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Storage study (Shelf life) and Consumer acceptability of value added (enriched) barnyard millet cookies

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ABSTRACT

The demand for processed foods is ever increasing due to the technological, industrial and economic advances of the developing societies of the world including India. India is recognized to be the second largest producer of biscuits next only to the United States of America with annual production of which was 7.40 lakh metric tonnes in 1997-98 which has escalated to 17.14 lakh metric tonnes in 2005-2009 (Agrawal, 1990). Hence, the present study was undertaken with the objectives of Assessment of storage quality of enriched barnyard millet cookies and their Consumer acceptability. Adequate number of cookies were wrapped in butter paper and packed in unit packs in metalized polyester polyethylene pouches, heat sealed and stored in aluminum boxes at room temperature. Temperature and relative humidity (RH) ranged from 24.30 to 27.48°C and 58.55 to 83.00%, respectively. The study showed that 91.33 per cent of consumers accepted iron enriched cookies highly and were ready to pay money to eat it.

Key words : *Iron rich cookies, Shelf life, Consumer acceptability, Room temperature, Relative humidity.*

Introduction

Increasing awareness of consumers regarding health and nutrition has led to experimentations for modification and development of bakery products to value added health foods. This may become a boon for further development of bakery products using low cost, nutritious ingredients. Among these bakery products cookies/biscuits are popular and well accepted as snack food. 'Cookie' is chemically leavened product, also known as 'biscuit'. Generally the term biscuit is used in the European countries and cookies in the United States of America. Biscuits and biscuit like products have been made and eaten by man for centuries (Hosney, 1986).

Materials and Methods

Good shelf life of foods is an important criteria in consumer acceptability and marketability of new products. Shelf life depends on chemical composition, packaging material, environmental factor and handling. The study of shelf life of foods helps in understanding mechanism of extending storage quality for added value. Barnyard millet in bulk was procured from Agricultural Research Station, Hanumanamatti, University of Agricultural Sciences, Dharwad. The dehulled millet was milled to flour using electrical flour mill Torrento Classic model. All other materials were purchased from local market Dharwad. Control cookies were prepared following the standard recipe. Barnyard millet cook-

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ies were prepared by incorporating millet flour in the standard recipe at different levels. Standardization trials were conducted with nutraceutical ingredients individually (ingredients such as linseed, full fat soy flour, cocoa powder, chocolate buttons, dry fruits, nuts and garden cress seeds)or in combination to arrive at the most acceptable nutraceutically enriched cookies. Cookies were manually prepared using a cookie dispenser and baked in a commercial baking oven with top temperature of 180 ºC and bottom temperature 150 ºC for 20 minutes.

Storage quality evaluation: Adequate number of cookies were wrapped in butter paper and packed in unit packs in metalized polyester polyethylene pouches, heat sealed and stored in aluminum boxes at room temperature for further studies (Plate 2). Temperature and relative humidity (RH) ranged from 24.30 to 27.48ºC and 58.55 to 83.00%, respectively, during September to February. Cookies samples were drawn fortnightly for quality evaluation in terms of sensory quality, moisture uptake and peroxide release. The storage study was continued till the products were rated as unacceptable as evaluated by the taste panel. Sensory quality of cookies was evaluated as indicated in 3.4. Moisture uptake was calculated after moisture estimation.

Peroxide value (meq/kg fat): Peroxide value is an indicator of rancidity developed in foods which indicates the storage quality of foods. The release of peroxides was analyzed by methods of Sadashivam and Manickam (1992) and expressed in meq/kg of fat.

Statistical analysis: Suitable statistical methods were used for data obtained in the present study. Mean, standard deviations were used to interpret mean sensory scores of cookies. Student's 't' test was used to test the difference between the organoleptic scores of barnyard millet and value added millet cookies.

Results

Many factors influence the shelf life of food products. Processed foods should possess good shelf life to withstand market pressure and consumer demands. The constituents of processed foods such as moisture, fats, antimicrobial constituents, packaging materials and the atmosphere of storage are important factors which influence shelf life. In the present investigation cookies were prepared with butter replacing hydrogenated fats by cent per cent to reduce trans-fat contents.

The experiments to assess storage quality of barnyard millet cookies including the most accepted value added cookies revealed interesting results. The cookies exhibited varied shelf life as indicated by sensory quality evaluation by the taste panel (Table 1 and 2). Lowest shelf life of 45 days in terms of sensory attributes was recorded in barnyard millet cookies followed by the control cookies, which were acceptable up to 75 days of storage at ambient conditions. The iron enriched barnyard millet cook-

Table 1. Effect of storage on colour, appearance and texture of iron enriched barnyard millet cookies

Days of storage	Colour and appearance			Texture		
	Control	Barnyard millet	Iron enriched	Control	Barnyard millet	Iron enriched
0	8.10	6.75	7.25	7.50	6.75	7.45
15	7.75	6.44	7.00	7.42	6.54	7.00
30	7.66	6.23	6.86	7.37	5.96	6.71
45	7.12	6.25	6.67	6.75	5.25	6.44
60	7.10	-	6.25	6.90	-	6.38
75	7.16	-	6.38	6.33	-	6.25
90	-	-	6.25	-	-	6.00
105	-	-	6.25	-	-	5.13
120	-	-	6.00	-	-	5.00
R2	0.85	0.83	0.91	0.85	0.95	0.93
Regression coefficient	-0.013	-0.011	-0.009	-0.015	-0.032	-0.01
P value	0.86**	8.40^{NS}	0.0063**	0.785**	2.441*	0.00173**

*Significant at 5 % level
** Significant at 1% level NS – Not significant

Table 2. Effect of storage on taste, flavour and overall acceptability of iron enriched barnyard millet cookies

Days of storage	Taste			Flavour			Overall acceptability		
	Control	Barnyard millet	Iron enriched	Control	Barnyard millet	Iron enriched	Control	Barnyard millet	Iron I enriched
0	7.40	6.87	7.27	7.50	6.75	7.57	8.50	6.75	7.27
15	7.42	6.72	6.75	7.42	5.55	7.25	7.57	6.63	6.87
30	7.00	5.63	6.58	7.00	5.65	6.84	7.33	5.78	6.58
45	6.62	4.25	6.44	6.75	4.57	6.67	6.87	4.85	6.33
60	6.40	-	6.13	6.60	-	6.50	6.40	-	6.50
75	4.66	-	6.38	4.14	-	6.50	4.66	-	6.50
90	-	-	6.00	-	-	4.88	-	-	6.28
105	-	-	5.13	-	-	4.90	-	-	5.00
120	-	-	5.00	-	-	4.75	-	-	5.00
R2	0.79	0.90	0.88	0.70	0.86	0.89	0.90	0.92	0.79
Regression coefficient	-0.03	-0.059	-0.016	-0.037	-0.0429	-0.024	-0.044	-0.043	-0.016
P value	1.68*	4.64*	0.014**	3.64*	6.75 NS	0.01**	0.33**	4.05*	0.123**

*Significant at 5 % level
** Significant at 1%level NS – Not significant

Table 3. Effect of storage on moisture content and peroxide value of iron enriched barnyard millet cookies

Days of storage	Moisture (%)			Peroxide value (meq/kg fat)		
	Control	Barnyard millet	Iron enriched barnyard millet cookies	Control	Barnyard millet	Iron enriched barnyard millet cookies
0	5.20	5.78	2.64	2.04	3.01	1.33
15	6.15	7.16	1.69	2.40	4.04	1.52
30	6.65	8.95	2.47	3.90	4.24	2.05
45	7.70	7.75	1.66	4.21	5.17	2.37
60	8.25	-	2.03	6.68	-	2.58
75	9.37	-	2.09	6.98	-	2.71
90	-	-	2.60	-	-	2.85
105	-	-	2.72	-	-	2.91
120	-		3.21	-	-	3.02
R2	0.990	0.569	0.288	0.942	0.947	0.916
Regression coefficient	0.053	0.051	0.006	0.072	0.044	0.014
P value	0.00306**	24.54^{NS}	13.56^{NS}	0.1245**	2.671*	0.0049**

* Significant at 5 % level
** Significant at 1%level NS – Not significant

ies were acceptable even on 120th day of storage period. The enhanced shelf life of iron enriched garden cress seed incorporated barnyard millet cookies may be due to the phenolic antioxidant constituents or other components of garden cress seeds. Further, the low shelf life of barnyard millet cookies compared to the control cookies may be due to the inherent fat content, high iron and copper contents in barnyard millet which might have acted as pro oxidants triggering the peroxide release, thus making it unacceptable (Baublis *et al.*, 2000). On the other side, refined flour contained less fat (Gopalan *et al.*, 2004) due to the removal of germ during milling and this may explain their longer shelf life due to no fat for auto oxidation. Further, in the millet cookies whole millet meal containing all the constituents including the fat was used. The process of milling might have exposed the fat containing endosperm to auto oxidation leading to peroxide release and rancidity. Another reason that could be attributed to low shelf life

Table 4. Consumer acceptability test for iron enriched barnyard millet cookies (N=150)

Consumer groups	Gender	Age range (years)	Frequency	Highly acceptable, would pay money to eat it Frequency (%)	Acceptable, would eat if offered freely Frequency (%)	Unacceptable, would not eat even when offered freely Frequency (%)
Faculty of UAS Dharwad campus including senior academicians	Both including	30-55	30	30 (100)	-	--
Students of Home Science College	Female only	18-22	30	25 (83.33)		5 (16.66)
School children	Both included	10-15	15	12 (80)	1(6.66)	2 (13.33)
Supporting staff of UAS, Dharwad	Both included	30-55	25	25 (100)		--
Farmers	Male	22-50	30	25 (83.33)	3 (10.00)	2 (6.66)
Members of NGOs and businessmen	Both included	30-55	20	20 (100)		--
Total	150	137 (91.33)	4 (2.66)	9 (6.00)		

of barnyard millet and control cookies in comparison to iron enriched garden cress seed cookies might be due to the initial moisture content of the former cookies (Table 3).

Due to increased rate of peroxide formation in barnyard millet and control cookies, the flavour and taste became unacceptable at 45 and 75 days of storage, respectively (Table 3). Similar decreased sensory scores were also reported by cookies prepared with whey protein concentrate by Raju *et al*. (2007), defatted soy flour by Singh *et al.* (2000a), and rice bran oil (25 to 100%) as demonstrated by Shariff *et al.* (2003).

During storage, the sensory scores for colour and appearance decreased in all the cookies; it might be due to absorption of moisture from atmosphere and oxidation of fats. These results are in close agreements with the findings of Iftikar (2002) and Shariff *et al*. (2003). The stored barnyard millet and control cookies lost their texture and rated less score at 45 and 75 days, respectively, where as iron enriched cookies remained acceptable, with light and crisp texture even up to 120 days of storage.

The rate of moisture pick up was very low in iron enriched cookies which was also demonstrated by Selvaraj *et al.,* (2002). Because of this, iron enriched barnyard millet cookies could be stored upto 120 days. Similarly the rate of peroxide formation was found to be slow in iron enriched cookies. This might be due to slower moisture pick up coupled with antioxidant nutraceutical components present in garden cress seeds such as sitosterol, campesterol and avenasterol (Moser *et al.,* 2009). Similar rate of peroxide formation was noted in biscuits prepared using natural antioxidants such as raisin, amla and drum stick leaf extracts by Reddy *et al.* (2005).

Discussion

The storage affected colour, appearance, texture and taste of the refined flour control cookies and barnyard millet cookies. The cookies lost their hardness, but peroxide value increased from 2.04 to 6.98 meq/kg fat and 3.01 to 5.17 meq/kg fat in both refined flour and barnyard millet cookies during storage period of 75 and 45 days, respectively, due to increased moisture content. Iron enriched barnyard millet cookies showed excellent storage stability. Although the score for colour and flavour decreased, the moisture and peroxide value did not increase much as compared to control and barnyard millet cookies.

The consumer acceptability test carried among 150 consumers comprising of senior academicians, college students, school children, farmers, non teaching staff and members of non government organization, showed that 91.33 per cent of consumers accepted iron enriched cookies highly and were ready to pay money to eat it.

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