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Sensorial and Nutritional Quality Evaluation of Pearl Millet (Pennisetum glaucum) Based Vegan Ice-cream

Indhumathi K[a], Nisarga N[b], Netravathi Hiremath[c], Pooja Anudhar G[d]*
MSc Nutrition & Dietetics[ab], Assistant Professor[cd], Department of Nutrition & Dietetics – School of Life Sciences, JSS Academy of Higher Education & Research, Mysore – 570004
indhusrimadhi@gmail.com[a], nisargag867@gmail.com[b], netravatih@jssuni.edu.in[c]
*Corresponding author: Dr Pooja Anudhar G: poojaanudharg@jssuni.edu.in

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Abstract:
Background: Vegan foods are commonly preferred by the consumers with lactose intolerance and who are highly prone to allergic for animal sourced proteins. Along with condition specific preference, demand for vegan foods by other sector of consumers has also positively skewed with the substantial demand. This cumulative demand has portrayed the long-term sustainability of vegan products in the market. Amongst the vegan products, ice-cream devoid of animal source is gaining more popularity as an alternative choice for conventional ice-cream. At the same time millets are gaining more importance due to their inbuilt nutraceutical and nutrition quality. Hence, with this background present study was undertaken with an objective to develop pearl millet based vegan ice-cream with different variations. **Methods:** A total of two variations with pearl millet were developed and compared with control. All the developed products were subjected for sensory evaluation, nutritional and phytochemical quality assessment with antinutritional property evaluation. **Results:** Sensory evaluation revealed that both variations have the comparable sensory scores as compared to control ice-cream. However, higher acceptability score was observed for PMVI 1 pearl millet based vegan ice cream variation followed by PMVI 2. Significant difference was observed in the proximate composition of all the three products including control. The protein concentration in the control sample was revealed to be higher than other two variations which were observed to be 2.86 and 3.48 g/100 in PMVI 1 and 2 respectively. Tannin and phytic acid content were found to be high in PMVI1 compared to the control and PMVI 2. Polyphenol content in PMVI1 found to be on par with PMVI 2 variation. From the sensory score, nutritional quality and phytochemical evaluation report, it was revealed that PMVI 1 ice-cream is best alternative choice to the control ice-cream.
Key words: Vegan food, sustainability, nutraceuticals, lactose intolerance

INTRODUCTION

Consumer preference has positively skewed towards plant based vegan products as alternatives for dairy products with substantial demand. Popularity for vegan products has shown the drastic change in the past decade. Vegan products are considered as an alternative for lactose intolerant, and subjects who are allergic to milk proteins and is also known be preferable by the sector of consumer wiling to change their lifestyle by the adoption of vegan diet [1][2].

This growing cumulative demand has portrayed the long-term sustainability of vegan products in the market. Vegan diet is generally excluded with meat, milk & milk products, honey, eggs which originates from animals [3]. People who are more prone to allergic or lactose intolerant and against to any animal products, they are following the veganism [4]. Ice-cream being one of the popular frozen dairy products known for its higher demand in the market. Amongst the vegan products, ice-cream devoid of animal source is gaining more popularity as an alternative choice for conventional ice-cream. In vegan ice-cream formulation plant-based milk like coconut milk, soy milk, nuts milk are commonly used. At the same time millets incorporation in any kind of product is gaining more importance due to their inbuilt nutraceutical and nutrition quality. Millets are known to high protein, mineral, vitamin, and antioxidant content, making them nutritionally superior than non-millet cereals. Millets are rich with complex carbohydrates as fibre being major source [5]. Pearl millet (*Pennisetum glaucum*) or any other millet incorporation known to be suitable for suitable for people suffering from gluten sensitive enteropathy as millets are devoid of gluten content. Even though millets are known to be treasure source of micronutrients, phytate and other antinutrients known to hinder the mineral bioavailability. However, many research studies suggested that, antinutrients content can be reduced with the help of conventional processing techniques like soaking, germinating, malting [6]. Germination is the process which enriches the biochemical components and involves the transition of a seed from dormant state to active state. This process known to involve in reducing the antinutrients and considered to increase the bioavailability and absorption of nutrients present in it [7]. Among the millets, pearl millet is considered to be highly nutritious and was found to be rich in resistant starch and insoluble dietary fibres [8], and is considered to be rich in iron content. Hence, with this background present study was undertaken with an objective to develop pearl millet based vegan ice-cream with different variations and were compared with control ice-cream.

MATERIALS AND METHODOLOGY

Development of pearl millet-based and control ice-cream

Pearl millet-based ice-cream with different variations (PMVI 1 and PMVI 2) were developed and compared with control ice-cream for their sensory acceptability, nutritional quality, phytochemical and antinutrients content along with pH. Ingredients used and along with standardized portion percent of each ingredient is presented in table 1.

Table 1: Ingredients used for control and pearl millet-based ice cream

Ingredients	Control	PMVI 1	PMVI 2
Milk powder (g)	20	-	-
Pearl millet (g)	-	15	21
Palm jaggery (g)	20	18	18
Coconut milk (ml)	37	35	29
Cashew nuts (g)	6	8	8
Yield (%)	100	100	100

Prior to the preparation of ice-cream, pre-processing technique applied for pearl millet processing is represented in figure 1. Germinated pearl millet was used in the developing the pearl millet-based ice-cream development. For coconut milk extraction, coconut was chopped into pieces and ground into fine paste in a mixer to extract coconut milk and refrigerated for 12hours. Further, thick creamy layer formed was used in the preparation of the ice-cream. Detailed protocol applied in vegan ice-cream development and control ice-cream is presented in figure 2. Developed ice-cream with different pearl millet variations along with control is presented in Figure 2a to 2c.

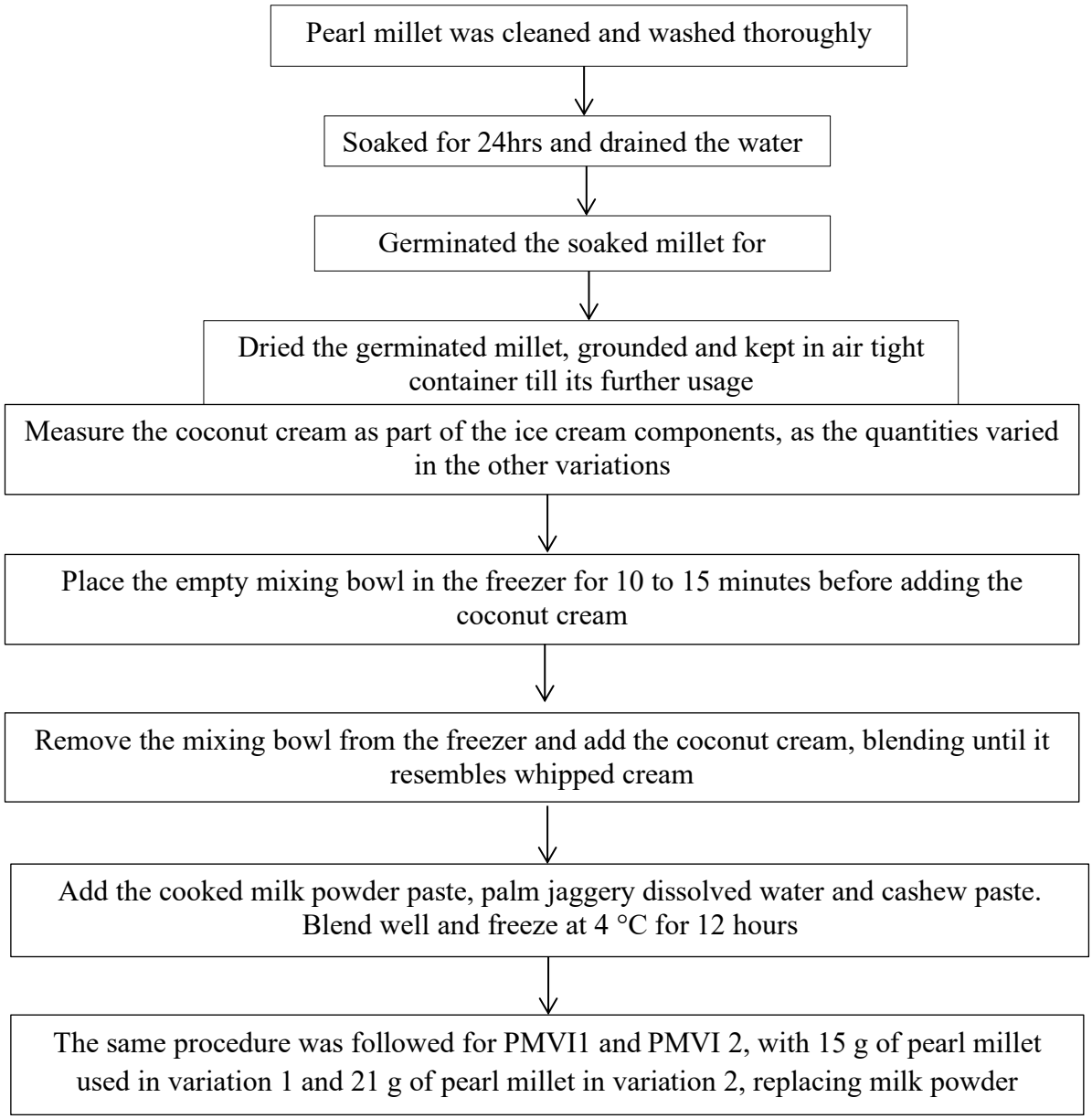


Figure 2: Flow chart of Ice cream development flow chart (Control, PMVI 1, PMVI 2)

Fig 2a: Control

Fig 2b: PMVI 1

Fig 2c: PMVI 2

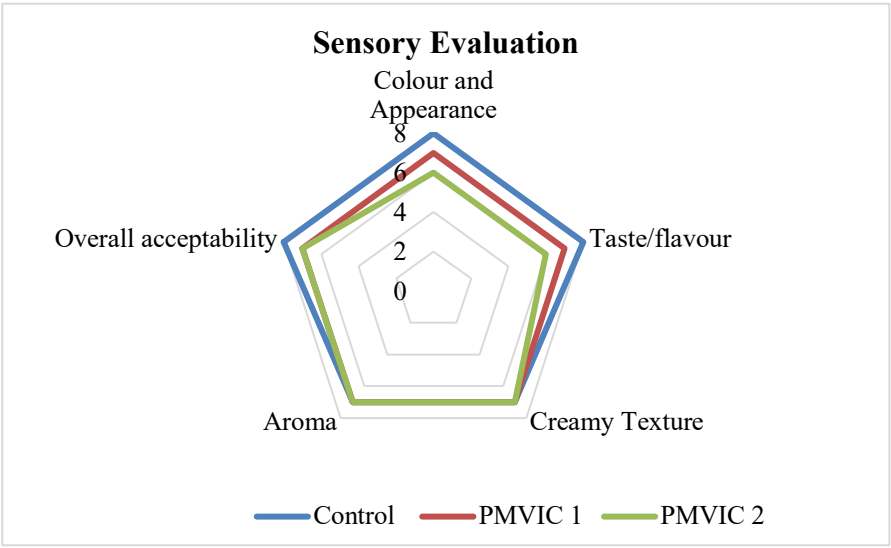
Product acceptability and nutritional quality

To know the acceptability of product, PMVI 1 and PMVI 2 were subjected to organoleptic evaluation. A total of 25 semi trained panel members were evaluated the pearl millet-based ice-creams along with control for comparison by using hedonic scale [9]. Nutrient analysis like moisture, protein, ash, fat, crude fibre was conducted in triplicate using AOAC 2007 [10] standard procedures for control and millet ice cream samples. Micronutrients like calcium and zinc were analysed to quantify the micronutrient amount in the samples. Antinutrients profile tannin, phytic acid and total phenolic were analysed using the standardised procedures [11] [12].

RESULTS AND DISCUSSION

Sensory evaluation and pH

As shown in Figure 3, the results indicated that the control product received slightly higher ratings for appearance, texture, and aroma. Although the overall acceptability of the control product was marginally higher than PMVI 1 and PMVI 2. Panel members preferred PMVI 1 over PMVI 2. PMVI 1 was found to be more acceptable than PMVI 2 with good sensory score.



Control ice cream had a pH of 6.43, and pH of pearl millet based PMVI 1 and PMVI 2 samples shown to have comparable pH with 6.35 and 6.33, respectively (Table 2). There were no significant differences between the control and formulated ice cream in their pH level. Due to

the processing techniques involved during the formulation lowers the pH and reduces the activity of spoilage microorganisms, implying that ice cream samples may be more stable [13]. The result obtained for pH of pearl millet-based ice cream and control was on par with data reported by Sulejmani and Demiri [14].

Table 2: pH of control and pearl millet-based ice cream

Samples	pH
Control	6.43
PMVI 1	6.35
PMVI 2	6.33
CD (5%)	0.04
F stat @ 95% CI	ns

Proximate analysis

Proximate composition of developed icecream and control is presented in Table 3. The control sample contained low moisture content, while variation 1 and 2 shown to possess comparatively high moisture, as it is attributed by the pearl millet incorporation. The protein concentration in the control sample was revealed to be higher than other two variations between experiments 1 and 2, which were found to be 2.87 and 3.49 respectively. High calcium content in control is incurred by the milk incorporation. Similarly, Amirtha et., [15] study found that the control outperformed variations 1 and 2. The fat percentages of the control and variation 1 were revealed to be high and were differed significantly in fat content. Comparatively PMVI 2 shown to possess low fat content. Fuangpaiboon and Kijroongrojana [16] conducted a similar investigation on millet ice cream where experimental variation was less in fat. The amount of carbohydrates in the control was found to be low than other two variations and was 28.33 g in PMVI 1 and 31.35 g in PMV2 per 100gm. Significant difference was observed between the control and variations; however, source of carbohydrate was from plant source in the variations. A study found that the carbohydrate values significantly varied between the control, variation 1 (PMVI 1), and variation 2 (PMVI 2) [17]. The crude fiber content was high in variation 2 than other two as there was a significant amount of pearl millet added to the variation 2 sample of ice cream where the similar fibre content was found in the formulation done by Ezhilarasi and Nazni P [18]

Table 3: Proximate analysis of pearl millet ice cream

Control and variations	Moisture (g/100g)	Carbohydrates (g/100g)	Protein (g/100g)	Fat (g/100g)	Crude fibre (g/100g)	Ash (g/100g)
Control	45.47	25.73	4.75	18.06	4.08	1.94
PMVI 1	48.04	28.33	2.87	15.12	4.57	1.07
PMVI 2	46.83	31.35	3.49	11.42	4.86	1.05
CD (5%)	0.20	0.43	0.28	0.31	0.23	0.07
F stat @ 95% CI	*					

Table 4 represents the calcium and zinc concentrations in the pearl millet-based ice cream and control sample. From the result, it was observed that, calcium content in control was found to be higher in the control sample (331.03mg/100g) than in the other samples 166.36mg/100g & 170.96mg/100g, due to addition of milk powder. A study on millet ice cream shown the similar result [19]. The zinc content was found in the control sample (1.097mg/100g), and variation 1 (0.95mg/100g) and 2 (1.030mg/100g) had a minor significance.

Table 4: Elemental analysis of pearl millet ice cream

Control and variations	Calcium (mg/100 g)	Zinc (mg/100 g)
Control	331.03	1.10
PMVI 1	166.37	0.95
PMVI 2	170.97	1.03
CD (5%)	2.26	0.04
F stat @ 95% CI	*	

In table 5 total polyphenol, tannin and phytic acid contents of developed products is presented in table 5. Among all the samples, V2 showed reduced both tannic and phytic acid content which may reduce the nutrient interactions and enhances the bioavailability.

Table 5: Anti-nutrient analysis of pearl millet ice cream

Treatments	Total phenolic contents (mg/100g)	Tannic acid(mg/100g)	Phytic acid (mg/100gm)
Control	**6.17**	**60.12**	**27.38**
PMVI 1	**8.67**	**86.32**	**35.74**
PMVI 2	**9.28**	**32.24**	**20.53**
CD (5%)	**0.33**	**1.12**	**0.80**
F stat @ 95% CI	*		

CONCLUSION

The germination of pearl millet improved the product's nutritious grade. The ice cream was made with processed pearl millet flour, coconut milk, and other elements. Conventional procedures were used for proximate analysis, mineral and anti-nutrient estimation, and organoleptic evaluation, all of which yielded beneficial results. Despite the fact that the control sample had the highest rating in sensory evaluation, variation 2 showed considerable improvement in nutritional characteristics such as high dietary fibre, low carbohydrate, low fat, and moderate protein levels. Pearl millet's high fibre and complex carbohydrate content assist lower blood glucose levels, making millet-based vegan ice cream appropriate for people with diabetes patients and lactose intolerance and can help people adjust to a vegetarian lifestyle.

Conflict of interest

All authors declare that they have no conflict of interest.

REFERENCES

1. Akalın H, Kınık Ö, Şatır G. Manufacturing plant-based non-dairy and probiotic frozen desserts and their impact on physicochemical, sensory, and functional aspects. J Food Sci Technol. 2024;1(1):1–10.
2. Taspinar T, Yazici GN, Güven M. Evaluating the potential of using plant-based milk substitutes in ice cream production. Biol Life Sci Forum. 2023;26(1):21.
3. Alcorta A, Porta A, Tárrega A, Alvarez MD, Vaquero MP. Foods for plant-based diets: Challenges and innovations. Foods. 2021;10(2):293.
4. Protudjer JL, Mikkelsen A. Veganism and paediatric food allergy: Two increasingly prevalent dietary issues that are challenging when co-occurring. BMC Pediatr. 2020;20(1):341.
5. Kaur S, Kumari A, Seem K, Kaur G, Kumar D, Verma S, et al. Finger millet (Eleusine coracana L.): From staple to superfood—a comprehensive review on nutritional, bioactive, industrial, and climate resilience potential. Planta. 2024;260(3):75.
6. Kumari R, Singh K, Jha SK, Singh R, Sarkar SK, Bhatia N. Nutritional composition and popping characteristics of some selected varieties of pearl millet (Pennisetum glaucum). Indian J Agric Sci. 2018;88(8):1222–1226.
7. Chauhan ES. Effects of processing (germination and popping) on the nutritional and anti-nutritional properties of finger millet (Eleusine coracana). Curr Res Nutr Food Sci J. 2018;6(2):566–572.
8. Ragaee S, Abdel-Aal ES, Noaman M. Antioxidant activity and nutrient composition of selected cereals for food use. Food Chem. 2006;98(1):32–38.
9. Cardello AV, Maller O, Masor HB, Dubose C, Edelman B. Role of consumer expectancies in the acceptance of novel foods. J Food Sci. 1985;50(6):1707–1714.
10. AOAC. Official methods of analysis of the Association of Official Analytical Chemists. 14th ed. Washington, DC: AOAC Int; 1990. p. 223–225, 992–995.
11. Gostinho AJ, de Souza Oliveira W, Anunciação DS, Santos JC. Simple and sensitive spectrophotometric method for phytic acid determination in grains. Food Anal Methods. 2016;9(1):2087–2096.
12. Jatav P, Tenguria RK. Determination of total alkaloids and tannins contents in leaves of *Buchanania lanzan*. J Coast Life Med. 2022;10(1):693–700.
13. Shamshad A, Iahtisham-Ul-Haq, Butt MS, Nayik GA, Al Obaid S, Ansari MJ, et al. Effect of storage on physicochemical attributes of ice cream enriched with microencapsulated anthocyanins from black carrot. Food Sci Nutr. 2023;11(7):3976–3988.
14. Sulejmani E, Demiri M. The effect of stevia, emulsifier and milk powder on melting rate, hardness and overrun of ice cream formulations during storage. Dairy/Mljekarstvo. 2020;70(2):85–95.
15. Amirtha G, Vijaya Vahini R, Sarah Priscilla S. Formulation and proximate evaluation of barnyard millet-based ice cream. Int J Med Res Allied Sci. 2021;1(2):59–66.
16. Fuangpaiboon N, Kijroongrojana K. Sensorial and physical properties of coconut-milk ice cream modified with fat replacers. Maejo Int J Sci Technol. 2017;11(2):133–140.

17. Sutar N, Sutar PP, Singh G. Evaluation of different soybean varieties for manufacture of soy ice cream. J Dairy Res. 2022;89(4):325–330.
18. Ezhilarasi CI, Nazni P. Effect of thermal pre-milling treatment on pearl millet and incorporation of psyllium husk in the formulation of vermicelli. Int J Food Sci Nutr. 2018;3(5):80–85.
19. Yangılar F. Mineral contents and physical, chemical, sensory properties of ice cream enriched with date fiber. Ital J Food Sci. 2015;27(3):397–406.