edible. Banana leaves are large, flexible and waterproof. They are often used as eco-friendly disposable food containers or as "plates" in South Asia and several South East Asian countries. Especially in the South Indian states of Tamil Nadu, Karnataka, Andhra Pradesh and Kerala, food is served in a banana leaf on every occasion and banana is served as a traditional dessert.

Despite the ongoing interest, some previous studies have failed to specify the ripening stage of banana, resulting in discrepancies in research results; for example, the amount of resistant starch reported in unripe banana flour varies between 30 and 57% on a dry basis (Liao and Hung 2015; Sarda *et al.,* 2016). Indeed, the failure to consider the ripening stage also affects the quality of commercial flours. For instance, Sarda *et al.* (2016) found high variability in resistant starch content among commercial unripe banana flour (4 to 62%), likely due to their different ripening stages. In addition, when ripening is considered, studies have only compared the behaviour of flour from the unripe and ripe stages regarding physicochemical characteristics (Pragati *et al.,* 2014), hygroscopic behaviour (Cardoso and da Silva Pena 2014) and bioactive compound content (Fatemeh *et al.,* 2012),

showing significant differences between those stages. Despite these studies, there is no information about the physicochemical and nutritional characteristics of banana flour obtained at different ripening stages.

Banana flour is becoming more popular for its taste and nutritive value as it contains more vitamins, minerals, fibers and carbohydrates. It also enhances the nutritive value of products in taste, flavor, appearance and colour by natural means.

Banana flour contains a high percentage of carbohydrates, starch and protein; it is used to make nutritious weaning mixes and supplementary foods. It also has high water absorption capacity and low gluten content. Therefore it is used as baby food and an alternative to wheat flour as a result, high-quality cakes and biscuits could be made from wheat-banana composites (Akubour, 1998; Mepba *et al.*, 2007).

Very little research has been done on the quality of banana flour production compared to other value-added products like chips, jam and jelly. Therefore, efforts are made to conduct an experiment on the effect of banana cultivar and maturity stage on flour production.

MATERIAL AND METHODS

Methodology for flour preparation. Good quality banana cultivars (Ney Poovan, Nendran, Mysore baale, Grand naine and Rajapuri) were selected at different maturity stages, unripe and ripe stage. Treated banana slices were drained and spread over stainless steel trays. The inner bottom of the tray was covered with white paper to avoid metal contact and covered with a white muslin cloth to keep off dust and dirt. Treated banana slices were drained and spread over stainless steel trays and kept in an oven drying at 60 to 65°C temperature. During drying slices were shaken every 30 minutes. Slices were dried to the level of 8.00 ± 0.5 per cent moisture. After drying, these slices were grounded in a grinding machine to obtain fine flour and sieved through 40 mesh size to get uniform flour.

Physical parameters

Powder recovery percentage

Powder recovery percentage

$$= \frac{\text{Weight of the Powder (g)}}{\text{Weight of the Fruit (g)}} \times 100$$

Drying duration (hours). The total time taken for drying banana slices to the moisture level 8.00 ± 0.5 per cent was recorded in hours.

Organoleptic evaluation. Organoleptic evaluation of banana flour with respect to appearance, flavour, texture and overall acceptability was adjudged on a five pointhedonic scale (Ranganna, 1986) by a panel of 12 untrained judges.

RESULTS AND DISCUSSION

Physical characteristics of banana flour

Powder recovery (%). The information on the effect of banana cultivar and maturity stage on the powder recovery percentage is shown in Table 1, among the different cultivars C_2 (Nendran) recorded the highest (24.21%) powder recovery, which was followed by C_1 (22.29%) and in the C_4 (Grand naine) the minimum of 14.48 per cent was noticed. With respect to different maturity stages, unripe stage (M_1) recorded the highest powder recovery of 20.32 per cent and the minimum of 18.83 per cent was noticed in the ripe stage (M_2). Concerning the interaction between the cultivars and maturity stages, the highest value of 25.87 per cent powder recovery was recorded in C_2M_1 (Nendran at unripe stage), followed by C_1M_1 (23.44%) and the minimum was recorded in the C_4M_2 (14.44%). These results are in accordance with Suntharalingam and Ravindran (1993), as powder recovery percentage depends on initial moisture content, pulp to peel ratio and pulp recovery percentage.

Drying duration (hours). The data presented in Table 1, it was observed that cultivar C_2 (Nendran) significantly recorded the minimum drying duration of 12.08 hours, followed by C_1 (Ney Poovan) with the drying duration of 16.33 hours and in C_4 (Grand naine) took the maximum of 25.18 hours. With respect to two different maturity stages, a substantially shorter drying duration (3.03 hrs.) was recorded in the M_1 (unripe stage) and the maximum (34.35 hrs.) drying duration was noticed in the ripe stage (M_2). Among the interactions between the cultivars and maturity stages, the significantly shorter duration (2.55 hrs.) was recorded in C_1M_1 (Ney Poovan at unripe stage), which was followed by C_2M_1 (3.05 hrs.) and in C_4M_2 (Grand naine at ripe stage) the maximum drying duration of 46.24 hours was noticed. Drying duration depends upon initial moisture and sugars content, during ripening the moisture and sugars content increased considerably and these findings are similar to the earlier work done by Pragati *et al.* (2014).

Organoleptic evaluation of banana flour

Appearance (score). The data represented in Table 2, among the different cultivars, it was observed that the significantly maximum (4.23) appearance score were recorded in C_2 (Nendran), which was followed by cultivar C_1 (3.88) and the minimum (3.46) was observed in cultivar C_4 (Grand naine).

Concerning two different maturity stages, M_1 (unripe stage) recorded a significantly higher appearance score of4.22 and the lower (3.33) was noticed in M_2 (ripe stage). The interaction effect on appearance score differ significantly and the maximum score of 4.63 was recorded in C_2M_1 (Nendran at unripe stage), followed by the C_1M_1 (4.45) and minimum (2.99) was observed in C_4M_2 (Grand naine at ripe stage).Variation in score was given based on the visual browning index or discolouration of final product (Pragati *et al.*, 2014).

Texture (score). From Table 2, it was observed that significantly the maximum (4.24) texture score was noticed in cultivar C_2 (Nendran) which was followed by C_1 (3.88) and the minimum (3.46) was recorded in

cultivar C_4 (Grand naine). With respect to different maturity stages, unripe stage (M_1) recorded the maximum texture score with a value of 4.24 and the ripe stage (M_2) recorded the minimum of 3.30 score. In the interaction effect between the cultivars and maturity stages the treatment C_2M_1 (Nendran at unripe stage) recorded significantly higher (4.69) score for texture, followed by C_1M_1 (Ney Poovan at unripe stage) with a score of4.41 and the minimum (2.94) was noticed in C_4M_2 (Grand naine at ripe stage). Differences in texture score are caused by differences in the varietal character of the flour (Pragati *et al.*, 2014).

Flavour (score). The data related to flavour of banana flour was shown in Table 2, among the different cultivars, it was observed that significantly the maximum (4.19) score was recorded in C_2 (Nendran), which was followed by C_1 (3.83) and the minimum (3.39) was observed in cultivar C_4 (Grand naine). Concerning different maturity stages, M_1 (unripe stage) recorded significantly higher flavour score of4.18 and the lower (3.24) was noticed in M_2 (ripe stage). The interaction effect between the cultivars and maturity stages on flavour score differ significantly, the maximum score of 4.64 was recorded in C_2M_1 (Nendran at unripe stage), followed by the treatment C_1M_1 (4.36) and the minimum (2.87) was observed in C_4M_2 (Grand naine at ripe stage). The higher core for flavour is due to correct blend of sweetness and sourness (Marak *et al.*, 2019).

Overall acceptability (score). From Table 2 among different cultivars, significantly the maximum (4.22) score for overall acceptability was noticed in C_2 (Nendran) which was followed by C_1 (3.86) and the minimum (3.43) was recorded in C_4 (Grand naine). With respect to different maturity stages, unripe stage (M_1) recorded the maximum overall acceptability score with a value of 4.21 and in the ripe stage (M_2) recorded the minimum of 3.29. The interaction effect between the cultivars and maturity stages, the treatment C_2M_1 (Nendran at unripe stage) recorded significantly higher (4.65) score for overall acceptability, followed by C_1M_1 (Ney Poovan at unripe stage) with a score of 4.41 and the minimum (2.93) was noticed in C_4M_2 (Grand naine at ripe stage). This due to change in the scoring of appearance, flavour and texture of the banana flour (Marak *et al.*, 2019).

Table 1: Effect of cultivar and stage of maturity on powder recovery and drying duration of banana flour.

Treatments	Mean	
	Powder recovery percentage	Drying duration (hours)
Factor-A		
C_1-Ney Poovan	22.29	16.33
C_2-Nendran	24.21	12.08
C_3-Mysore baale	16.25	22.02
C_4 -Grand naine	14.48	25.18
C_5-Rajapuri	20.65	18.64
S.Em±	**0.02**	**0.01**
CD @ 1%	**0.09**	**0.05**
Factor-B		
M_1-Unripe stage	20.32	3.03
M_2-Ripe stage	18.83	34.35
S.Em±	**0.02**	**0.01**
CD @ 1%	**0.07**	**0.03**
Interaction		
C_1M_1-Ney Poovan at unripe stage	23.44	2.55
C_2M_1-Nendran at unripe stage	25.87	3.05
C_3M_1-Mysore baale at unripe stage	16.93	3.11
C_4M_1-Grand naine at unripe stage	14.52	3.31
C_5M_1-Rajapuri at unripe stage	20.82	3.11
C_1M_2-Ney Poovan at ripe stage	21.13	30.11
C_2M_2-Nendran at ripe stage	22.59	21.11
C_3M_2-Mysore baale at ripe stage	15.57	40.13
C_4M_2-Grand naine at ripe stage	14.44	46.24
C_5M_2-Rajapuri at ripe stage	20.48	34.16
S.Em±	**0.03**	**0.02**
CD @ 1%	**0.12**	**0.08**

Table 2: Effect of cultivar and stage of maturity on organoleptic evaluation of banana flour.

Treatments	Mean			
	Appearance (Score)	Texture (Score)	Flavour (Score)	Overall acceptability (Score)
Factor-A				
C_1-Ney Poovan	3.88	3.88	3.83	3.86
C_2-Nendran	4.23	4.24	4.19	4.22
C_3-Mysore baale	3.58	3.60	3.52	3.57
C_4 -Grand naine	3.46	3.46	3.39	3.43
C_5-Rajapuri	3.74	3.69	3.63	3.69
S.Em±	**0.006**	**0.004**	**0.005**	**0.004**
CD @ 1%	**0.023**	**0.018**	**0.022**	**0.016**
Factor-B				
M_1-Unripe stage	4.22	4.24	4.18	4.21
M_2-Ripe stage	3.33	3.30	3.24	3.29
S.Em±	**0.004**	**0.003**	**0.003**	**0.003**
CD @ 1%	**0.014**	**0.011**	**0.014**	**0.010**
Interaction				
C_1M_1-Ney Poovan at unripe stage	4.45	4.41	4.36	4.41
C_2M_1-Nendran at unripe stage	4.63	4.69	4.64	4.65
C_3M_1-Mysore baale at unripe stage	3.98	4.05	3.97	4.00
C_4M_1-Grand naine at unripe stage	3.93	3.97	3.90	3.93
C_5M_1-Rajapuri at unripe stage	4.12	4.08	4.02	4.07
C_1M_2-Ney Poovan at ripe stage	3.30	3.35	3.30	3.32
C_2M_2-Nendran at ripe stage	3.82	3.78	3.73	3.78
C_3M_2-Mysore baale at ripe stage	3.17	3.15	3.07	3.13
C_4M_2-Grand naine at ripe stage	2.99	2.94	2.87	2.93
C_5M_2-Rajapuri at ripe stage	3.35	3.30	3.24	3.30
S.Em±	**0.010**	**0.006**	**0.008**	**0.006**
CD @ 1%	**0.039**	**0.025**	**0.031**	**0.023**

CONCLUSION

The treatment combination C_2M_1 (Nendran at unripe stage) showed the maximum powder recovery percentage (25.87%), the minimum drying duration and a good sensory score. Based on the above findings, the cultivar C_2 (Nendran) and unripe stage (M_1) combination proved to be best for flour production.

FUTURE SCOPE

Need to study what extent maida (refined wheat flour) can be replaced by this standardized powder for product preparation.

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Conflict of Interest. None.

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