Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

J P P Journal of Pharmacognosy and Phytochemistry

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(4): 714-717
Received: 22-05-2018
Accepted: 26-06-2018

Puniyamoorthy Sheela
Research Scholar,
Dept of Food Science,
Community Science College and Research Institute Tamil Nadu Agricultural University,
Madurai, Tamil Nadu, India

Thiyaga moorthy UmaMaheswari
Assistant Professor, Department of Food Science and Nutrition,
CSC&RI, TNAU, Madurai,
Tamil Nadu, India

Shanmugavel Kanchana
Professor and Head, Department of Human Development,
CSC&RI, TNAU, Madurai,
Tamil Nadu, India

Somasundaram Kamalasundari
Assistant Professor, Department of Food Science and Nutrition,
CSC&RI, TNAU, Madurai,
Tamil Nadu, India

Ganapathysamy Hemalatha
Professor and Head, Department of Food Science and Nutrition,
CSC&RI, TNAU, Madurai,
Tamil Nadu, India

Correspondence
Thiyaga moorthy UmaMaheswari
Assistant Professor, Department of Food Science and Nutrition,
CSC&RI, TNAU, Madurai,
Tamil Nadu, India

Development and evaluation of fermented millet milk based curd

Puniyamoorthy Sheela, Thiyaga moorthy UmaMaheswari, Shanmugavel Kanchana, Somasundaram Kamalasundari, and Ganapathysamy Hemalatha

Abstract
Millet is an important cereal and nutritious food rich in minerals and phytochemicals. The concern in use of millets is its ant nutritional factors, which can be improved by various processing methods. With this view, soaking and germination parameters of five minor millets were standardized for extraction of millet milk. The water absorption ability and germination percentage was higher in 24h of soaking and germination which influences the yield of millet milk. The highest milk yield was obtained from foxtail millet, little millet and proso millet. The millet milk thus obtained was pasteurized and fermented with commercial curd culture NCDC 260 for 6h. The pH of millet milk curd ranged from 3.5 to 4.16. Based on sensory evaluation, overall acceptability of the developed product was high. The results of the study indicated that the nutritive value can be improved by germination and fermentation. Millet based curd can add value and novelty to the final product.

Keywords: minor millets, soaking, germination, millet milk, fermentation and curd

Introduction
Interest in innovative foods is increasing rapidly as part of the trend towards more health conscious nutrition. Drinks based on malt or cereals contain only natural sugar and are excellent sources of antioxidants, vitamins and other health-promoting substances. Millets are nutritionally superior, especially in micronutrient content compared to the commonly consumed cereals. Usually millets are grown in marginal areas but they are relatively rich in proteins and minerals and are superior in amino acid balance in comparison to conventional cereal crops besides vitamins and fibre [1, 2]. Millets are also rich sources of phytochemicals and micronutrients and they have good balance of aminoacids [3]. The main drawback in millet nutrition is its bioavailability due to very high antinutritional factors which can be reduced by various processing techniques.

Soaking is one of the method used to improve the nutritional value of millet that leads to the breakdown several components into simpler compounds which alter the texture, flavor, aroma and taste [4]. Soaking followed by germination can improve the nutrition of millets as it helps in reducing starch component, induces hydrolytic enzymes for phytate reduction and some flavanoid components. Sprouted seeds contain high protein, low unsaturated fatty acids, low carbohydrate and vitamins compared to ungerminated seeds. Mineral content such as phosphorus, calcium, zinc and copper were higher in sprouts as the hydrolysis of phytic acid gets activated during germination. Hence, soaking and germination of millet is important processing method in developing food product with low viscosity and high energy [5, 6]. And there is meagre information on soaking and germination time of millets to extract the millet milk and developing millet milk based value additional products with bio available nutrients. This study mainly focuses on standardizing soaking and germination time to obtain improved millet milk yield and to evaluate curd based on millet milk.

Materials and methods
Matured grains (whole grains) of a local variety of minor millets *viz*., fox tail millet (*Setaria italica*), little millet (*Panicum sumatrense*), kodo millet (*Paspalum setaceum*), proso millet (*Panicum miliaceum*), and barnyard millet (*Echinochloa utilis*) were purchased from local market of Madurai district. All the five millets were cleaned to remove any foreign materials. Fifty grams of each millet were weighed and soaked for 16 h and 24h after which it was allowed for germination in muslin cloth for 24h. The physical parameters *viz*., water absorption, germination percentage, root and shoot length for soaked and germinated grains were analysed. The germinated millet grains were ground to extract millet milk and filtered.

The milk yield was quantified for different millets and physicochemical parameter such as solids not fat (SNF) by lactometer and total soluble solids (TSS) by hand refractometer of different millet milk was estimated. The millet milk was then filtered, pasteurized, cooled, inoculated with commercial curd culture NCDC 261 and incubated at 30°C to 6 h until clean curdling. Titratable acidity and pH of millet curd was analysed by AOAC [7] method. The prepared millet based curd of five millets was subjected to sensory evaluation by a panel of 9 semi trained judges using a nine point hedonic scale [8].

Statistical analysis

Data were analyzed using Data Entry Module for Agres Statistical Software (Version 3.01) developed by Tamil Nadu Agricultural University, Coimbatore. The data obtained from the various experiments were performed in triplicates and were expressed as mean ± standard deviation and to find out the significance between different treatments using Factorial Completely Randomized Design (FCRD) methods described by Gomez and Gomez [9].

Results and Discussion

Food processing methods can be used to enhance the bioavailability of micronutrients in plant based diets which included thermal processing, mechanical processing, soaking, fermentation and germination/malting. These methods aim to increase the physicochemical accessibility of micronutrients by decreasing the antinutritional compounds that improve bioavailability [10]. In this study, five minor millet grains were used for extraction of milk by varying soaking and germination time. Various parameters were assessed for grains, millet milk and millet based curd *viz*., water absorption, germination percentrage, root and shoot length, milk yield of the germinated grains, solid not fat, TSS, pH, and acidity respectively.

From the table 1 it was observed that T3-kodo millet had higher water absorption capacity (70±0.11ml) among the five millets after 24h of soaking. The lowest water absorption level was observed in T1-foxtail millet (15±0.08ml). Soaking of grains is a well-known food processing technique used for reducing anti-nutritional compounds. The statistical analysis showed the water absorption capacity of 24h soaking was highly significantly than 16h at P<0.05 level.

Table 1: Water absorption capacity (ml) of selected millets after soaking

Parameters	16 h soaking	24 h soaking
T_1	15 ± 0.20	40 ± 0.69
T_2	40 ± 0.14	55 ± 0.17
T_3	35 ± 0.14	70 ± 0.11
T_4	20 ± 0.09	40 ± 0.59
T_5	40 ± 0.98	50 ± 0.28
SED	0.5331	0.8686
CD (0.05)	1.1362*	1.8513*
CV%	2.51	2.41

T_1- Foxtail millet, T_2- Little millet, T_3- Kodo millet, T_4- Proso millet, T_5-Barnyard millet

Physical parameters of germinated millets

The root and shoot length of the grains varies from different millets in 16h and 24h of germination period (Table 2). After 16h soaking, T1-foxtail millet had highest root length and T2-little millet had highest shoot length. There was no root and shoot length observed in T5-barnyard millet. After 24h of soaking, root length ranged between 0.5 to 2.6 cm and shoot length was between 0.1 to 1.5 cm. At 24h of soaking and germination, little millet had maximum of 60% percentage germination and the lowest level of germination percentage was observed in the treatment of T4-proso millet and T5-barnyard millet (20%) which might be due to the low seed viability. Generally germination is done to increase availability of nutrients, to decrease the ant nutritive compound and to add new flavor by enzyme activity during germination [11]. Germination process enhances the hydrolysis of complex organic compounds which are insoluble in the seeds and form more simple organic compounds that are water soluble. In addition, fat will be degraded to produce energy [12]. It was reported that the soluble nutrients in sorghum was increased by soaking and germination treatment due to degradation of carbohydrates, proteins and fats. The soaking for 24 h and germination for 36 h increases the nutritional value of sorghum [13].

Table 2: Physical parameters of germinated millets

Parameters	16 h soaking		24 h soaking		Germination Percentage	
	Root length (cm)	Shoot length (cm)	Root length (cm)	Shoot length (cm)	16 h soaking (%)	24 h soaking (%)
T_1	1.6±0.04	0.7±0.01	2.1±0.00	1.5±0.02	50±0.67	50±0.88
T_2	1.4±0.00	1.6±0.00	2.6±0.08	1.8±0.05	55±0.05	60±0.42
T_3	1.5±0.04	0.5±0.01	1.5±0.03	0.7±0.0	38±0.90	40±0.02
T_4	1.3±0.02	0.5±0.01	1.9±0.03	0.8±0.00	20±0.17	20±0.72
T_5	0.0	0.0	0.5±0.01	0.1±0.00	0.0	20±0.72
SED	0.0203	0.0125	0.0311	0.0145	0.3564	0.5283
CD(0.05)	0.0432*	0.0266*	0.0663*	0.0308*	0.7597*	1.1261*
CV%	2.47	2.68	2.56	2.09	1.55	1.97

T_1- Foxtail millet, T_2- Littlemillet, T_3- Kodo millet, T_4- Proso millet, T_5-Barnyard millet

Parameters analysed for millet milk and curd

The milk yield obtained from different millets at varied soaking and germination time was quantified. For 16h soaking and 24h germination the milk yield ranged between 90 to 140ml in all the five millets. Among these treatments, the highest milk yield was obtained from foxtail millet, little millet and proso millet (140ml) and the least level of the milk yield from barnyard millet (90ml) whereas after 24h soaking and 24h germination, the milk yield was higher in foxtail millet (160ml). The milk yield was correlated with percentage of germination and found to be directly proportional to the germination. The millet milk thus obtained was analysed for solids not fat and total soluble solids and the values were significantly different at 5% level (Table 2 and 3).

Table 3: Millet milk parameters

Parameters	16h Soaking & 24h Germination			24 h soaking & 24h germination		
	Millet Milk yield (ml)	SNF	TSS	Millet Milk yield (ml)	SNF	TSS
T_1	140±2.43	2.22 ±0.01	2°brix	160±2.36	2.47 ± 0.02	2°brix
T_2	140±4.98	2.62 ±0.00	2°brix	150±0.2	2.62±0.08	2°brix
T_3	120±2.7	2.52 ±0.00	3°brix	140±3.05	3.27 ±0.05	3°brix
T_4	140±3.56	3.72 ±0.11	4°brix	140±4.67	3.95 ±0.09	4°brix
T_5	90±3.13	3.27 ±0.00	2°brix	115±0.9	3.52 ±0.11	2°brix
SED	1.8647	0.0420		1.7508	0.0541	
CD(0.05)	3.9746*	0.0895*		3.7317*	0.1154*	
CV%	2.09	2.07		1.76	2.42	

T_1- Foxtail millet, T_2- Littlemillet, T_3- Kodo millet, T_4- Proso millet, T_5-Barnyard millet

The pH values of millet based curd ranged between 3.55±0.04 to 4.16±0.08. The highest acidity was found in fermented proso millet and barnyard millet (1.22%) and least was recorded for foxtail millet and little millet (0.72%) after 6h of fermentation.

Table 4: Parameters of fermented millet milk (after 6h of incubation at 30°C)

Parameters	pH	Acidity (% lactic acid)
T_1	4.15±0.03	0.72±0.02
T_2	4.16±0.08	0.74±0.02
T_3	4.11±0.11	0.86±0.02
T_4	3.55±0.04	1.22±0.03
T_5	3.55±0.01	1.22±0.00
SED	0.0720	0.0162
CD(0.05)	0.1535*	0.0345*
CV%	2.61	2.41

T_1- Foxtail millet, T_2- Littlemillet, T_3- Kodo millet, T_4- Proso millet, T_5-Barnyard millet

The sensory scores for the millet based curd was given in figure 1. The figure showed that there were same score obtained for the consistency and taste of the millet based curd. Colour and appearance of the product scored 8 points in T2, T4 and T5. The flavour of the millet product got lowest level this because of flavonoid compound presesnce in the millet for this some artificial flavouring agent can modify the product to cent per cent acceptability. Modha and Pal [14] reported that fermented pearl millet based milk beverage has sensorily acceptable quality and shelf-life of 7 days without any preservative at refrigerated storage (5–7°C) when packed in glass bottles.

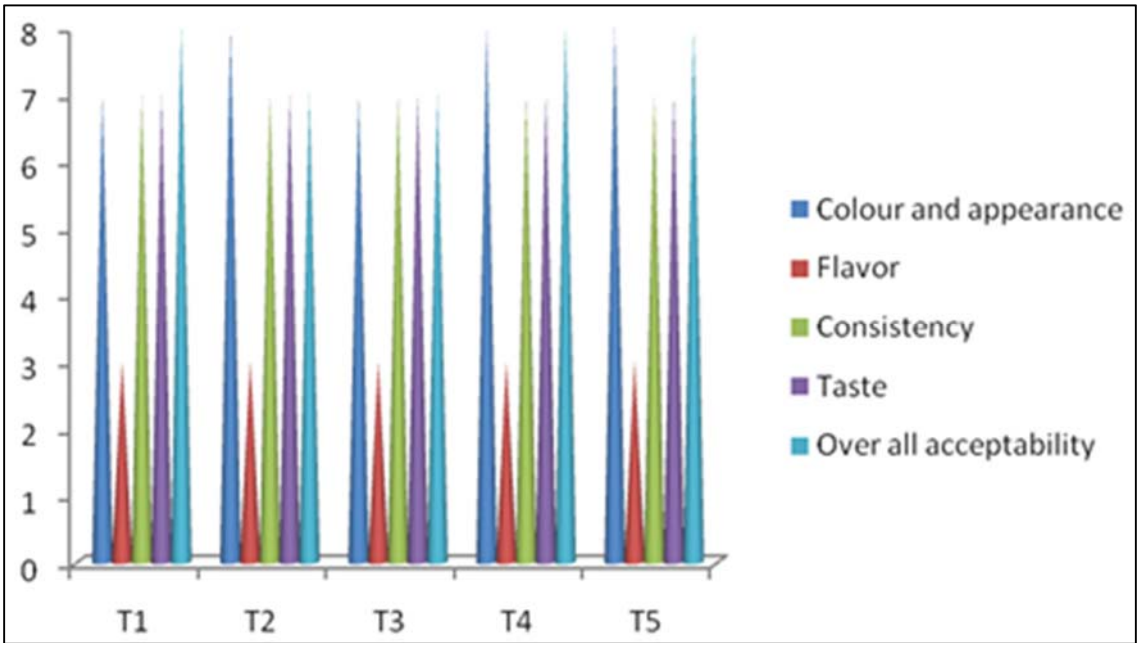

Fig 1: Sensory score value for the developed product

Conclusion

In the present study, the parameters for extraction of millet milk were standardized. A fermented curd like product was prepared using millet milk and was found to contain 0.74 to 1.2% acidity and pH was between 3.5 to 4.5. The overall acceptability of the final prepared product was highly acceptable for millet milk based curd based on sensory evaluation. Soaking and germination are processing method to reduce antinutritional factors and to increase the nutritive value. Hence, novel millet based fermented product rich in

available nutrient was developed, further standardization and analysis is needed for confirmation and validation.

Acknowledgement
This financial support provided by DST SERB, New Delhi is greatly acknowledged by the authors.

References

1. Parameswaran K, Sadasivam S. Changes in the carbohydrates and Nitrogenous components during germination of proso millet (*Panicum miliaceum*). Plant Foods and Human Nutrition. 1994; 45:97-102.
2. Singh P, Raghuvanshi RS. Finger millet for food and nutritional security. African Journal of Food Science 2012; 6(4):77-84.
3. Mal B, Padulosi S, Ravi SB. Minor millets in South Asia: learnings from IFAD-NUS Project in India and Nepal. Maccarese, Rome, Italy: Bioversity Intl and Chennai, India: M.S. Swaminathan Research Foundation. 2010, 1-185.
4. Parveen S, Hafiz F. Fermented cereal from indigenous raw materials. Pakistan Journal of Nutrition. 2003; 2(5):289-291.
5. Dicko MH, Gruppen H, Zouzouho OC, Traore AS, Van Berkel WJH, Voragen AGJ. Effect of germination on the activities of amylases and phenolic enzymes in sorghum varieties grouped according to food end - use properties. Journal of Science of Food and Agriculture. 2006; 86:953-963.
6. Inyang CU, Zakari UM. Effect of germination and fermentation of pearl millet on proximate, chemical and sensory properties of instant Fura-A Nigerian cereal food. Pakistan Journal of Nutrition. 2008; 7(1):9-12.
7. AOAC. Association of Official Analytical Chemists, Official methods of analysis. The Association of official Agricultural Chemists. Washington, DC, USA, 2000.
8. Watts BM, Yumaki CL, Jeffry LE, Elais LG. Basic sensory methods for food evaluation. The International Development Research Centre, Ottawa, Canada, 1989.
9. Gomez KH, Gomez AA. Statistical procedures for Agricultural Research, 2nd Edition, John Wiley and Sons, New York. 1984, 381.
10. Hotz C, Gibson RS. Traditional food-processing and preparation practices to enhance the bioavailability of micronutrients in plant-based diets. Journal of Nutrition 2007; 37:1097-1100.
11. Uvere PO, Orji GS. Lipase activities during malting and fermentation of sorghum for burukutu production. Journal of the Institute of Brewing. 2002; 108(2):256-260.
12. Sukamto. The change of composition of nitrogen, phospat and activity of anti-nutrition during the germination of seeds soybean (Perubahan Komposisi Nitrogen dan Fosfat serta Aktivitas Anti Gizi Selama Perkecambahan Biji Kedelai). Yogyakarta, Indonesia: Gadjahmada University, Master thesis, 1992.
13. Narsih Yunianta, Harijono. The study of germination and soaking time to improve nutritional quality of sorghum seed, International Food Research Journal 2012; 19(4):1429-1432.
14. Modha H, Pal D. Optimization of Rabadi-like fermented milk beverage using pearl millet Journal of Food Science and Technol ogy. 2011; 48(2):190-196.