International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(3): 3453-3457

Received: 17-03-2018
Accepted: 25-04-2018

D Kiruthika
M.Sc Student, Department of Foodscience and Nutrition, Community Science College and Research Institute, Madurai, Tamil Nadu, India

PS Geetha
Assistant Professor, Department of Differently Abled Studies, Community Science College and Research Institute, Madurai, Tamil Nadu, India

T Uma Maheswari
Assistant Professor, Department of Agricultural Microbiology, Agricultural College and Research Institute, Madurai

S Kamala Sundari
Assistant Professor, Department of Foodscience and Nutrition, Community Science College and Research Institute, Madurai, Tamil Nadu, India

A Kavitha Pushpam
Assistant Professor, Department of Biotechnology, Agricultural College and Research Institute, Madurai, Tamil Nadu, India

Correspondence
D Kiruthika
M.Sc Student, Department of Foodscience and Nutrition, Community Science College and Research Institute, Madurai, Tamil Nadu, India

Development and quality evaluation of buttermilk based pearl millet beverage

D Kiruthika, PS Geetha, T Uma Maheswari, S Kamala Sundari and A Kavitha Pushpam

Abstract
Millets play an important role in the food and nutritional security of the poor in arid and semiarid regions of the world. As the use of millets is on rise, the present study focused on the development of butter milk based pearl millet beverage. The standardization of pearl millet based spiced buttermilk beverage was attempted and prepared by gelatinizing pearl millet flour and roasted Bengal gram flour with butter milk and addition of spices. Different lots of pearl millet paste and buttermilk incorporated beverages offered for organoleptic evaluation. Based on hedonic 9 scale and mean score results reveled that over all accepatability was high in the combination of (20 PMF: 80 BM) and it had the mean score of 8.3 which denoted 'like very much'. The storage study was performed for a period of one week during which physico chemical parameters and microbiological analysis and stability were analysed. In the freshly prepared beverage (100ml), the protein and fat content was 11.36g and 3.33g, pH was 4.2, Acidity (0.10%), fibre (2.46g), minerals (Fe 9.28 mg, Ca 33.3 mg and P 119.76 mg and Mg 64.41 mg) and total antioxidant 92.43 mg/ 100g, polyphenols17.28 mg GAE/ g, flavonoids 14.85 mg QE/100g.The nutritional composition of formulated spiced buttermilk based pearl millet beverage was superior than commercial spiced buttermilk due to incorporation of millets and protein rich Bengal gram. The total plate count (TPC), yeast & mould count, coliforms, lactic acid bacteria (LAB) were observed for fresh beverage and 7th day of storage. Observed results concluded bacterial colonies were found in TPC 4-15x 10^2 cfu /ml within the safety level, 12-45 x 10^2 cfu /ml LAB colonies were observed due to the addition of buttermilk. The Yeast-mould and coliform count were nil which was indicative for hygienic conditions were followed during production, processing, handling and storage. The method standardized for production of buttermilk based pearl millet beverage is very simple and can be applied for industrial production.

Keywords: Buttermilk based pearl millet beverage, stability, physico chemical, microbial quality

1. Introduction
Pearl millet (*Pennisetum typhoides*) is the sixth most important cereal in the world. Pearl millet was found significantly rich in resistant starch, soluble and insoluble dietary fibers, minerals, and antiox-idants [1]. It contains about 92.5% dry matter, 2.1% ash, 2.8% crude fiber, 7.8% crude fat, 13.6% crude protein, and 63.2% starch [2].
Chick pea has beneficial effects on some of the important human diseases such as CVD, Type 2 diabetes, digestive diseases and some cancers [3]. Chick pea has significant amounts of all the essential amino acids and important vitamins such as riboflavin, niacin, thiamine, folate and the vitamin A precursor β-carotene and Calcium, Magnesium, Phosphorus and especially potassium. The crude protein content of chickpea varies from 12.4 to 31.5%. Chickpeas contain about 6% fat that is important in the vegetarian diets of resource-poor consumers. [4]
Buttermilk has remained an excellent source of nutrition as it consists of good amounts of potassium, phosphorus, vitamin B12, riboflavin, enzymes, protein, and calcium [5].
Fermented milk beverage contains appreciable amount of milk proteins and phospholipids. During the manufacturing of fermented milk beverage the digestibility of proteins and fats is significantly increased, due to the effect of lactic acid and the proteolytic activity of lactic cultures and due to the applied homogenization and lipase activity of cultures. An improved utilization of calcium, phosphors and iron may be due to the effect of lactic acid. A considerable decrease of vitamins B12 and B6 may be partly balanced by a considerable increase in folic acid. A significant increase of choline may be beneficial in the fat oxidation and the regulation of the cholesterol metabolism.

Milk fermented beverage are valuable component of the mixed diet in addition to an increased digestibility. It stimulates the secretion of gastric and intestinal juices [6].

Millets are nutritionally, especially in micronutrient content superior to the commonly consumed cereals. Luteolin, a flavone present in millets is reported to have antioxidant, anti-inflammatory, cancer preventive and anti-arrhythmic properties. Value-addition and improving health benefits of millets by combining with traditional cereals and fermented milk and by applying advanced technologies for their processing and preservation opens new avenues for the product diversification [7]. Hence this present study was attempted to develop a butter milk based millet beverage, prepared by addition of Bengal gram flour and spices. Reason for the study was lack of buttermilk based millet beverages availability in market and also consumer demands on traditional products. Novelty in this study was addition of buttermilk and Bengal gram act as a complete protein source and the combination of millet with buttermilk it act as a prebiotics and probiotics for improving the gut health and treating several gastro intestinal diseases. Finally, the developed product was wholesome nutritious source for consumers.

2. Materials and methods

2.1 Sample collection and preparation

The basic ingredients like Pearl millet, roasted bengal gram, salt, cumin, ginger, green chillies, asafoetida was procured from local market and was cleaned to remove dirt, dust and other foreign materials. All the millet samples were soaked into clean water for 4 hr for reducing the anti-nutritional factors present in the millet seed coat. Soaked millets were dried at cabinet drier (60ºc for 3 hr) and then grains were grounded, sieved through 52 mesh sieve before use.

The flour was kept in air tight container. Cumin seeds were roasted and grounded into fine powder. Curry leaves and coriander leaves thoroughly washed and dried at a cabinet drier 60 ◦c for 3 hrs and then grinded into fine powder. Green chillies and ginger extract was obtained by grinding known amount by addition of water.

2.2 Formulation of Beverage

Buttermilk based millet beverages were prepared and standardized using gelatinization method. Standardization procedure given below as flow chart in Fig.1, and the different lots of pearl millet paste and buttermilk incorporation were given below as table 1.

Table 1: Standardization of Butter Milk Based Pearl millet Beverage

Treatment	Pearl Millet flour: Buttermilk ratio	water	Bengal gram flour(g)	Spices					Curry leaves powder	Coriander Leaves powder
				Asafoetida (g)	Cumin powder (g)	Salt (g)	Ginger extract (ml)	Green chillies extract (ml)		
T_1	10:90	30	2.5	0.03	0.3	1.5	2.0	2.0	0.3	0.3
T_2	20:80	30	2.5	0.03	0.3	1.5	2.0	2.0	0.3	0.3
T_3	30:70	30	2.5	0.03	0.3	1.5	2.0	2.0	0.3	0.3
T_4	50:50	30	2.5	0.03	0.3	1.5	2.0	2.0	0.3	0.3

2.3 Organoleptic evaluation of buttermilk based pearl millet beverage

1. Overall Acceptability

Butter milk based pearl millet beverage prepared in laboratory was evaluated organoleptically by a panel members and judges using 9 point Hedonic scale. The mean score card given in Table 2. Based on sensory scores over all accepatabilty was high in T2 (8.3) according to the sensory response like taste, flavor, consistency, colour and appearance. T4 had the lowest over all acceptability score. Finally, the sensory results revealed that T2 was the best treatment for storage study. It had the mean score of 8.3 which denoted 'like very much'by hedonic scale.

Table 2: Organoleptic evaluation of buttermilk based pearl millet beverage

Treatments	Flavour	Taste	Appearance & Colour	Consistency	Overall acceptability
T1	8	8.1	8.3	7.8	8.05
T2	8.1	8.3	8.5	8	8.3
T3	8.1	8	8.3	7.6	8
T4	8	7.6	7.8	7.0	7.6

2. Storage Study

For the storage study, selected treatment T2 (20PMF:80 BM) were prepared, subjected to storage at 4 ºC for studying the shelf life of the product. All the Physicochemical, Microbiological and sensory parameters were analysed within a period of 7 days.

2.4 Chemical composition of butter milk based millet beverage

The chemical composition of standardized buttermilk based millet beverages were determined by following methods. Rheological properties like sedimentation and wheying off was estimated by the method suggested by Hussain *et al*., 2014 [8]. The moisture content by hot air oven method (AOAC, 1997) [9], the protein content by Ma and Zuazaga. 1942 [10], the fat content was estimated by extracting the sample with petroleum ether (60-80 ºC) as described by Cohen, 1917 [11] using Soxhlet apparatus. The crude fibre content was determined by the method of AOAC, 1997 [9]. pH meter (M/s. EUTECH Instruments, Mumbai, India) was used to measure the pH of the samples [12]. Acidity of the samples was estimated by the method described by Saini *et al*. (2000) [13]. The radical scavenging activity of the samples was determined by the 2, 2,-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay. The DPPH assay was performed as described in Lim *et al.* (2007) [14]. Total phenols were determined by the method given by sadasivam manickam (2008) [15].Total flavonoids were determined by AlCl3 method as described by Lamaison and Carnet (1990) [16]. The minerals like iron, calcium, magnesium, phosphorus, potassium were

determined by the method given by Ranganna, 1995) [17]. Yeasts and moulds enumeration by pour plate method given by Yousef and Carlstron, (2003) [18]. The microbial load of the stored samples was enumerated by pour plate method described by Istawankiss (1984) [19].

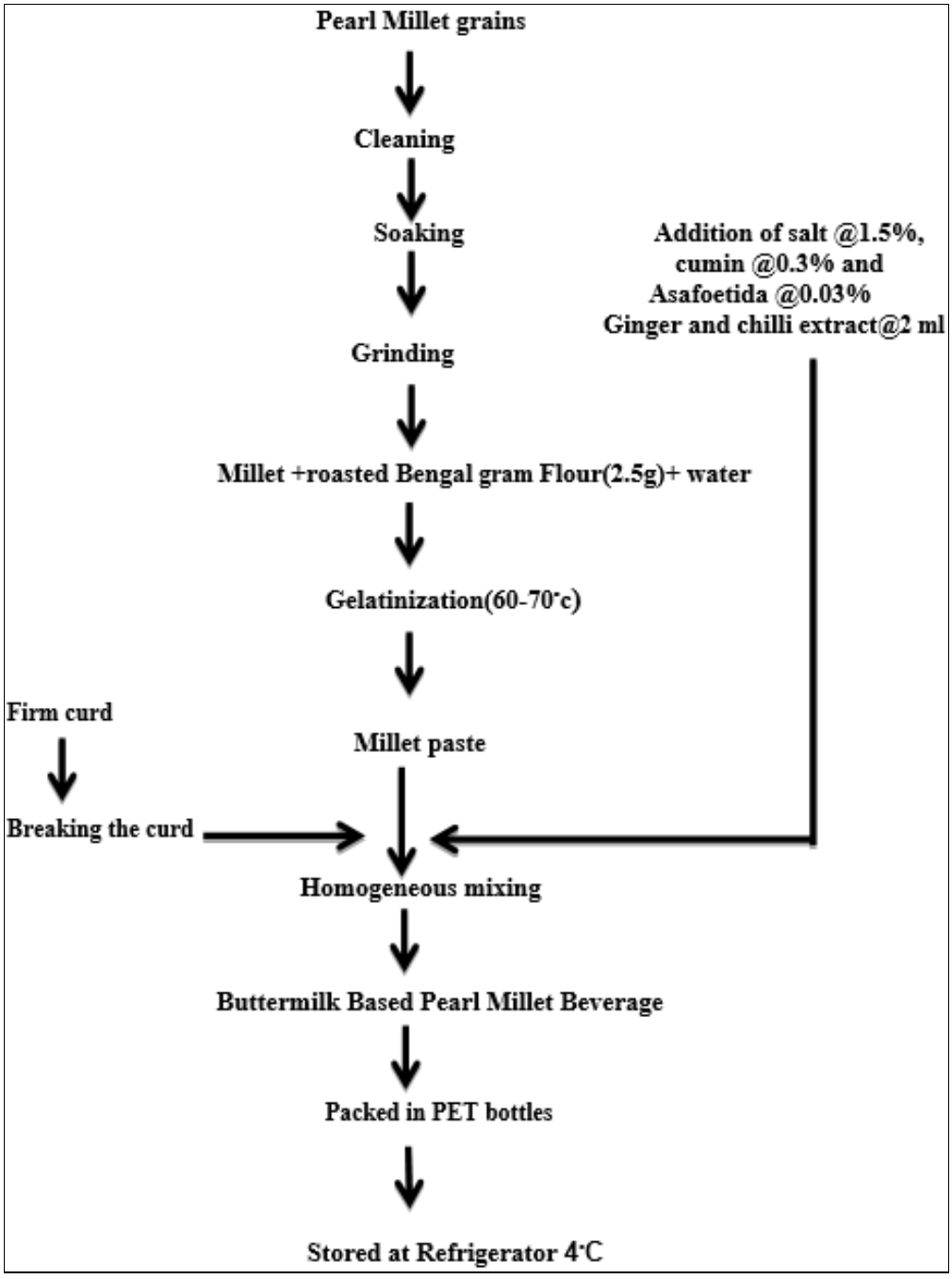

Fig 1: Flow chart for Standardization of butter milk based millet beverage

3. Result and Discussion

3.1 Chemical Composition

The physico chemical composition of the buttermilk based pearl millet beverage (BPMB) during initial and final stage of the storage were given in the Table 3. It showed that moisture content of fresh sample 91.68%, 7th day 91.59%. The pH of fresh ranged from 4.66 to the 7th day 4.59. Ilango *et al*., 2014 [20] reported that pH of fermented pearl millet beverage *koozh* ranged from 4.3 to 4.9 in all samples this showed observations had significant difference to the above mentioned study. The acidity % in BPMB ranged between 0.16% to 4.59%. Sudha *et al*., [7] reported that that the acidity of the fermented millet sprout milk beverage were in the range of 0.608 – 0.987%. The protein content in the product (BPMB) ranged from 11.28 g and declined to 10.86. It may be due to the increased acidity and pH which leads to protein denaturation and wheying off. Compared to the similar studies, protein was highly increased in the (BPMB) due to addition of Bengal gram flour. Das *et al*., [6] observed that protein content in the Sorghum based fermented milk beverage was 2.8-3.8g.The fat content ranged from 3.31, and the fibre 2.46 and did not show any significant difference in the 7th day of the storage. Das *et al*., [6] stated that fat content in the Sorghum based fermented milk beverage was 2.3-2.6g. The minerals like Fe, Ca, Mg, P ranged from 9.28 mg, 24.46 mg, 64.41 mg, 119.76 mg. The phyto chemical studies results revealed that Total antioxidant activity flavonoids and phenols was 92.43 mg/100 ml, 17.28 mg of GAE/g of DW, 14.85 QE mg/100 ml in initial day of storage respectively. There was no significant reduction in the phytochemicals after 7 days of storage.

Table 3: Chemical composition of Butter milk based Pearl Millet Beverage

Constituents(Per 100 ml)	0 days	7 days
Moisture (%)	91.68±0.99	91.59±1.38
P^H	4.66±0.18	4.59±0.18
Acidity (%)	0.16±0.002	0.18±0.02
Protein (g)	11.38±0.29	11.26±0.35
Fat (g)	3.31±0.05	3.31±0.10
Fibre (g)	2.46±0.06	2.46±0.06
Iron (mg)	9.28 ±0.22	9.98±0.22
Calcium (mg)	33.3 ±1.29	33.5±0.39
Phosphorus (mg)	119.76±2.70	119.76±2.05
Magnesium(mg)	64.41±0.39	64.41±2.03
Total antioxidant (mg/100 ml)	92.43±2.67	92.39±1.25
Polyphenols GAE/ g (DM) mg	17.28±0.48	17.26±0.36
Flavonoids (mg QE/100 ml)	14.85±0.21	14.87±0.35
Sedimentation(ml/10ml)	0	8.4±0.14
Wheying off %	0	0.016±0.001
Viscosity (CP)	46.08±0.75	42.86±1.31

3.2 Stability Studies

The stability of the developed product was analysed (Table 3) based on sedimentation and wheying off property. During 1 st day of storage, there was no sedimentation and wheying off where as at the 7 th day of storage, the sedimentation and wheying off was observed (0.016%). Sudha *et al*., 2016 [7] observed that the wheying off of the samples varied from 0.014 – 0.020%. It may attributed due to significant increase of pH and acidity of the product and its leads to protein denaturation and wheying off. It was the main cause of separation of whey layer and the sediment in the beverage. Amice-Quemeneur *et al*. 1995 [21] reported that the sedimentation of cereal solids was zero on day 1, it gradually increased on storage. Sedimentation in fermented/cultured milk beverages is a major hurdle for storage of product. Because of low pH, acidic milk products suffer from protein sedimentation, which leads to whey separation on storage. The viscosity of the butter milk based pearl millet beverage (BPMB) ranged from 46.08 cP to 42.88 cP. Modha *et al*., 2011 [22] observed the viscosity of beverage prepared from buttermilk (58 cp) was higher than that of skim milk (53 cp) based beverage. It showed that subsequent decline in viscosity may be due to the reaction between due to action of spoilage microorganisms which led to breakdown of casein network. Similar trend was observed by Khurana and Kanawjia (2006) [23] for mango lassi.

3.3 Microbial evaluation of Buttermilk based millet beverage

The Total plate count of the product (BPMB) for the fresh 4 x 10^2 cfu /ml, for the seventh day of storage 15 x 10^2 cfu/ml and the coliforms and yeast – mould count were nil Das *et al*., 2015 [6] reported the microbial load in the sorghum based fermented milk beverage. The standard plate count was 13- 15 x 10^2 cfu/ ml and yeast and mould was 10-11 x 10^2 cfu/ ml and the coliforms were Nil. Observed microbial loads in the (BPMB) comes under within the safety level and fit for consumption. Absence of coliforms in the product (BPMB) which indicate that hygienic conditions were followed during production, processing, handling and storage. LAB count in the product ranged from 12 x 10^6 cfu/ml and for the seventh day 45 x 10^6 cfu/ml due to addition of buttermilk in the product.

4. Conclusion

The method standardized for production of Buttermilk based pearl millet beverage is very simple and can be applied for industrial production. The present study resulted in the developed buttermilk based pearl millet beverage had the overall nutritional composition of the protein and fat content was 11.36g and 3.33g, pH was 4.2, Acidity (0.10%), fibre (2.46g), minerals (Fe 9.28 mg, Ca 33.3 mg and P 119.76 mg and Mg 64.41 mg,) and the phytochemical components also high. The over all accepatability score was high and the shelf life of 7 days without any preservative at refrigerate storage (4°c) when packed in pet bottles. The developed beverage highly nutritious compared with the commercial spiced buttermilk and it had complete instant energy source of protein and energy for the daily requirements and the addition buttermilk with millet act as pre and probiotic for improve the gut health and treating gastrointestinal diseases. Future considerations for this study was mainly focused on improving the stability and the product by addition of stabilizer to prevent the sedimentation and wheying off of the product and improving the shelf life of the product by addition of food graded preservatives at permissible level to ensure the any time availability of the product in the market and useful for consumers.

5. Reference

1. Ragaee S, Abdel-Aal ES, Noaman M. Antioxidant activity and nutrient composition of selected cereals for food use. Food Chemistry. 2006; 98(1):32-8.
2. Ali MAM, El Tinay AH, Abdalla AH. Effect of fermentation on the in vitro protein digestibility of pearl millet. Food Chem. 2003; 80(1):51–4.
3. Jukanti AK, Gaur PM, Gowda CL, Chibbar RN. Nutritional quality and health benefits of chickpea (Cicer arietinum L.): a review. British Journal of Nutrition. 2012; 108(S1):S11-26.
4. Singh U. Nutritional quality of chickpea (Cicer arietinum L.): current status and future research needs. Plant Foods for Human Nutrition. 1985; 35(4):339-51.
5. Conway V, Couture P, Gauthier S, Pouliot Y, Lamarche B. Effect of buttermilk consumption on blood pressure in moderately hypercholesterolemic men and women. Nutrition. 2014; 30(1):116-9.
6. Das A. Quality evaluation of Sorghum based fermented milk beverage. The Pharma Innovation. 2015; 4(6, Part B):83.
7. Sudha A, Devi KS, Sangeetha V, Sangeetha A. Development of Fermented Millet Sprout Milk Beverage Based on Physicochemical Property Studies and Consumer Acceptability Data, 2016.

8. Hussain SA, Garg FC, Pal D. Effect of different preservative treatments on the shelf-life of sorghum malt based fermented milk beverage. Journal of food science and technology. 2014; 51(8):1582-7.
9. AOAC (Association of Official Analytical Chemists). Official methods of analysis of the association of official analytical chemistry. 16th (Eds.), Washington. 1997; 2:235-236.
10. Ma T, Zuazaga G. Estimation of protein. In: Ranganna, S. Analysis and quality control for fruits and vegetables products. Tata mcgraw Hill. 1942; 2:3-10.
11. Cohen EH. Journal of Association of Official Analytical Chemists. 1917; 54:212.
12. EUTECH Instruments, Mumbai, India.
13. Saini RS, Sharma KD, Dhankar OP, Kaushik RA. Laboratory manual ofanalytical techniques in Horticulture. Agrobios Pub. Jodphur. India, 2000, 72.
14. Lim YY, Lim TT, Tee JJ. Antioxidant properties of several tropical fruits: A comparative study. Food chemistry. 2007; 103(3):1003-8.
15. Sadasivam S, Manickam A. Biochemical methods third edition, New age international Publishers, Newdelhi, India, 2008.
16. Lamaison JL, Carnat A. Levels of principal flavonoids in flowers and leaves of Crataegus-Monogyna Jacq and Crataegus-Laevigata (Poiret) Dc (Rosaceae). Pharmaceutica Acta Helvetiae. 1990; 65(11):315-20.
17. Ranganna S. Manual of analysis of fruits and vegetables products, Tata McGraw Hill publishing Co., Ltd., New Delhi. 1995, 3-4, 9-10.
18. Yousef AE, Carlstrom C. Salmonella. In: Yousef AE and Carstrom C (Eds) Food microbiology: a laboratory manual. John Wiley and Sons, New Jersey, 2003.
19. Istawankiss. Testing methods in food microbiology, Elsevier Pub Ltd., 1984, 395-397.
20. Ilango S, Antony U. Assessment of the microbiological quality of koozh, a fermented millet beverage. African Journal of Microbiology Research. 2014; 8(3):308-12.
21. Amice Quemeneur N. Influence of the acidification process on the colloidal stability of acidic milk drinks prepared from reconstituted nonfat dry milk. En: Journal of Dairy Science. 1995; 78(12):2683-2690.
22. Modha H, Pal D. Optimization of Rabadi-like fermented milk beverage using pearl millet. Journal of food science and technology. 2011; 48(2):190-6.
23. Khurana HK, Kanawjia SK. Extension of shelf-life of mango lassi using biopreservatives. XXXV Dairy Ind. Confererence, 2006, 23-5.