The Pharma Innovation

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Studies on physico-chemical properties of little millet and its exploration in biscuits

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Abstract
The present research work was carried out to explore the possibility of utilization of underutilized but highly nutrient rich little millet in biscuits. Little millet is a rich source of protein, crude fiber, micronutrient such as iron and can be utilized in bakery products such as biscuits. The little millet contains moisture 11.79%, fat 4.66%, carbohydrates 68.98%, protein 7.75%, crude fiber 7.58%, Phosphorus 218 mg/100 g, and iron 9.45 mg/100 g. Preliminary experiments were carried out to find out optimum level of little millet flour with maida for the preparation of quality biscuits. The quality biscuits were prepared from 30% maida and 70% little millet (MLF_{70}). The selected treatments were packed in LDPE and PP stored at ambient (30 ± 4 °C) for 90 days to study their storage feasibility. Chemical composition of the fresh biscuits prepared from 30% maida and 70% little millet flour (MLF_{70}) that showed moisture content was 4.15%, protein 9.02%, crude fat 28.55%, crude fiber 5.39%, carbohydrates 69.06% and iron 7.22 mg/ 100 g. The sensory evaluation of biscuits was carried out regularly at an interval of one month for 3 month during storage. The results on overall acceptability score of biscuits are influenced by storage. The results indicated that score for overall acceptability decreased for MLF_{70} from 7.97 to 7.13 in LDPE and 7.83 to 6.44 in PP were observed for 90 days of storage. Storage study of biscuits showed that the biscuits prepared by incorporation of maida, and little millet flour can be stored up to 3 month in LDPE with minimum losses in sensory, nutritional and textural characteristics as compare to PP. There was no significant difference in protein, crude fiber, calcium and iron content with advancement of storage period during 3 month. The biscuits were found to be acceptable up to 3 month storage at ambient temperature. The total cost of production of biscuits prepared from maida and little millet flour (MLF_{70}) for 1 kg was Rs.156/-.

Keywords: Little millet, biscuits, nutritional value, organoleptic properties

Introduction

The 'Millet' is a term collectively referring to annual grasses with thousands of small seeds. The word 'Mill' refers to thousands of grains that can be held in a handful, indicating the grains. Millets belongs to genera in the subfamily 'Ponicoideae' and these are a part of the grass family 'Poaceae'. Millet is a some grain like food that grows in stalk of grasses. In fact, one of the earliest identified crops were two drought-resistant species of millet *viz*; sorghum and proso millet in North China, but rice in South China. Suggestions of the possibility to separate northern and southern centers of plant domestication. Generally the millets have four genera *Panicum*, *Setaria*, *Echinochloa*, and *Pennisetum*. Many of them cultivated commercially as well as domestically. Millets are cultivated with little attention and generally as a inputs in most regions of the India for local use.

Among the cultivated species mainly includes little millet (*Panicum miliare*), Italian millet (*Setaria italica*) also called as foxtail millet, barnyard millet (*Echinochloa esculenta*), browntop millet (*Dixie signalgrass*). Considering the health importance of millets groups, they stands for good nutrional qualities in terms of diabetes and other cancer and heart related problems. Little millet (*Panicum miliare*) is an annual warm to tropical season crop. It is tetraploid with basic chromosome number of 36 (Moulik, 1997) [26], also Chenn and Revoize (2006) [32] reported the hexaploid with 2n=54. Botanically, little millet inflorescence is a panicle and about 15-45 cm long and 1-5 cm in width (Seetharam *et al*., 2003) [27] Usually the spikelet is 2-3.5 mm in length (Boor, 1960) [28].

A 100 grams of little millet serves about calories 329, crude protein 7.75%, fiber 7.06%, crude fat 4.66%, total carbohydrates 68.98%, phosphorous 218-220 mg, iron 9.45% and most important magnesium 90 mg. It also good amount of niacin and thiamin respectively. The nutrional importance of millets is superior to the cereals. Although having most essential nutrients, little millet has also lot of scope in compositing and overcoming nutritional

disorders and ensuring adequate nutrition for young and adults. For the people looking to add more of the protein to their diet than other nutrition, little millet can be a good substition. It contains high protein content than rice and wheat, providing about 15-16% of the daily value for women and men. Little millet is better source of both insoluble and soluble dietary fiber. The soluble dietary fiber is more than that of insoluble. This dietary fibeer supplements body more than 25% of the daily energy value. Millets are a mineral-rich food. It is easy to digest so help to relief from constipation problem and can help you maintain your stomach health and further reduce your risk of colon cancer. Little millet is the ideal diet choice.

Millets are having the high content in Vitamins and antioxidants, minerals, dietary fiber, some sulphur containing amino acids like niacin and phytochemicals and hence are termed as "nutri-cereals". Millets have higher proportions of non-starchy polysaccharides and dietary fiber. Millets release sugars slowly after consuming it and thus have a low glycemic index by (Chhavi and Sarita, 2012) [29]. Small millet grass crops are generally viewed as important for the wellness and health of the people and can help in preventing many kinds of health related issues to modern lifestyle including obesity, diabetes (Jones et al., 2000; Jones, 2006) [30-31]

Little millet is one the important millet among all minor millets having known by several local name like Sava in Marathi, Samai in Tamil, Gajro in Gujrathi, Swank in Punjabi, Chama in Malayalam. Little millet is Poaceae family grassy plants with having short slender culm and relatively small grains having remarkable ability to survive under drought condition. Little millet can be cultivated in all types of soils in India and sustains adverse climatic conditions. Though little millet has got comparatively less attention from the plant breeders that appears to thrive under various conditions where no other edible plant will survive in such conditions. Little millet matures within about 2.5 to 5 months. The yields are generally less than 0.5 tones/ ha. Little millet has an excellent developing capacity compared to other millet.

Materials and Methods
The experiment was conducted in the laboratory of Department of Food Science and Technology, Post Graduate Institute at Mahatma Phule Krishi Vidyapeeth, Rahuri during the year 2021-2022.

Packaging material
The packaging materials like low density polyethylene (LDPE), polypropylene (PP) were purchased from the local market.

Ingredients
The major ingredients for the preparation of biscuits such as maida, sugar and Vanaspati ghee were purchased from local market.
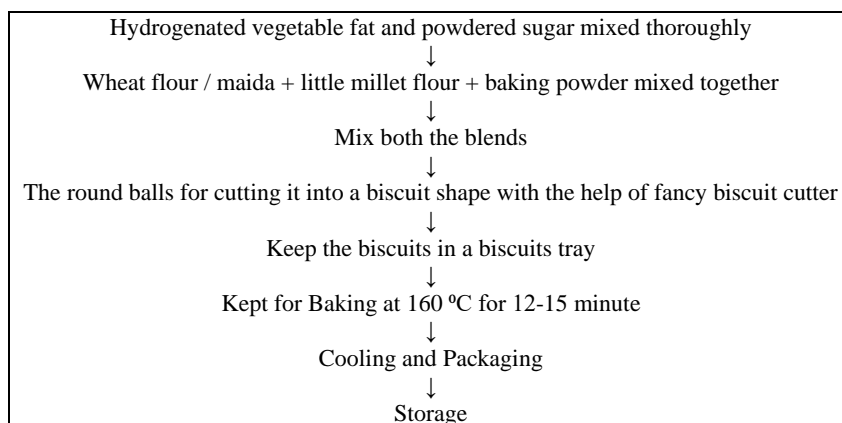
Method

Hydrogenated vegetable fat and powdered sugar mixed thoroughly
↓
Wheat flour / maida + little millet flour + baking powder mixed together
↓
Mix both the blends
↓
The round balls for cutting it into a biscuit shape with the help of fancy biscuit cutter
↓
Keep the biscuits in a biscuits tray
↓
Kept for Baking at 160 ⁰C for 12-15 minute
↓
Cooling and Packaging
↓
Storage

Fig 1: Flow chart for preparation of little millet biscuits

Table 1: Treatment details

Treatments	Maida flour (%)	Little millet flour (%)
MLF_0 (Control)	100	0
MLF_{10}	90	10
MLF_{20}	80	20
MLF_{30}	70	30
MLF_{40}	60	40
MLF_{50}	50	50
MLF_{60}	40	60
MLF_{70}	30	70
MLF_{80}	20	80
MLF_{90}	10	90
MLF_{100}	0	100

Physico-chemical analysis of raw material and biscuits

The method described in A.A.C.C. (2000) [1] for determining moisture was used. The protein content of biscuits q was q estimated by determining total nitrogen content using standard Micro-Kjeldhal method and fat content of the biscuits estimated by the soxhlet method A.A.C.C (2000) [1]. The crude fiber content in the product was estimated by A.A.A.C. (2000) [1]. The carbohydrate content in the selected biscuits were obtained by subtracting from 100, the sum of values of moisture, protein, fat and ash content per 100 g of the sample (Raghuramulu *et al.*, 1993) [10]. ß-carotene content of the selected samples was determined by the method of A.O.A.C. (1980) [2].

Packaging and storage of biscuits

The selected treatment (T_{70}) i.e. 30% maida and 70% little millet blended biscuits was packed in low density polyethylene (LDPE), polypropylene (PP) and stored for 90 days. The biscuits were drawn at an interval of 30 days and evaluated for chemical and sensory quality.

Sensory evaluation of biscuits prepared by incorporation of little millet flour

Sensory evaluation of biscuits prepared by incorporation of little millet flour was carried on by 9 point hedonic scale. The average scores of the ten judges for different quality characteristics *viz.* Colour and appearance, flavour, texture, taste and overall acceptability were recorded.

Statistical analysis

All experiments were carried out by using Completely Randomized Design (CRD) and Factorial Completely Randomized Design(FCRD).The data obtained in the present investigation were analyzed for the statistical significance according to the procedure given by Rangaswamy (2010) [10].

Results and Discussion

Table 2: Physico-chemical composition of raw materials used in the preparation of biscuits

Sr. No.	Physical and Chemical constituents	Mean value (Little millet flour)	Mean value (Maida)
1.	Color	Dull whitish	White
2.	Bulk density (g/cm^3)	1.49	0.599
3.	Moisture (%)	11.79	13.29
4.	Protein (%)	7.75	11.02
5.	Fat (%)	4.66	0.89
6.	Crude fiber (%)	7.58	0.41
7.	Carbohydrates (%)	68.98	62.90

Each value represents the average of three determinations.

Table 3: Sensory evaluations of fresh biscuits prepared by incorporation of little millet flour

Sample with code	Colour and appearance	Flavour	Texture	Taste	Overall acceptability
MLF_0 (Control)	8.01	7.99	8.01	8.2	8.02
MLF_{10}	8.22	8.29	8.09	8.46	8.27
MLF_{20}	8.23	8.29	8.27	8.4	8.32
MLF_{30}	8.23	8.1	8.48	8.5	8.40
MLF_{40}	8.32	8.5	8.48	8.7	8.47
MLF_{50}	8.31	8.5	8.5	8.5	8.51
MLF_{60}	8.73	8.7	8.6	8.78	8.75
MLF_{70}	8.89	9.0	8.87	9.0	8.97
MLF_{80}	7.78	7.89	7.5	7.77	7.80
MLF_{90}	7.59	7.76	7.29	7.54	7.57
MLF_{100}	7.09	7.39	7.01	7.19	7.17
Mean	8.11	8.25	8.23	8.27	8.20
S.E.±	0.05	0.07	0.07	0.06	0.01
C.D at 5%	0.016	0.21	0.22	0.18	0.03

*Maximum score out of 9. All results are mean value of ten determinations.

Whereas,

MLF_0 = (100 maida: 0 little millet flour), MLF_{10} = (90 maida: 10 little millet flour),

MLF_{20} = (80 maida: 20 little millet flour), MLF_{30} = (70 maida: 30 little millet flour)

MLF_{40} = (60 maida: 40 little millet flour), MLF_{50} = (50 maida: 50 little millet flour),

MLF_{60} = (40 maida: 60 little millet flour), MLF_{70} = (30 maida: 70 little millet flour),

MLF_{80} = (20 maida: 80 little millet flour), MLF_{90} = (10 maida: 90 little millet flour),

MLF_{100} = (0 maida: 100 little millet flour).

The organoleptic evaluation of biscuits prepared by different combination of little millet and maida were carried out at department of food science and technology. The biscuits were prepared and presented to panel of ten judge for assessing the quality and acceptability of product. Organoleptice valuation of biscuits was carried out using a 9 point hedonic scale of sensory characteristics such as colour, texture, taste and overall acceptability.

The average values of 90 days biscuits for MLF_{70} (30% maida and 70% little millet flour)) in PP packaging material was moisture 4.22 percent, protein 8.87 percent, fat 28.45 percent, crude fiber 5.30 percent, carbohydrate content 68.94 percent and iron content was 7.22 mg/100 g whereas in polypropylene packaging material was moisture 4.25 percent, protein 8.85 percent, fat 28.44 percent, crude fiber 5.28percent, carbohydrate content 68.92 percent and iron content was 7.18 mg/100 g

Changes in the chemical content of biscuits prepared from maida and little millet during storage period

Table 4: Chemical analysis of selected treatments

Treatment	Moisture (%)	Protein (%)	Fat (%)	Crude fiber (%)	Carbohydrate (%)	Iron (mg/100 g)
			Treatment			
T_0: MLF_0	4.10	12.01	25.79	0.28	73.89	2.70
T_1: MLF_{70}	4.14	9.03	28.55	5.35	69.06	7.24
S.E. ±	0.009	0.006	0.009	0.007	0.010	0.009
CD at 5%	0.028	0.019	0.028	0.021	0.029	0.027
			Packaging material			
P_0: LDPE	4.29	10.42	26.64	2.77	71.41	4.94
P_1: PP	4.31	10.44	26.63	2.78	72.05	4.91
S.E. ±	0.009	0.002	0.008	0.007	0.010	0.009
CD at 5%	0.027	0.007	NS	0.020	0.029	0.029
			Storage period			
C_1: 30 Days	4.27	11.43	26.67	2.80	71.42	4.98
C_2: 60 Days	4.30	11.41	26.64	2.79	71.38	4.92
C_3: 90 Days	4.33	11.39	26.60	2.78	72.38	4.90
S.E. ±	0.011	0.003	0.011	0.008	0.011	0.012
CD at 5%	0.033	0.012	0.033	0.026	0.034	0.034
			Interaction			
$T_0P_0C_1$	4.22	12.04	25.84	0.29	73.86	2.68
$T_0P_0C_2$	4.25	11.98	25.81	0.28	73.85	2.63
$T_0P_0C_3$	4.26	11.92	25.77	0.27	73.81	2.61
$T_0P_1C_1$	4.27	12.02	25.82	0.28	73.83	2.66
$T_0P_1C_2$	4.39	11.95	25.78	0.27	73.82	2.62
$T_0P_1C_3$	4.38	11.93	25.75	0.26	77.81	2.58
$T_1P_0C_1$	4.29	9.97	27.53	5.30	69.02	7.28
$T_1P_0C_2$	4.32	9.92	27.48	5.29	68.99	7.27
$T_1P_0C_3$	4.36	9.87	27.449	5.28	68.96	7.23
$T_1P_1C_1$	4.30	9.95	27.448	5.31	69.02	7.28
$T_1P_1C_2$	4.34	9.91	27.46	5.30	68.94	7.22
$T_1P_1C_3$	4.38	9.32	27.45	5.29	68.93	7.19
S.E. ±	0.02	0.42	0.02	0.04	0.02	0.03
CD at 5%	NS	NS	NS	0.011	0.07	NS

Where, MLF_0= 100% maida, MLF_{70}= 30% maida and 70% little millet flour.
LDPE= Low Density Polyethylene, PP= Polypropylene
C1 = 30 Day, C2= 60 Days, C3= 90 Day

The data in Table 4 shows that protein contents decreased in T_{10} with increasing little millet flour concentration, this is due to replacing the maida which is major source of the protein and fat. On the other side, moisture, crude fibre increased in T_{70} by increasing the level of little millet flour, as from the proximate composition of little millet flour it is clear that millet flour is a major source of the crude fibre, iron and fat. Except moisture all other parameters found decreased in final analysis as compared to initial analysis. Biscuits stored in polypropylene shows better quality than LDPE.

Table 5: Sensory evaluation of the biscuits fortified from maida and little millet flour

Sample with code	Colour and appearance	Flavour	Texture	Taste	Overall acceptability
MLF_0 (Control)	8.01	7.99	8.01	8.2	8.02
MLF_{10}	8.22	8.29	8.09	8.46	8.27
MLF_{20}	8.23	8.29	8.27	8.4	8.32
MLF_{30}	8.23	8.1	8.48	8.5	8.40
MLF_{40}	8.32	8.5	8.48	8.7	8.47
MLF_{50}	8.31	8.5	8.5	8.5	8.51
MLF_{60}	8.73	8.7	8.6	8.78	8.75
MLF_{70}	8.89	9.0	8.87	9.0	8.97
MLF_{80}	7.78	7.89	7.5	7.77	7.80
MLF_{90}	7.59	7.76	7.29	7.54	7.57
MLF_{100}	7.09	7.39	7.01	7.19	7.17
Mean	8.11	8.25	8.23	8.27	8.20
S.E.±	0.05	0.07	0.07	0.06	0.01
C.D at 5%	0.016	0.21	0.22	0.18	0.03

*Maximum score out of 9. All results are mean value of ten determinations.

Whereas,

MLF_0 = (100 maida: 0 little millet flour), MLF_{10} = (90 maida: 10 little millet flour),

MLF_{20} = (80 maida: 20 little millet flour), MLF_{30} = (70 maida: 30 little millet flour),

MLF_{40} = (60 maida: 40 little millet flour), MLF_{50} = (50 maida: 50 little millet flour),

MLF_{60} = (40 maida: 60 little millet flour), MLF_{70} = (30 maida: 70 little millet flour),

MLF_{80} = (20 maida: 80 little millet flour), MLF_{90} = (10 maida: 90 little millet flour),

MLF_{100} = (0 maida: 100 little millet flour).

The data in table 5 show that little millet and maida blended biscuits (30% maida and 70% little millet flour) remain in good condition at ambient temperature during the entire storage period of 3 months. The biscuits stored in polypropylene bags showed good quality than LDPE during 3 months of storage. The overall acceptability score of little millet flour and maida blended biscuits was decreased in aPP and 8.71 to 8.41 in aluminium foil.

Conclusion

These results indicates that MLF_{70} biscuits (30 percent maida and 70 percent little millet flour) with constant levels of other ingredients stored at ambient temperature had better acceptability till 90th day. It is evident from all the physicochemical properties that MLF_{70} biscuits (30 percent maida and 70 percent little millet flour) are the best for preparation of little millet biscuits of good quality. The biscuits stored in PP bags showed good quality than LDPE during 3 month storage.

References

1. ACC. Official Methods of Analysis of AACC International, American Association of Cereal Chemists, Washington D.C; c2000.
2. O. A. C. Offical Methods of Analyasis, 18th edition. Association of Official Analytical Chemist. Washignton DC; c2000. p. 454.
3. Amerine MA, Pangborn RM, Roessler EB. Principles of Sensory Evaluation of Food. Academic Press. New York; c1980. p. 549.
4. Baker RD. Millet production; c2003. Available on http://Lubbock.tamu.edu/ othercrops/docs / nmsumilletprod. htm.
5. Bushway AA, Belyea PR, Bushway RJ. Foxtail millet as a source of oil, polysaccharide, and protein. Journal of Food Science. 1981;46:1349-1350.
6. Butt MS, Sharif K, Mukhtar T, Rasool J. Storage studies of red palm oil fortified biscuits. Nutr. Food Sci. 2004;34(6):272-276.
7. James GB. Food Processing Handbook. Edited by James G. B. Wiley-VCH Verlag GmbH and Co. KGaA, Weinheim; c2005. p. 27.
8. Leelavathi K, Rao PH. Development of high fiber biscuits using wheat bran: J Food Sci. Technol. 1993;30(3):187-190.
9. Mayela BJ, Denisse AC, Ernesto AC, Katarzyna W, Kazimierz W, Guadalupe AG, et al. Bread development with soybean, chia, linseed, and folic acid as a functional food for woman. Archivos Latino americanos De Nutricion. 2007;57(1):78-84.
10. Mulvancey F, Cohen C. Effect of added fat on the rheological properties of wheat flour dough. Cereal Chem. 1997;74(2):304-311.
11. Ojeka EO, Ayodele JT. Determination of chromium, copper, lead and nickel in some Nigerian vegetables oils. Spectrum. 1995;2:75-78.
12. Pasha I, Butt MS, Anjum FM, Shehzadi N. Effect of dietetic sweeteners on the quality of biscuits. International Journal of Agriculture and Biology. 2002;4(2):245-248.
13. Raghuramulu N, Nair MK, Kalyanasundaram S. A Manual of Laboratory Technique, National Institute of Nutrition, Indian Council of Medical Research, Hyderabad, India; c1993. p. 69-72.
14. Rangaswamy R. A Text Book of Agricultural Statistics, Second edition and New Age International Publishers. New Delhi; c2010. p. 234-458.
15. Rao TS, Rajmanuja MN, Ashok N, Vaibhaker HS. Storage properties of whole egg powder incorporated biscuits. J. Food Sci. Tech. 1995;32(6):470-476.
16. Rey CE, Tecantea A, Valdivia MA. Dietary fibre content and antioxidant activity of phenolic compounds present in Mexican foxtail millet (Setaria italica L.) seeds. Food Chemistry. 2006;107(2):656-663.
17. Salazar VM, Maira R, Segura C, Luis A, Chel G, David A. Antihypertensive and antioxidant effects of functional foods containing foxtail millet (Setaria italica) Protein Hydrolysates. Scientific, Health and Social Aspects of the Food Industry; c2011. p. 382-398.
18. Shariff M, Butt M, Huma N. Oil extraction from rice industrial waste and its effect on physic-logical characteristics of biscuits. Nutr. Food Sci. 2005;35(6):416-427.
19. Shiau SY, Yeh A. Effect of alkali and acid on dough rheological properties and Characteristics of extruded noodles. J. Cereal Sci. 2001;33:27-37.
20. Singh R, Singh G, Chauhan GS. Nutritional evaluation of soy fortified biscuits. J Food Sci. Technol. 2000;37(2):162-164.
21. Sujitha R, Thirumani D. Physicochemical and sensory characteristics of value added breakfast biscuits. Int. J Adv. Res. 2014;2(3):556-563.
22. Tosco G. Los beneficios de la chía en humanos y animales. Nutrimentos de la semilla de chía y surelación con los requerimientos humano sdiarios. Actualidades Ornitológicas, No. 2004;119:1-70.
23. Ushakumari SR, Malleshi NG. Small millets: Nutritional and technological advantages. Food uses of small millets and avenues for further processing and value addition, Ed. Krishnegowda, K. and Seetharam, All India Coordinated Small Millets Improvement Project, ICAR, UAS, Bangalore; c2007.
24. Vanesa Y, Susana M, Mabel C. Physical properties of foxtail millet (Setaria italica.) seeds. Industrial Crops and Products. 2008;28(3):286-293.
25. Veena B, Chimmad BV, Naik RK, Shantakumar G. Physico-chemical and nutritional studies in barnyard millet. Karnataka J Agric. Sci. 2005;18(1):101-105.
26. Moulik SP, Ghosh S. Surface chemical and micellization behaviours of binary and ternary mixtures of amphiphiles (Triton X-100, Tween-80 and CTAB) in aqueous medium. Journal of molecular liquids. 1997 Aug 1;72(1-3):145-61.

27. Seetharam B, Yammani RR. Cobalamin transport proteins and their cell-surface receptors. Expert reviews in molecular medicine. 2003 Jun;5(18):1-8.
28. Boor L, Hanok M, Conant FS, Scoville Jr WE. Rheological Testing of Elastomers at Low Temperatures. Part II. Rubber Chemistry and Technology. 1960 Sep;33(4):1114-1131.
29. Chhavi A, Sarita S. Evaluation of composite millet breads for sensory and nutritional qualities and glycemic response. Malaysian journal of Nutrition. 2012 Mar 1;18(1).
30. Jones Q, Rafaeli S. Time to split, virtually: 'Discourse architecture 'and' community building' create vibrant virtual publics. Electronic Markets. 2000 Jan 1;10(4):214-223.
31. Jones JD, Dangl JL. The plant immune system. nature. 2006 Nov 16;444(7117):323-329.
32. Chen SL, Renvoize SA. Miscanthus. Flora of China. 2006;22:581-583.