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Organoleptic and Nutritional Evaluation of Biofortified Pearl Millet Hybrid HHB-299 Value Added Products

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Abstract: Pearl millet is gluten free source of energy, protein, vitamins and minerals. It is rich in B vitamins, potassium, magnesium, iron, zinc, copper and manganese. It has high calories and greatly helps growing children and pregnant women. Three pearl millet-based value-added food products (*laddu*, cake and *mathari*) were prepared using different recipes. All the products were sensory evaluated using nine-point hedonic scale and their organoleptic acceptability was analyzed by panel members. Results showed that amongst different samples of pearl millet *laddu*, sample with pearl millet flour (75%) and mung bean flour (25%) scored maximum (7.94±0.30). In pearl millet *mathri*, sample having ratio of pearl millet flour (50%) and refined wheat flour (50%) scored maximum acceptance (8.04±0.39) whereas for pearl millet cake with ratio of pearl millet flour (25%) and refined wheat flour (75%) scored (8.46±0.36) maximum acceptability. These products with high mean value had better sensory characteristic and were more acceptable also. Proximate analysis of pearl millet was done followed by estimation of nutritive value of the pearl millet products developed.

Key words: Organoleptic, pearl millet, value addition.

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Rajasthan is the largest producer of pearl millet in India. Pearl millet grains flour is used for making bread for human consumption and the plant biomass is consumed as fodder by animals (Amarender *et al.,* 2013). Pearl millet is rich in fat content (5 mg 100 g^{-1}) with better fat digestibility. It has high proportions of slowly digestible starch (SDS) and resistant starch (RS) which contribute to low glycemic index (GI) and is the need of the transforming diets, food habits and the food industry. Due to the excellent nutritional properties and resilience to climate change, pearl millet along with other millets is renamed as *nutri-cereal* (Gazette of India, No. 133 dated 13th April, 2018) for production, consumption and trade and is also included in public distribution system.

It is a good source of carbohydrate and energy. The protein content in pearl millet ranges from 9 to 21% which is comparable to that of wheat (11.8 g $100g^{-1}$) and is higher than in sorghum (10.4 g 100 g^{-1}), rice (6.8 g 100 g^{-1}), and maize

(4 g 100 g^{-1}) (Kaur *et al*., 2014). Protein of pearl millet consists of albumins and globulins (22-28%), prolamin and prolamin-like (22-35%), glutelin and glutelin-like compounds (28-32%) of total N. The amino acid balance is also better than sorghum. In comparison to maize, pearl millet is 40% richer in amino acid methionine and lysine. Lysine content is 21% greater than corn and 36% greater than sorghum (Leder, 2004). Pearl millet is also richer in fat content (5-7 g $100g^{-1}$) than rice, maize, wheat, and sorghum (Gopalan *et al*., 2003). About 70% of the dry grain is predominantly carbohydrates, consisting of 56-65% starch, of which 20-22% is amylose. It is rich in vitamins A and B, and antioxidants such as coumaric acids and ferulic acid. In addition, it is rich in unsaturated fatty acids (75%) and phytic acid, which are considered to be useful in lowering cholesterol and phytate, which in turn reduces cancer risk. It also exhibits antioxidant activities due to the presence of polyphenols, anthocyanins, phytates, phytosterols, tannins and pinacosanols and thus plays a significant role in anti-aging. It is also enriched with many essential amino acids except lysine and threonine and has relatively higher methionine. Being gluten-free, it is extremely useful for people suffering from celiac diseases who are generally allergic to the gluten content of wheat and other cereals. Pearl millet is exceptionally useful for people suffering from diseases like diabetes, obesity, diabetic, heart disease, atherosclerosis and metabolic diseases due to its health beneficial properties

It is also called the "Powerhouse of Nutrition" due to its richness with essential nutrients in good quantity and quality, which are vital for leading healthy and nutritious life. Pearl millet has high contents of various macronutrients as well as micronutrients like iron, zinc, magnesium, calcium, phosphorous, copper, manganese, riboflavin, and folic acid. Owing to such excellent nutritional values, it is gaining popularity and is preferred by people all over the world including developed countries. The nutritional significance of millets demand for development of new millet-based food products (Birania *et al.,* 2020). In pearl millet many bio-fortified hybrids have been developed with high iron and zinc content in the grain. HHB 299 is a recently developed variety notified in year 2018 having 73 ppm Fe and 41 ppm Zn content in grains (Satyavathi *et al.,* 2018). The hybrid HHB 299 is also in seed chain operative in state of Rajasthan by National Seed Cooperation (Anonymous, 2023) hence its availability is ample for mass production of value-added products. Therefore, looking the benefits of pearl millet in general and specificity of biofortified hybrids Krishi Vigyan Kendra of ICAR-CAZRI, Jodhpur developed value added food such as *laddu*, cake and *mathri*. From the grains of HHB 299 hybrid. The present study was conducted with an objective to develop and find out the acceptability of these biofortified pearl millet value added products by sensory and nutritional evaluation.

Material and Method

Pearl millet grains were procured from farmer fields where KVK-CAZRI, Jodhpur has conducted varietal demonstration of bio-fortified hybrid variety HHB 299. The clean and healthy grains of pearl millet were used for preparation of flour using electric grinder, the ground content was further graded through a mesh sieve to obtain fine flour. The powdered sample was stored in air tight container until further use for experiments following standard procedures. Three products were prepared viz., *laddu*, cake and *mathri* by taking different combinations of the ingredients and were identified as products *i.e.,* A, B, C and D were developed. The developed pearl millet powder products were subjected to sensory evaluation by five panel members using 9 point hedonic scale (Ranganna, 1986) to test the liking and disliking of products. Semi trained panel carried out the evaluation. The mean score obtained for samples A, B, C and D pearl millet products were calculated and statistically analyzed. Proximate analysis for nutritional quality was done using standard procedures (AOAC, 1990)

Results and Discussion

Pearl millet laddu

Four variable samples were produced taking variable combination of four ingredients i.e., pearl millet and mung bean flour with grounded sugar and ghee (Table 1). The ingredients were accurately weighed and mung bean flour was replaced by pearl millet flour at 25, 50, 75 and 100% respectively for making of the pearl millet products. Sensory evaluation

Table 1. Ingredients used for the preparation of pearl milletladdu

Ingredient	Sample A (%)	Sample B (%)	Sample C (%)	Sample D (%)
Pearl millet flour	25	50	75	100
Mung bean flour	75	50	25	-
Sugar ground	60	60	60	60
Ghee	50	50	50	50

Table 2. Sensory evaluation of pearl millet laddu

Types	Appearance	Colour	Texture	Flavour	Taste	Overall acceptability
Sample A (P:MF:: 25:100)	6.9±0.25	7.0±0.25	6.0±0.24	6.2±0.25	6.8±0.32	6.58±0.26
Sample B (P:MF::50:50)	7.0±0.48	6.6±0.25	6.9±0.9	6.4±0.25	7.0±0.04	6.78±0.38
Sample C (P:MF::75:25)	7.8±0.28	7.6±0.31	7.7±0.3	8.2±0.39	8.4±0.25	7.94±0.30
Sample D (P:100)	6.4±0.22	6.8±0.32	6.2±0.4	6.2±0.49	6.0±0.20	6.32±0.32

P: Pearl millet flour; MF: Mung bean flour

mean score of pearl millet *laddu* is given in table 2. Evaluation of organoleptic attributes of the pearl millet *laddu* for colour, flavor, texture, appearance, taste and over all acceptability was done by panel members. It was found that the overall acceptability of Sample-C of pearl millet *laddu* was excellent and the mean score was 7.94±0.30. The Sample-B, Sample-A and Sample-D of pearl millet laddu had mean scores of 6.78±0.38, 6.58±0.26 and 6.32±0.32, respectively.

Pearl millet mathri

Pearl millet *mathari* was prepared by replacing refined wheat flour withpearl millet flour at 25, 50, 75 and 100%, respectively in addition to other ingredients viz., ghee, black pepper, ajwain and salt (Table 3). Evaluation of organoleptic attributes of the pearl millet *mathri* for colour, flavour, texture, appearance, taste and over all acceptability was done by panel members. It was found that the overall acceptability of Sample-B pearl millet *mathri* was excellent and the mean score was 8.04 ±0.39 (Table 4). The Sample-A, Sample-C and Sample-D Pearl millet *mathri* mean scores were 7.38±0.33, 6.52±0.35 and 5.16±0.32, respectively.

Pearl millet cake

Pearl millet cake was prepared by replacing refined wheat flour with pearl millet flour at 25, 50, 75 and 100%, respectively in addition to other ingredients viz., coco powder, baking powder, baking soda, oil and milk (Table 5). Evaluation of organoleptic attributes of the pearl millet cake for colour, flavour, texture, appearance, taste and over all acceptability was done by panel members. It was found that the overall acceptability of Sample-A pearl millet Cake was excellent and the mean score was 8.46±0.36 (Table 6). The Sample-B, Sample-C and Sample-D of pearl millet cake mean

Table 3. Ingredients used for the preparation of Pearl millet Mathri

Ingredient	Sample A	Sample B	Sample C	Sample D
Pearl millet flour (%)	25	50	75	100
Refined flour (%)	75	50	25	-
Ghee (%)	30	30	30	30
Black pepper and ajwain	1 tsp	1 tsp	1 tsp	1 tsp
Salt	1 tsp	1 tsp	1 tsp	1 tsp

Table 4. Sensory evaluation of pearl millet mathri

Types	Appearance	Colour	Texture	Flavour	Taste	Overall acceptability
Sample A (P:RF:: 25:100)	7.9±0.48	7.0±0.28	7.0±0.42	7.2±0.28	7.8±0.20	7.38±0.33
Sample B (P:RF::50:50)	8.0±0.42	7.6±0.58	8.2±0.7	8.4±0.25	8.0±0.02	8.04±0.39
Sample C (P:RF::75:25)	6.8±0.40	6.6±0.35	6.2±0.3	6.6±0.28	6.4±0.45	6.52±0.35
Sample D (P :100)	5.2±0.28	5.4±0.32	5.0±0.2	4.8±0.38	5.4±0.42	5.16±0.32

P: Pearl millet flour; RF: Refined flour

Table 5. The ingredients used for making pearl millet cake

Ingredient	Sample A	Sample B	Sample C	Sample D
Pearl millet flour (%)	25	50	75	100
Refined flour (%)	100	50	25	-
Coco powder	¼ Cup	¼ Cup	¼ Cup	¼ Cup
Backing powder	1 tsp	1 tsp	1 tsp	1 tsp
Baking soda	¼ tsp	¼ tsp	¼ tsp	¼ tsp
Oil	30 ml	30 ml	30 ml	30 ml
Milk	1½ Cup	1½ Cup	1½ Cup	1½ Cup

Table 6. Sensory Evaluation of pearl millet cake

Types of	Appearance	Colour	Texture	Flavour	Taste	Overall acceptability
Sample A (P:RF:: 25:100)	8.9±0.35	8.4±0.58	8.0±0.24	8.2±0.25	8.8±0.39	8.46±0.36
Sample B (P:RF::50:50)	6.9±0.42	7.60±0.25	7.9±0.58	7.40±0.4	7.0±0.28	7.36.±038
Sample C (P:RF::100:25)	7.20±0.28	6.80±0.22	7.20±0.38	6.80±0.26	7.28±0.28	7.05±0.28
Sample D (P::100)	6.2±0.39	6.6±0.25	6.40±.28	6.0±0.32	6.4±0.25	6.32±0.29

P: Pearl millet flour; RF: Refined flour

scores were 7.36±0.38, 7.05±0.28 and 6.32±0.29, respectively.

Nutritive value of pearl millet products

It was observed that pearl millet *laddu* contains 2114 kcal energy, 25 g protein, 218 g carbohydrate, 143 g fat, 84 mg calcium, and 20 mg iron. Pearl millet *mathri* contains 892 kcal energy, 16 g protein, 240 g carbohydrate, 42 g fat, 121 mg calcium and 7 mg iron. Pearl millet cake contains 2415 kcal energy.53 g protein, 327 g carbohydrate, 99 g fat, 1290 mg calcium and 7.5 mg iron.

Pearl millet value added products are gaining importance, studies done on pearl millet cultivar ICTP-8203 value added products have shown that biofortified pearl millet hybrids are highly acceptable and can become part of the daily diet (Huey *et al*., 2017). Organoleptic evaluation of pearl millet value added products has been found acceptable (Singh and Mehra 2017; Johari and Kawatra, 2018; Kumari, 2018; Kalange *et al.,* 2020; Phalphale *et al.,* 2021; Bansal *et al.,* 2022).

Conclusion

Pearl millet due to its nutritional superiority and richness in micronutrients such as iron and zinc and can mitigate malnutrition and hidden hunger. Development of biofortified pearl millet hybrids has offered potential to develop more nutritious value added products with high Fe and Zn content. Value addition is also very useful to promote its consumption. Pearl millet *laddu,* cake and *mathri* have shown high acceptance and nutritive value. Hence these pearl millet products can be promoted, the recipe of the best sample identified can be used by the stakeholders for commercial sale.

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