



Evaluation of Physico-Chemical Properties of Cookies from Little Millet

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Millet based cookies were standardized by incorporating little millet flour at 25, 50 and 75% levels. The developed cookies were evaluated for its sensory attributes and were highly acceptable at 50% level. The developed products were analyzed for their physico-chemical properties using standard procedures. Incorporation level of little millet flour in cookies on the physical characteristics such as spread ratio, weight and moisture content increased. The substitution of little millet flour increased the yellowness index and decreased the whiteness index. Cutting force increased whereas firmness decreased due to incorporation of little millet flour. The fibre and iron content of the little millet cookies was 3.95g and 4.43mg respectively and was higher than the control cookies. The shelf life of the product was better in plastic containers (600gauge-P₂) than poly propylene bags (200gauge-P₁) upto 15 days and the microbial population was within the safer limit during the storage period.

Key words: Little millet, Cookies, Sensory evaluation, Texture profile analysis, Physico-chemical properties.

Millets are small seeded annual coarse cereals grown throughout the world. In developing countries, millets are consumed by people from the low economic strata and as forage crop (Baker, 2003). They are nutritionally comparable or even superior to staple cereals such as rice and wheat (Gopalan *et al.*, 2004). Millets are rich in vitamins, minerals, sulphur containing amino acids and phyto-chemicals and hence are termed as 'nutri-cereals'. They have higher proportions of non starchy polysaccharides and dietary fibre. Millets release sugars slowly and thus have a low glycemic index.

Advancement of science and technology, demographic shift and change in the lifestyle of people has changed their food habits and people are inclining to ready to eat and more refined products of wheat and rice. This has brought drastic reduction in the consumption of millet foods. Millets have great potential for being utilized in different food systems by virtue of their nutritional quality and economic importance. There is a wide scope of their exploitation in different food products including baked goods like breads, biscuits, cakes, cookies, breakfast cereals, muffins, pies, pancakes, snacks and extruded food stuffs. The present study was undertaken to blend little millet flour with refined wheat flour in the preparation of cookies and to evaluate its physico-chemical properties, texture profiles and sensory qualities.

Materials and Methods

Little millet (*Panicum milliare Lam.*) grains were procured from Jamunamarathoor (Jawadhu Hills), Thiruvannamalai District of Tamil Nadu. The grains

were cleaned to remove dust and other foreign materials and grinded in a commercial roller flour mill. The flour was sieved using a BS 40-mesh sieve to obtain fine flour and was stored in stainless steel containers. The other ingredients were purchased from the local market.

Preparation of small millet cookies

Cookies were prepared using refined wheat flour (T₁ - control), little millet flour (T₂, T₃, and T₄). Cookies were prepared using refined wheat flour and little millet flour in the ratio of 75:25, 50:50 and 25:75 and the other ingredients were powdered sugar (30g), vanaspathy (50g), baking powder (0.5g) and corn flour (1g) as given in table 1. The dough was rolled into uniform sheet of desired size (thickness of 0.6cm and 4cm diameter) and was cut into circular shapes using cookies cutter and baked in an oven at 180°C for 20 min. After 24hrs, the cookies were packed in thermally sealed Poly Propylene bags (200gauge -P₁), Plastic containers (600gauge -P₂) and stored for one month at room temperature and relative humidity of 65-85%. Based on the scores of sensory evaluation, the T₃ combination was found to be highly acceptable than the other combinations. The cookies were analysed for their physico-chemical properties, texture profiles, sensory qualities and microbial populations at alternate days during the storage period.

Texture analysis of little millet based cookies dough

The texture of the dough was determined using the texture analyzer (TA-XT2i, Stable Micro Systems, Model: Texture Export Version 1.22, Surrey, UK). The texture analyzer measures force, distance and time, which provides three-dimensional product analysis (Bourne *et al.*, 1966).

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Physical properties of little millet based cookies

Diameter, thickness, spread ratio were calculated as per the method described by the AACC, 1969.

Sensory quality

Cookies were evaluated for their sensory attributes by a panel of trained members using 9 point hedonic scale (Watts *et al.*, 1989). The mean of sensory scores for attributes viz. colour and appearance, flavour, texture, taste and overall acceptability were recorded.

Colour

Colour of cookies was measured using Hunter Lab Colorimeter. Hunter lab calorimeter value L (0=black, 100=white), a (+value = red, -value = green) and b (+value = yellow, -value = blue) values were recorded (Wyszecki and Stiles, 1982).

Texture analysis

Texture analysis of the little millet cookies were done by Texture Analyzer (Make Stable Micro System, UK, Model TA-XT2). TA test was done for measuring the cutting force of cookies. [AACC, 1983 and Bourne, 1978].

Nutrient Analysis

The little millet cookies were analysed for moisture (Ranganna, 1995). Carbohydrates (Dubois *et al.*, 1956), Crude protein (Micro kjeldahal, $N \times 6.25$), crude fat (solvent extraction), ash (muffle furnace - dry ash), calcium (titration), iron (colorimetric) were determined by the AOAC (1980). Crude fibre (acid and alkali), tannin (colorimetric) were determined by the method of Sadasivam and Manickam (1996).

Table 2. Physical characteristics of dough and cookies

Treatment	Dough		Cookies		
	Hardness / Compression (Kg)	Stickiness (g)	Diameter (mm)	Thickness (mm)	Spread Ratio (mm)
Refined wheat flour (T ₁)	1.44 ± 0.00	29.05 ± 0.17	41.46 ± 0.20	7.57 ± 0.25	5.47 ± 0.15
Little millet flour (T ₃)	0.95 ± 0.03	25.47 ± 0.87	42.25 ± 0.22	7.39 ± 0.29	5.72 ± 0.19

Texture properties of dough and cookies

The effect of incorporation of little millet flour on texture properties of dough and the cookies such as hardness and stickiness was studied and data has been tabulated in table 2. It was observed that with the incorporation of little

Table 3. Mean value for hardness of cookies during storage

Treatment	Hardness (kg)							
	Day 1	Day 3	Day 5	Day 7	Day 9	Day 11	Day 13	Day 15
Refined wheat flour (T ₁)	1.447 ± 0.18	1.490 ± 0.06	1.235 ± 0.00	1.269 ± 0.06	1.391 ± 0.03	1.371 ± 0.11	1.437 ± 0.11	1.150 ± 0.00
Little millet flour (T ₃)	0.876 ± 0.03	0.862 ± 0.01	1.001 ± 0.01	0.800 ± 0.03	0.774 ± 0.03	0.959 ± 0.00	0.993 ± 0.02	1.040 ± 0.04

The hardness of the cookies decreased during the storage period (Table 3). Initially the hardness of cookies was 1.447 for T₁ and 0.876 for T₃ and the final values were 1.150 for T₁, and 1.040 for T₃.

Microbial Population

The microbial load of the little millet cookies were enumerated by the method described by Istavankiss (1984).

Statistical Analysis

Statistical determinations including the Mean ± SED should be indicated. Analysis of variance (ANOVA) to distinguish the responses of different levels of substitution were performed using Completely Randomized Design (CRD). The level at which significant differences are reported as $p \leq 0.05$.

Results and Discussion

Physical properties of dough and cookies

It was observed that the dough weight of T₃ was 173g, which was higher than the T₁ 160g due to the high fibre content of little millet flour. The height of the little millet cookies before baking and after baking was

Table 1. Formulation of cookies

Ingredients	Refined wheat flour	Little millet flour	Little millet flour	Little millet flour
	(T ₁)	(T ₂)	(T ₃)	(T ₄)
Refined wheat flour (g)	100	75.0	50.0	25.0
Little millet flour (g)	-	25.0	50.0	75.0
Powdered sugar (g)	30.0	30.0	30.0	30.0
Vanaspathy (g)	50.0	50.0	50.0	50.0
Baking powder (g)	0.5	0.5	0.5	0.5
Corn flour (g)	1.0	1.0	1.0	1.0

0.5cm and 0.6cm respectively. The final weight of the cookies was 158g for T₁ and 170g for T₃ and number of cookies was 20 in T₁ and 25 in T₃.

millet flour, increased the hardness of the cookies, whereas stickiness decreased. The diameter and thickness of the T₃ was 42.25mm and 7.39 mm and that of T₁ was 41.46mm and 7.57mm respectively. Spread ratio of little millet based cookies was higher than the control (5.72mm for T₃ and 5.47mm for T₁).

Sensory qualities

The mean scores of the sensory attributes for little millet cookies were high and found to be highly acceptable at 50% incorporation level. The colour

Table 4. Effect of storage on colour of the small millet based cookies

Colour of cookies	Days	Refined wheat flour (T ₁)				Little millet flour (T ₃)			
		1	5	10	15	1	5	10	15
L*	P ₁	68.16	68.00	69.96	71.73	64.54	64.89	65.58	65.45
	P ₂	68.16	68.06	70.02	71.92	64.54	64.92	65.66	65.53
a*	P ₁	2.08	2.29	2.85	1.50	2.74	2.80	2.56	2.28
	P ₂	2.08	2.23	2.94	1.7	2.74	2.83	2.60	2.34
b*	P ₁	22.67	23.61	22.03	18.01	21.57	21.11	20.92	18.80
	P ₂	22.67	23.64	22.14	18.16	21.57	21.32	21.14	19.45

P₁ - Poly Propylene 200 gauge,P₂ - Plastic container 600 gauge

and appearance of the cookies were found to be highly acceptable in P₁ and P₂ at end of the storage period. The mean score for flavour was 8.70 and 8.72 in P₁ and P₂ for T₁ and 8.25 and 8.28 in P₁ and P₂ for T₃ samples at the end of the storage period. The crispiness of the cookies decreased during the storage period. The taste of the cookies was found

to be highly acceptable at 50% incorporation level in 600 gauge plastic containers up to 15 days.

Colour value of the small millet based cookies

The colour value of little millet based cookies is tabulated in Table 4. Control cookies had lighter colour (68.16-71.92) (as indicated by their higher L* values)

Table 5. Nutrient changes in the millet based cookies during storage (per100g)

Nutrient	Refined Wheat Flour (T ₁)				Little Millet Flour (T ₃)				CD* (0.05)
	P ₁		P ₂		P ₁		P ₂		
	0 day	15 th day	0 day	15 th day	0 day	15 th day	0 day	15 th day	
Moisture (g)	12.58	12.72	12.58	12.65	8.24	8.36	8.24	8.31	0.048
CHO (g)	66.54	65.42	66.54	65.51	66.85	66.82	66.85	66.84	0.064
Protein (g)	8.65	8.44	8.65	8.50	7.25	7.22	7.25	7.24	0.072
Fat (g)	20.12	20.08	20.12	20.11	21.87	21.83	21.87	21.86	0.053
Crude fibre (g)	0.46	0.38	0.46	0.44	3.95	3.91	3.95	3.94	0.037
Ash (g)	1.00	0.79	1.00	0.86	0.90	0.87	0.90	0.89	0.051
Calcium (mg)	20.46	20.35	20.46	20.39	18.15	18.11	18.15	18.14	0.062
Iron (mg)	2.12	2.07	2.12	2.10	4.43	4.40	4.43	4.41	0.039
Tannin (mg)	7.50	7.45	7.50	7.48	25.47	25.39	25.47	25.44	0.045

*Significant at 5% level ($p \leq 0.05$),P₁- 200 gauge polyethylene pack,P₂- 600 gauge plastic container

compared to little millet based cookies (64.54-65.53). The lightness (L*) of the cookies gradually increased during storage.

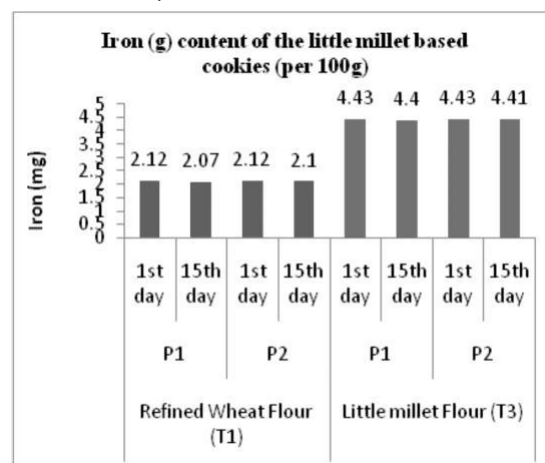
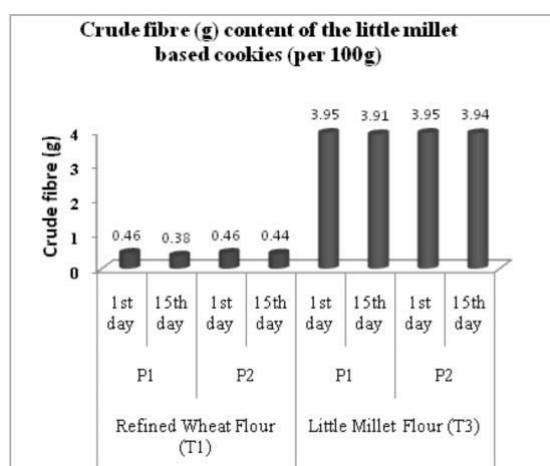
Nutrient analysis of the small millet based cookies

The nutrient content of the little millet based cookies is presented in Table 5. The moisture content of the little millet cookies ranged from 8.24g to 8.36g per 100g of the product. The fibre, iron and tannin content of the little millet cookies was 3.95g, 4.43mg and 25.47mg and found to be higher than the control

0.46g, 2.12mg and 7.50mg respectively. (fig.1 and 2). The statistical analysis revealed a highly significant difference for moisture and carbohydrate content at 5% level ($p \leq 0.05$) between treatment, packaging and storage.

Microbial Population

The microbial load of the cookies was found to increase during the storage period in different packaging materials. Initially the total microbial load of T₁ and T₃ samples was nil. At the end of the



storage period the total plate count of T₃ was 0.42 and 0.30 x10⁻⁴ cfu /g in P₁ and P₂. The total yeast and mold count of T₃ was 0.35 and 0.28 x10⁻⁴ cfu /g in P₁ and P₂. Among the packaging materials 600 gauge plastic container (P₂) samples showed less microbial population in both the treatments and was found to be within the safer limits.

Conclusion

The study revealed that little millet based cookies were highly acceptable at 50% incorporation level upto 15 days in different packaging materials based on the physical characteristics of the dough and the sensory and nutritional characteristics of the cookies. The fibre, iron and tannin content of the little millet based cookies were higher than the refined wheat cookies. The microbial load was found to be within in the safer limit at the end of the storage period.

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References

- AACC, 1969. Methods of analysis, 7th edn. American Association of Cereal Chemists, St Paul, Minnesota, USA.
- AACC, 1983. Methods of analysis, 8th edn. American Association of Cereal Chemists, St Paul, Minnesota, USA.
- AOAC, 1980. Official Method of Analysis, 11th edn. Association of Official Analytical Chemists, Washington, D.C.
- Baker, R.D. 2003. Millet Production. http://Lubbock.tamu.edu/other_crops/doc/nmsumilletprod.htm [Accessed 20 February, 2010].
- Bourne, M.C. 1978. Texture profile analysis. *Food Technol.* **32**: 62-80.
- Bourne, M.C., Moyer, J.C. and Hand, D.B. 1966. Measurement of food texture by a universal testing machine. *Food Technol.* **20**: 522-526.
- Dubois, M., Gilles, K.A., Hamilton, J.K., Rebers, P.A., and Smith, F. 1956. Colorimetric method for determination of sugars and related substances. *Anal. Chem.*, **28**: 350-356.
- Gopalan, C., Ramashastry, B.V. and Balasubramaniam, S.C. 2004. Nutritive Value of Indian Foods. ICMR, New Delhi.
- Istavankiss. 1984. *Testing Methods in Food Microbiology*. Elsevier Pub. Ltd. 395-397.
- Ranganna, S. 1995. Manual analysis of fruit and vegetable products. Tata McGraw & Hill Publishing, Co. Ltd., New Delhi: 891.
- Sadasivam, S. and Manickam, A. 1996. Bio-chemical methods. 2nd Edn, New Age International (P) Ltd. New Delhi: 63.
- Watts, B.M., Jlimaki, G.L., Jeffery, L.E. and Elias, L.G. 1989. Basic sensory methods for food evaluation. International Development Research Centre (IDRC), Ottawa, Canada.p1-16.
- Wyszecki, G. and Stile, W.S. 1982. Color Science. Concept and Methods, Quantitative Data and Formulae. 2nd ed. John Wiley and Sons, New York.