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Utilization of immature banana powder in developed *Kurdai*

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To prevent the losses of immature banana drying method was applied to convert raw immature banana into banana powder by drying the raw immature banana flakes in tray dryer at 50°C for 12hrs. *Kurdai* is Indian traditional wheat fermented food, native to Maharashtra and parts of Gujarat. It is locally popular as a snack food after being deep fried for consumption. This study was conducted to evaluate physico-chemical property of immature banana powder and *Kurdai*. The objective to develop *Kurdai* with nutritional property by adding 5, 10, 15 and 20 per cent immature banana powder (IBP), and determine the effect of this on the nutritional properties. *Kurdai* were made through fermentation, cooking and sun drying process. The *Kurdai* were characterized. The presented study indicated that immature banana powder is a potential source of fibre when substituted for white milky extract (cheek) in *Kurdai* product. The incorporation of 5 per cent immature banana powder in the *Kurdai* ingredients significantly increased their fibre and protein and decrease carbohydrates. Now-a-days consumers demand convenience, quality and innovative food products. Consumers expect the food producers to deliver high quality products for a reasonable price. In addition, consumer's tastes and preferences are also changing. Health is considered important, but not at the expense of quality. Consumers want to experience novel and interesting foods, which are fresh, convenient and tasty.

Key Words : Tray drying, Immature banana powder, White milky extract, Nutritional properties, *Kurdai*

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INTRODUCTION

Banana (*Musa* spp.) belongs to family *Musaceae*. It is known since the dawn of ancient history as one of the delicious fruits "in the world. The fruit is soft, sweet and pleasantly flavoured. The fruit is eaten in the fresh form and also as cooked vegetable in the tropics. It is also used for the preparation of popular products like banana, fig, banana powder, banana beer, starch and yeast. Banana is the largest produced and maximum consumed amongst the fruits cultivated in India. It is highly nutritive and very delicious. India leads the world in banana production with an annual output of 14.2 million tons (Agricultural Statistics, 2016). To increase the utilization of banana, production of immature banana powder and its incorporation to various innovative products is usually practiced in banana producing countries. (Shaikh *et al.,* 2017). Banana powder prepared from unripe banana possess the thickening and cooking properties almost similar to that of starch. In most of the South East Asian countries, however, banana is mainly consumed ripe; hence, preparation of banana powder from ripe fruit will increase the utilization of the fruit and could be used to prepare value added products requiring solubility, sweetness and high energy content (Joshi *et al.,* 2015).

It is starchy, rich in carbohydrate, calcium, phosphorus, iron and other food nutrients (Joshi *et*

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al.,2015). It a sweet and salt free diet. Banana ranks first in production and second in area, among the fruits grown in india. production of 291 lakh metric tones annually from an area of 846 lakh hectares. In India Maharashtra 3rd ranks of production in banana. In Maharashtra state banana is grown with 65,000 hectares with approximate production of 30 lakh MT of fruits and the productivity of Jalgaon district is 50 MT (2015-16). other major banana growing districts are Buldhana, Dhule, Nandurbar, Nandd and Parbhani (Patil *et al.*, 2012).

Ardhapuri (Musa main Group Cavandish Subgroup) is a local cultivar having high yield potential and is well acclimatized in the region which is largely grown by the farmers of Marathwada region. However, its yield potential is not fully exploited due to various production and other constraints like lack of proper management practices and poor fertilization schedule which result in poor yield. This cultivar can be brought upto the standard of exportable banana by proper horticultural management practices and suppling judicious plant nutrients.

Fermentation is the scientific process of breakdown of complex sugars to simpler substances by microbial action. Consumption of fermented foods has been a tradition throughout history mainly because they were produced as a method to prevent spoilage. There has been little scientific awareness on indigenous traditional fermented foods (Davidson and Ziavonic *et al.*, 2003). Since fermented foods are a rich hub of natural microflora, systematic studies of indigenous fermented foods would be of great benefit in addressing the rising issue of food security. *Kurdai* is Indian traditional wheat fermented food, native to Maharashtra and parts of Gujarat. It is locally popular as a snack food after being deep fried for consumption. Its nutrition profile and fermentation biochemistry have never been studied. The significance of the present study lies in studying the microbial aspects of Kurdai as a novel ecological niche and exploring the bio-technological potential of the isolates. The major target of food processing such as fermentation is preservation. With microbes developing resistance to antimicrobial compounds, and increased public concern towards the use of synthetic approaches, natural methods of food preservation have been the focus of many research groups. Natural antimicrobials from microbial sources (Pavitra *et al.*,2015).

METHODOLOGY

Immature banana (*Musa cavendish*):

Immature banana (*Musa cavendish*) having a varieties of Ardhapuri which is purchased from Banana Research Center Jalgaon.

Sample preparation:

The fruit were peeled and cut into transeverse slices of about 2-3 mm thickness. The sliced were then dipped in 0.5 per cent citric acid solution for 5 min, drained and dried in tray drying at 50ºC for 12 hrs. the dried samples were ground to pass through 60 mesh screen to obtain banana powder (Shaikh *et al.*, 2017).

Preparation of *Kurdai:*

Wash and soak wheat for 3 days. Wash the wheat and change the water daily. It means if you have soaked wheat today morning, wash and change water next day morning and repeat the same on 3rd day. On 3d wheat ferments and puffs up. Wheat becomes soft and if you press it in 2 fingers, it releases white milky extract (cheek). This is an important step in making *Kurdai*. Wash and clean wheat on the 3rd day. Add some more water in wheat. Take in blender pot and add water in it. Blend this in blender. Take out the blended wheat into a pan. Add some more water and clean the blender pot. Add that water in blended mixture. Add lots of water in the blended mixture and wash it really good. Remove the roughage aside. Take a pot and place cheese cloth or cotton cloth over it. Place a strainer over it and strain the blended wheat mixture through it. Add some water and strain it again. Take the roughage again, add some more water. Wash it really good and drain it through the cheese cloth. Take the drained mixture, cover and keep overnight. Cheek will settle down and water will float above it. Next morning, try to drain maximum water from it. Measure the quantity of cheek left behind and add same quantity of hot water in it. Heat up a pan on medium heat and add oil so as not to form lumps of cheek. Add water, salt and cover and bring it to boil. When water begins to boil, add white milky extract (cheek) and immature banana powder into boiling water. Use rolling pin for stirring continuously to avoid lumps formation of white milky extract (cheek). Cooking of white milky exract (cheek) is the most important step in this process. Cook the white milky

extract (cheek) until it is nice and thick. Cover and cook for about 5 minutes. After 5 minutes, remove the lid and check. The cheek becomes transparent. Turn off the gas and cheek is already. Grease the surface on which you are going to make *Kurdai* with oil. Take chakali mould and place shev making dish in it. Fill up the cheek in chakali mould and roll out *Kurdai*. Sundry the *Kurdai* under hot sun for about 1-2 days. You can store *Kurdai* in air tight container.

Compositional analysis of immature banana powder:

The immature banana powder was used for the estimation of moisture, fat, protein, ash, fibre and carbohydrate was by using standard procedures (AOAC, 2005) as referred below.

Moisture content:

Moisture content was determined by using hot air oven drying method. 10 g. of sorghum flour sample of each material was taken in pre-weighed empty Petri plate and dried in hot air oven at 105^0C till constant weigh were obtained (6-7 hrs.). Then plates were cooled in desiccators. The moisture content was calculated by using formula:

$$\% \text{ moisture content} = \frac{\text{Final weight} - \text{Intial weight}}{\text{Weight of sample}} \times 100$$

Fat content:

The sample sorghum flour was transferred to a thimble paper and the top of the thimble was plugged with cotton. The thimble was next placed in the fat extraction chamber of the Soxhlet apparatus. A previously weighed flask was filled with solvent e.g. hexane and was attached to the extraction chamber. The condenser was attached to the assembly. Extraction was carried out at proper temperature for 5 hrs. The excess hexane was recovered by boiling it further. Then the flask was dried and the weight was recorded. Formula for calculation of fat content by using Soxhlet apparatus method.

$$\% \text{ fat content} = \frac{\text{Final weight of beaker} - \text{Empty weight of beaker}}{\text{Sample weight}} \times 100$$

Protein content:

The determination of protein content was carried out by Kjeldhal's method using 5 g of sorghum flour sample. The Kjeldhal methods based on wet combustion of the sample by heating with concentrated sulphuric acid in the presence of metallic other catalysts to effect the reduction of organic nitrogen in the sample to ammonia which retained in solution as ammonium sulphate. Then digested sample was distilled with NaOH and titrated with 0.1 N HCL. The percentage of nitrogen of was calculates by using following formula:

$$\% \text{ nitrogen} = \frac{\text{(Sample titre - Blank titre) x N of HCL x Volume of digest x 100}}{\text{Weight of sample x Aliguot of the digest}} \times 100$$

Protein content=% Nitrogen x 6.25

Ash content:

About five g of the powder sample was accurately weighed into a pre-weighed silica crucible. It was then carbonized in silica crucible on burner followed by heating at about 550°C for 6 hrs in the muffle furnace to get complete white coloured ash, allowed to cool in the furnace. Then the crucible was transferred to a desiccator and weighed as possible to prevent moisture absorption. The ash was calculated using following formula.

$$\% \text{ ash content} = \frac{\text{Weight before ashing} - \text{Weight after ashing}}{\text{Weight of sample}} \times 100$$

Fibre content:

Fibre estimation carried with the help of muffle furnace. Moisture and fat free sorghum flour sample (2 g) digested with 200 ml of 1.25 per cent H_2SO_4 by gentle boiling for half an hour. The contents filter and the residue washed several times with hot distilled water till it became free from acid. Acid free residue then transferred to the same flask to which 200 ml of 1.25 per cent NaOH is added. The contents digested again for half an hour, filtered it and residue was again washed with hot distilled till it became alkali free. The residue dried in an oven overnight at 100ºC and weighed and then placed in muffle furnace at 600ºC (±50ºC) for 4 hours. The loss in weight after ignition the sample represents the fibre in the sample.

$$\% \text{ fibre content} = \frac{\text{Initial weight} - \text{Loss in weight of sample}}{\text{Initial weight of sample}} \times 100$$

Carbohydrate content:

Carbohydrate was calculated by difference by using following formula:

% Carbohydrate content = 100 - (% Moisture + % Ash + % Fat + % Protein)

Functional analysis of immature banana powder:

Bulk density (*BD*) :

Bulk density of the sample was determined

according to the method of Musa *et al.* (2008). Flour sample (30g) was weighed into a 25 ml measuring cylinder and the volume occupied was measured and recorded.

$$\text{Bulk density} = \frac{\text{Mass (g)}}{\text{Volume (ml)}}$$

Swelling index:

The method of Ukpabi and Ndimele was used. The swelling index (SI) of the samples was determined by putting 25 g of each sample in a 210 ml measuring cylinder. Distilled water (150 ml) was added and allowed to stand for four hours before observing the level of swelling. The swelling index was calculated by formula:

$$\text{Swelling index} = \frac{\text{Volume after soaking} - \text{Volume before soaking}}{\text{Weight of sample}}$$

Water absorption capacity (WAC) :

Water absorption capacity was performed according to the method of Elkhalifa and Bernhardt (2010). One grams of each milled sample (W_1) were weighed into a pre-weighed centrifuge tube (W_2) and 10 ml of distilled water were added. Samples were vortexed and allowed to stand for 30 min at 25 ± 2°C before being centrifuged at 4,000 g for 25 min. Excess water was decanted by inverting the tubes over absorbent paper and samples were allowed to drain and reweighed (W_3). The percentage of water absorption capacity were calculated as:

$$\text{WHC (\%)} = \frac{W_3 - W_2}{W_1} \times 100$$

Oil absorption capacity (OAC):

Oil absorption capacity was performed according to the method of Elkhalifa and Bernhardt (2010). One grams of each milled sample (W_1) were weighed into a pre-weighed centrifuge tube (W_2) and 10 ml of sunflower oil were added. Samples were vortexed and allowed to stand for 30 min at 25 ± 2°C before being centrifuged at 4,000 g for 25 min. Excess oil was decanted by inverting the tubes over absorbent paper and samples were allowed to drain and reweighed (W_3). The percentage of oil absorption capacity were calculated as:

$$\text{OHC (\%)} = \frac{W_3 - W_2}{W_1} \times 100$$

OBSERVATIONS AND ASSESSMENT

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Physico-chemical property of immature banana powder:

Table 1 : Physico-chemical property of immature banana powder

Parameter (%)	Values
Moisture content	9.13±0.01
Ash	1.71±0.02
Fat	0.65±0.02
Fibre	8.49±0.08
Protein	4.18±0.07
carbohydrates	84.23±0.03

Results are expressed as mean values and standard deviation of three replicates

Effect of different level of immature banana powder incorporation on physico-chemical characteristics of control *Kurdai* :

Immature banana powder had significantly improved the nutrient and taste as compared to the control. Generally the present result suggested T_1 (immature banana powder 5% + 95% wheat from milky extract) showed good physico-chemical properties as compared to the other. Increase the immature banana powder colour was changed and also effect on texture.

Table 2 : Effect of different level of immature banana powder incorporation on physico-chemical characteristics of control *Kurdai*

Parameter (%)	Level of immature banana powder %				
	T_0	T_1	T_2	T_3	T_4
Moisture	4.81±0.03	4.53±0.02	4.69±0.04	4.68±0.03	4.93±0.01
Fat	1.28±0.03	1.32±0.02	1.50±0.07	1.56±0.01	1.63±0.05
Ash	1.89±0.03	1.95±0.01	1.91±0.01	1.96±0.02	1.98±0.02
Protein	8.68±0.05	8.70±0.05	8.93±0.01	9.01±0.01	9.03±0.02
Fibre	1.34±0.02	1.49±0.03	1.42±0.02	1.45±0.02	1.69±0.01
Carbohydrates	83.35±0.01	83.5±0.05	82.94±0.2	82.79±0.01	82.43±0.02

Results are expressed as mean values and standard deviation of three replicates

Table 3: Functional property of immature banana powder

Parameter	TD1	TD2	TD3	TD4	TD5	Sun drying
Bulk density (g/ml)	0.55±0.02	0.46±0.02	0.45±0.03	0.50±0.1	0.47±0.02	0.57±0.06
WAC (g/g)	5.69±0.02	5.42±0.02	5.21±0.01	5.49±0.03	5.68±0.01	5.83±0.01
OAC (g/g)	7.73±0.03	7.07±0.06	7.39±0.03	7.04±0.01	7.50±0.04	7.53±0.02
Swelling index (ml/g)	0.89±0.06	0.93±0.01	0.93±0.01	0.90±0.02	0.92±0.02	0.88±0.04

Results are expressed as mean values and standard deviation of three replicates

Table 4 : Evaluation table for formulated *Kurdai* on 9 point hedonic scale

Parameter	T_0	T_1	T_2	T_3	T_4
Colour	8.0	7.9	7.6	7.5	7.4
Texture	7.6	7.5	7.3	7.1	6.9
Flavour	7.7	7.9	7.6	7.5	7.4
Appearance	7.3	7.5	7.2	7.2	7.0
Taste	7.8	8.5	8.0	7.6	7.5
Overall acceptability	7.7	8.0	7.4	7.3	7.2

Results are expressed as mean values and standard deviation of ten replicates

Functional property of immature banana powder:

Bulk density is a measure of heaviness of powder and an imported parameter that determines the suitability. Powder for packaging and transportation of particular food. The low bulk density of powder could be useful in the formulation. The high water absorption capacity of the powder suggests they could be useful in *Kurdai* formulation. Oil absorption capacity is important in retain the flavour and provide soft texture to food like cakes.

Evaluation table for formulated *Kurdai* on 9 point hedonic scale:

The effect of different level of immature banana powder incorporation on sensory characteristics of control kurdai is presented in Table 3. The sensory score for colour was decreasing with increasing level of immature banana powder. This was due to increasing level of immature banana powder which gave a dark brown colour to *Kurdai* which was not preferred by the panellist, similar effect was observed by (Srivastava *et al*., 2012). Development of roughness on the surface *Kurdai* with increasing level of immature banana powder was the cause of poor appearance. The texture of immature banana incorporated *Kurdai* was found hard as compared to control *Kurdai*. Therefore, the sensory score of all immature banana *Kurdai* incorporated *Kurdai* for texture was less than the control *Kurdai*. Proportionate decrease in sensory score for texture was observed with increasing level of immature banana powder. This was because of cracks formed with addition of immature banana powder.

Conclusion:

Drying of immature banana and preparation of banana powder could increase the shelf-life of the quickly perishable fruit and would increase the utilization Immature banana powder produced in this study was brownish in colour with visible dark spot . The immature banana powder was low in moisture content and fat which is flavourable. The results obtained in the project claimed that the nutritive value of *Kurdai* incorporated with immature banana powder was higher as compare to control sample of *Kurdai*. Sensory valuation of *Kurdai* prepared from different blends shows the decrease in colour score. Fading of colour was observed as the level of supplementation of the immature banana powder was increased in the white milky extract (*Cheek)*. The results obtained in the project claimed that the nutritive value of *Kuradi* incorporated with immature banana powder was higher as compare to control sample of *Kurdai*. Based on the sensory results it can be concluded that T_1 *i.e.* 95:5 (White milky extract : immature banana powder) blend of *Kurdai* was acceptable overall.

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