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Shelf life study of foxtail millet (*Setaria italica*) based laddu

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Abstract

Foxtail millet (*Setaria italica*) is known for its health benefits as it is nutritionally superior to conventional food grains. Laddu are ball-shaped sweets which are popular in India and are often served at festive or religious occasions. Hence, an attempt was made to develop foxtail millet based value added laddu and storage study was carried out. *Besan laddu* was taken as control. The foxtail millet laddu was evaluated for changes in moisture content, free fatty acid and organoleptic characteristics during storage period at ambient conditions in comparison with *besan laddu* packed in high density polyethylene (HDPE) covers. As the storage period advanced, the moisture and free fatty acid content increased in *besan laddu* and foxtail millet laddu. There was significant decrease in the scores for sensory parameters as the storage period advanced.

Keywords: Foxtail millet laddu, sensory evaluation, Storage study, moisture and free fatty acid

Introduction

Traditional foods are developed through ages invented, modified, utilized and evolved to overcome the monotony in the diet. The traditional food of India has been widely appreciated for its extensive use of locally grown crops. Indian traditional food is known for its large assortment like sweet, savoury and spicy traditional foods. Further, the significance of traditional foods is more appreciable when their nutritive value is known. By virtue of diversity, India is blessed with many traditional foods specifically prepared for festivals, rituals and physiological conditions (Ananthanarayan *et al.*, 2019). With improvement in food technology, convenience food and ready to eat foods are emerging in market.

India has rich treasure of traditional foods specifically prepared for festivals, rituals and physiological conditions (Inamdar *et al.*, 2005). The traditional food of India has been widely appreciated for its fabulous use of locally grown crops. Value addition of some traditional food products with millets showed to be a highly strategic intervention in the popularization of nutritionally rich local crops *i.e.* millets. Which are currently largely neglected and underutilized (Yenagi *et al.*, 2010). Foxtail millet is a good source of protein (12.3 g/100 g) and dietary fibre (14 g/100 g). The carbohydrate content is low (60.9 g/100 g). Besides, it is rich in minerals (3 g/100 g) and phytochemicals (Gopalan *et al.*, 2010).

Laddu is an Indian sweet made from a mixture of flour, sugar and shortening and other ingredients that vary by recipe, which is shaped into a ball. Further, the significance of traditional foods is more appreciable when their nutritive value and the storage stability are known. Shelf life can be defined as the finite length of time after which the product stored under specific packaged and environmental condition becomes unacceptable. Hence the study was taken to know the storage stability of Foxtail millet based laddu.

Material and Methods

The present study was carried out in the Department of Food Science and Nutrition, College of Community Science, University of Agricultural Sciences, Dharwad Karnataka during the year 2018-19. The raw materials like foxtail millet, Bengal gram dhal flour, ghee and sugar powder of Dharwad, Karnataka. The millet grains were washed, rinsed, shade dried and milled from the local commercial milling machine. For preparation of laddu (Fig. 1 and 2), heat the ghee in frying pan. Add respective flours to it. Roast it till colour turns to golden brown and develops aroma (it takes 45 minutes). Allow it to rest to warm temperature. Add powdered sugar to the roasted flour mix.

Mix well and make small balls by hands (Sudha *et al.*, 2021a, Sudha *et al.*, 2022b and Sudha *et al.*, 2021c). Standardization trials indicated that acceptable foxtail millet *Laddu* could be developed by incorporating 50 per cent foxtail millet flour, 50 per cent Bengal gram dhal flour, 45 per cent ghee and 75 per

cent sugar powder in the standard *laddu* recipe. *Besan laddu* (100 per cent bengal gram dhal flour, 50 per cent ghee and 85 per cent sugar powder was taken as control (Sudha *et al.*, 2021d, and Sudha *et al.*, 2021e).

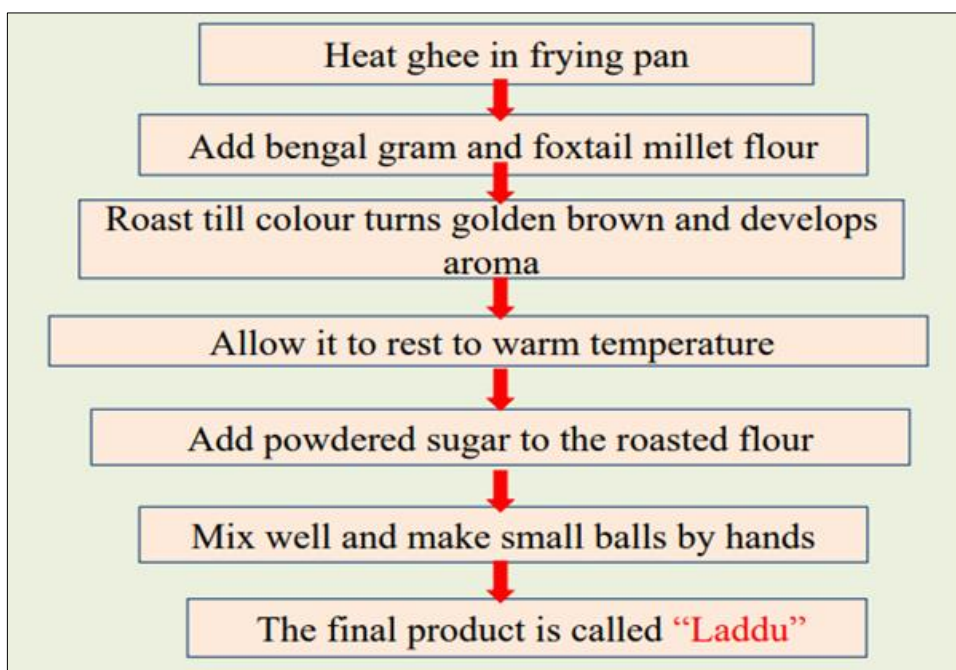


Fig 1: Flow diagram for preparation of optimized *laddu*

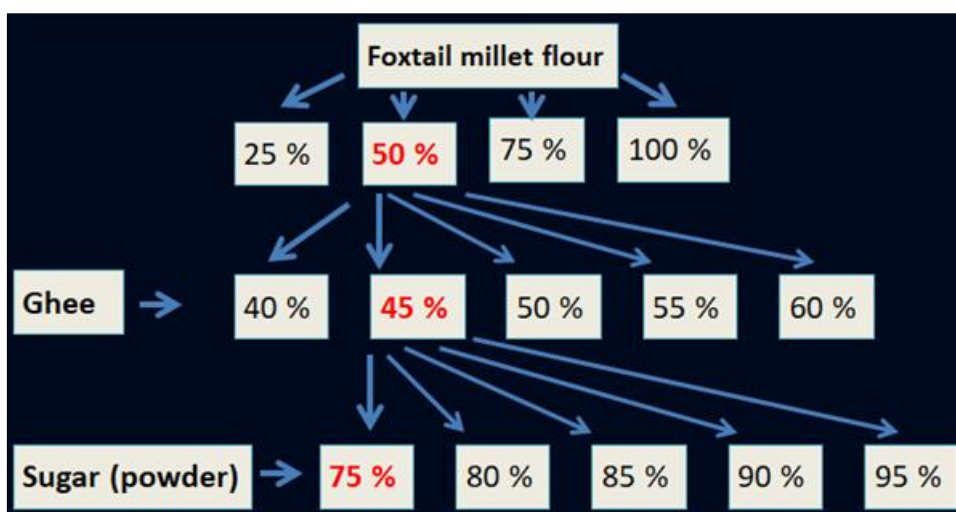


Fig 2: Standardization of following ingredients: Foxtail millet flour, ghee and sugar powder (for the development of foxtail millet based *laddu*).

Storage stability of foxtail millet *laddu*

The control (*Besan laddu*) and the developed foxtail millet *laddu* were prepared on large scale and stored in HDPE packets by sealing, at room temperature. *Laddu* samples were drawn every fifteen days and evaluated for changes in moisture content, free fatty acid content and sensory qualities.

Moisture content: A known quantity of sample was weighed into previously weighed moisture cups and dried in a hot air oven at 98 to 100 °C to a constant weight (AOAC 2005). Moisture content was calculated using the formula.

$$\text{Moisture content (\%)} = \frac{\text{Initial weight} - \text{Final weight}}{\text{Weight of the sample}} \times 100$$

Free fatty acid content

The amount of free fatty acid present gives the indication of age and quality of fat in foods. Standard (Sadasivam and Manickam, 2008) procedure was used to estimate the free fatty acid content of *laddu* samples during storage. Reagents used were 1% phenolphthalein in 95% ethanol, 0.1 N potassium hydroxide and Neutral solvent: Mix 25 ml ether, 25 ml 95% alcohol and 1 ml of 1% phenolphthalein solution and neutralise with N/10 alkali. Dissolve 1-10 g of oil or melted fat in 50ml of the neutral solvent in a 250 ml conical flask. Add a few drops of phenolphthalein. Titrate the contents against 0.1 N potassium hydroxide. Shake constantly until a pink colour which persists for fifteen seconds is obtained.

$$\text{Acid value (mg KOH/g)} = \frac{\text{Titre value} \times \text{Normality of KOH} \times 56.1}{\text{Weight of the sample (g)}}$$

Sensory evaluation of laddu during storage: Sensory qualities of the value added foxtail millet based *laddu* was conducted in comparison with *besan laddu*, control and developed foxtail millet *laddu*. A nine point hedonic scale was used, which describes sensory attributes viz., appearance, colour, texture, taste and flavour on nine point scale. Sensory evaluation was done by a panel of 15 semi trained judges at every 15 days interval.

Results and Discussion

The results of foxtail millet *laddu* evaluated for changes in moisture content, free fatty acid and organoleptic characteristics during storage period at ambient conditions in comparison with *besan laddu* packed in high density polyethylene (HDPE) covers. The changes in moisture content (%) during storage of *besan laddu* and foxtail millet *laddu* depicted in Table 1. The moisture content increased in foxtail millet *laddu* and *besan laddu* as the storage period advanced. The initial moisture content in foxtail millet *laddu* was 0.27% however it increased significantly after 30, 45, 60, 75 and 90 days of storage and it was 0.67, 0.75, 0.85, 1.12 and 1.44% respectively.

The changes in free fatty acid (mgKOH/g) during storage of *besan laddu* and foxtail millet *laddu* at ambient conditions were shown in the Table 2. With the increase in the storage period there was increase in FFA in both the *laddus*. The initial free fatty acid content in foxtail millet *laddu* was 2.88 mgKOH/g however it increased significantly after 30, 45, 60, 75 and 90 days when compared to initial free fatty acid Content 5.31, 5.40, 7.49, 11.14 and 11.67 respectively. The initial free fatty acid content in *besan laddu* was 1.91 mg/KOH/g and significant increase in free fatty acid was observed after 30, 45, 60, 75 and 90 days i.e. 4.80, 5.03, 5.61, 9.96 and 10.40 respectively. Free fatty acid content of *besan laddu* was lower in all storage days when compared to foxtail millet *laddu* however it was not significant.

During storage period at ambient condition, the moisture content raised in both control and foxtail millet *laddu*. The moisture and free fatty acid content was increased significantly during storage periods. The moisture content of *besan laddu* increased from 0.44 to 1.18 per cent and for foxtail millet *laddu* from 0.27 to 1.44 per cent. This increase may be due to environmental conditions. The FFA content of *besan laddu* increased from 1.91 to 10.40 mgKOH/g and for foxtail millet *laddu* from 2.88 to 11.67 mgKOH/g. After 90 days of storage, the increase in the FFA content might be due to the formation of secondary oxidative products resulting from the breakdown of hydroperoxide with increase in the moisture (Lean and Mohamed, 1999 and Alyas *et al.*, 2006). Coulibaly and Chen (2012) reported that breakfast food developed based on processed foxtail millet and soybean were stored upto 90 days without preservatives and fat acidity reported 3 mg of KOH/100 g. Ranganna *et al.* (2014) also reported that cold extruded products like vermicelli and pasta prepared from barnyard, foxtail, kodo, little and proso millets

to be stored upto 2 months affecting the quality in 300, 400 polyethylene package.

Effect of storage on appearance, colour, texture, taste, flavour and overall acceptability of *laddus* are shown in Table 3. On the first day the scores of appearance were 8.7 and 8.6 for *besan laddu* and foxtail millet *laddu*. However, it decreased after 90 days of storage, the scores decreased to 7.2 and 6.8 for *besan laddu* and foxtail millet *laddu* respectively. On the initial day, the colour of *besan laddu* and foxtail millet *laddu* scored 8.6 and 8.5 respectively. However, it decreased after 90 days of storage, the scores decreased to 7.3 and 6.5 for *besan laddu* and foxtail millet *laddu* respectively. However, there was significantly decrease in appearance and colour of *besan laddu* and foxtail millet *laddu* scores after 90 days.

On the initial day, the texture for *besan laddu* and foxtail millet *laddu* scored 8.7 and 8.5 respectively. After 90 days of storage, the texture of *besan laddu* and foxtail millet *laddu* decreased to 5.6 and 5.8. *Besan laddu* and foxtail millet *laddu* scored 8.6. However, it decreased to 5 and 5.7 respectively. On the initial day, the flavour for *besan laddu* and foxtail millet *laddu* scored 8.5 and 8.4 respectively. After 90 days of storage, the texture of *besan laddu* and foxtail millet *laddu* decreased to 5 and 5.4 respectively. However, there was significantly decrease in texture, taste and flavour and of *besan laddu* and foxtail millet *laddu* scores after 90 days.

Table 3 presents the mean organoleptic scores for changes in overall acceptability of *besan laddu* and developed foxtail millet *laddu* during storage period. On the first day the scores were 8.7 and 8.5 for *besan laddu* and foxtail millet *laddu* and the scores decreased significantly after 90 days of storage, the scores decreased to 5.8 and 5.1 for *besan laddu* and foxtail millet *laddu*.

In present study, on 60 days of storage, there was no difference in sensory parameters and overall acceptability in foxtail millet *laddu* and *besan laddu*. There was decrease in the scores might be due to absorption of moisture from atmosphere and oxidation of fats. The *laddus* were acceptable till the 75 days of storage. However, the scores decreased significantly after 75 and 90 days of storage when compared to initial scores.

Table 1: Effect of storage on moisture content of *Besan laddu* and foxtail millet *laddu*

Storage days	Moisture (%)		
	<i>Besan laddu</i>	Foxtail millet <i>laddu</i>	
1	0.44 ± 0.05a	0.27 ± 0.02a	
15	0.57 ± 0.03a	0.49 ± 0.03ab	
30	0.65 ± 0.04a	0.67 ± 0.02b	
45	0.71 ± 0.02a	0.75 ± 0.04b	
60	0.81 ± 0.79b	0.85 ± 0.04c	
75	0.92 ± 0.04b	1.12 ± 0.05c	
90	1.18 ± 0.03b	1.44 ± 0.05d	
	SEM	CD	F value
Days (D)	0.21	0.35	398.44**
Sample (S)	0.17	0.44	17.83**
S*D	0.08	0.16	22.88**

** Significant at 1% level

Each value is mean of three replications

Values with same superscript are not significantly different

Table 2: Effect of storage on free fatty acid content of *Besan laddu* and foxtail millet *laddu*

Storage days	Free fatty acid (mgKOH/g)	
	<i>Besan laddu</i>	Foxtail millet <i>laddu</i>
1	1.91 ± 0.03a	2.88 ± 0.40a
15	2.21 ± 0.05a	3.16 ± 0.14ab
30	4.80 ± 0.13b	5.40 ± 1.22bc
45	5.03 ± 0.46b	5.31 ± 0.34bc
60	5.61 ± 0.02b	7.49 ± 0.11d
75	9.96 ± 0.43c	11.14 ± 1.23e
90	10.40 ± 0.32c	11.67 ± 1.63e
	SEM	CD
Days (D)	1.17	2.40
Sample (S)	1.46	3.00
D*S	0.55	1.13
		F value
		152.84**
		23.41**
		0.82**

** Significant at 1% level

Each value is mean of three replications

Values with same superscript are not significantly different

Table 3: Effect of storage on sensory parameters of foxtail millet *laddu* and *besan laddu*

Storage days	Appearance		Colour		Texture		Taste		Flavour		Overall acceptability				
	BL	FL	BL	FL	BL	FL	BL	FL	BL	FL	BL	FL			
1	8.7a ± 0.48	8.6a ± 0.51	8.6a ± 0.51	8.5a ± 0.52	8.7a ± 0.48	8.5a ± 0.52	8.6a ± 0.51	8.6a ± 0.69	8.5a ± 0.52	8.4a ± 0.51	8.7a ± 0.48	8.5a ± 0.52			
15	8.6a ± 0.51	8.4a ± 0.51	8.5a ± 0.52	8.2a ± 1.03	8.5a ± 0.52	8.2a ± 0.91	8.5a ± 0.52	8.2a ± 0.91	8.5a ± 0.52	8.4a ± 0.84	8.6a ± 0.51	8.3a ± 0.67			
30	8.5a ± 0.52	8.1a ± 0.56	8.5a ± 0.52	8.4a ± 0.51	8.5a ± 0.52	8.1a ± 0.99	8.4a ± 0.69	8.0a ± 0.81	8.4a ± 0.69	8.3a ± 0.67	8.6a ± 0.51	8.3a ± 0.42			
45	8.0a ± 0.66	8.1a ± 0.31	8.2a ± 0.78	8.2a ± 0.63	8.2a ± 0.63	8.1a ± 0.87	8.3a ± 0.82	8.0a ± 0.47	8.3a ± 0.82	8.1a ± 0.73	8.4a ± 0.69	8.2a ± 0.78			
60	7.9a ± 0.73	8.1a ± 0.73	8.0a ± 0.81	8.0a ± 0.47	7.8a ± 1.13	7.9a ± 0.99	7.9a ± 0.73	8.0a ± 0.81	7.7a ± 0.94	7.8a ± 0.91	7.9a ± 0.87	8.0a ± 0.66			
75	7.8a ± 0.42	7.3a ± 0.48	7.9a ± 0.31	7.5a ± 0.70	7.6b ± 0.84	7.5b ± 0.70	7.6a ± 0.69	7.5b ± 0.84	7.5a ± 0.84	7.7a ± 0.94	7.4b ± 0.69	7.4a ± 0.69			
90	7.2b ± 0.63	6.8b ± 0.91	7.3b ± 0.67	6.5a ± 0.84	5.6c ± 0.84	5.8c ± 0.91	5.0b ± 1.15	5.7c ± 1.05	5.0b ± 1.15	5.4b ± 1.07	5.8c ± 0.63	5.1b ± 0.52			
	F value	SEM	CD	F value	SEM	CD	F value	SEM	CD	F value	SEM	CD	F value	SEM	CD
Days D	18.65**	0.70	1.38	18.67**	0.72	1.44	28.94**	0.96	1.90	38.57**	0.93	1.84	39.35**	0.97	1.93
Sample S	3.43 NS	1.87	3.70	4.22*	1.94	3.85	0.68 NS	2.56	5.08	0.10 NS	2.48	4.92	0.04 NS	2.60	5.16
D*S	1.01NS	0.26	0.52	1.11 NS	0.27	0.54	0.33 NS	0.36	0.71	1.10 NS	0.35	0.69	0.33 NS	0.36	0.72

Conclusion

Standardization trials indicated that acceptable foxtail millet *laddu* could be developed by incorporating 50 per cent foxtail millet flour, 50 per cent bengal gram dhal flour, 45 per cent ghee, 75 per cent sugar powder and 40 minutes roasting time in the standard *laddu* recipe. The developed *laddu* had good binding property and was highly acceptable by sensory evaluation and could be stored well upto 75 days. At present there is demand for ready to eat foods and therefore it has opened challengeable avenue to start production of such foods at commercial scale to benefit innumerable population and it can provide ample opportunity of employment for the enthusiastic entrepreneurs.

References

- 1 Alyas SA, Abdulah A, Idris NA, Top ABM. Evaluation of storage stability of yellow cake made with red palm fat. *J Oil Palm Res.* 2006;5(1):81-86.
- 2 Ananthanarayan L, Dubey KK, Muley AB, Singhal RS. Indian Traditional Foods: Preparation, Processing and Nutrition. *Traditional Foods.* 2019;4(1):127-199.
- 3 Anonymous. Official methods of analysis, Association of Official Analytical Chemists 18th ed., Washington, DC, USA. AVI Publishing Co. Inc. Westport, CN. 2005.
- 4 Coulibaly A, Kouakou B, Chen J. Extruded adult breakfast based on millet and soybean: nutritional and functional qualities, source of low glycemic food. *J Nutr. Food Sci.* 2012;2(1):151-155.
- 5 Gopalan C, Ramasastri BV, Balasubramaniam SC. Nutritive value of Indian foods, National Institute of Nutrition, ICMR, Hyderabad. 2010.
- 6 Inamdar V, Chimmad BV, Naik R. Nutrient composition of traditional festival foods of north Karnataka. *Journal of Human Ecology.* 2005;18(1):43-48.
- 7 Lean LP, Mohamed S. Antioxidative and antimycotic effects of turmeric, lemon-grass, betel leaves, clove, black pepper leaves and *Garcinia atriviridis* on butter cake. *J Sci. Food Agric.* 1999;79(1):1817-1822.
- 8 Ranganna B, Ramya KG, Kalpana B, Veena R. Development of cold extruded products (Vermicelli and Pasta). *Int. J Agric. Engg.* 2014;7(2):360-364.
- 9 Sadhasivam S, Manikam A. Biochemical Methods for Agricultural Sciences. Wiley Eastern Limited, New Delhi, 2008, 27-28p.
- 10 Sudha KV (a), Karakannavar SJ, Yenagi NB, Inamdar B. Effect of roasting on the physicochemical and nutritional properties of foxtail millet (*Setaria italica*) and Bengal gram dhal flours. *The Pharma Innovation Journal.* 2021;10(5):1543-1547.
- 11 Sudha KV (b), Karakannavar SJ, Inamdar B, Yenagi NB.

- Development of Foxtail Millet (*Setaria italica*) based Laddu. Asian Journal of Dairy and Food Research. 2022. DOI: 10.18805/ajdfr.DR-1744.
- 12 Sudha KV (c), Karakannavar SJ, Inamdar B, Yenagi NB. Development and Nutritional Evaluation of Foxtail Millet (*Setaria italica*) based Laddu. Asian Journal of Dairy and Food Research. 2021. DOI: 10.18805/ajdfr.DR-1773.
- 13 Sudha KV (d), Karakannavar SJ, Inamdar B, Yenagi NB. Optimization, value addition and sensory evaluation of foxtail millet (*Setaria italica*) based laddu The Pharma Innovation Journal. 2021;10(12):1038-1042.
- 14 Sudha KV (e), Karakannavar SJ, Inamdar B, Yenagi NB. Market potentiality, economic analysis and consumer acceptability of foxtail millet (*Setaria italica*) based laddu The Pharma Innovation Journal. 2021;10(12):1043-1047.
- 15 Yenagi NB, Handigol JA, Ravi SB, Mal B, Padulosi S. Nutritional and technological advancements in the promotion of ethnic and novel foods using the genetic diversity of minor millets in India, 2010.