

Standardisation and Quality Evaluation of Finger Millet Based Nutri Flakes

Riya K. Zacharia^{1*}, E. R. Aneena², Seeja Thomachan Panjikkaran², C. L. Sharon² and P. S. Lakshmi²

¹*Department of Community Science, College of Horticulture, Kerala Agriculture University, Vellanikkara, Thrissur, Kerala, India.*

²*Department of Community Science, College of Horticulture, Kerala Agriculture University, Vellanikkara, Thrissur, Kerala, India.*

Authors' contributions

This work was carried out in collaboration among all authors. Author RKZ designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors ERA and STP managed the analyses of the study authors CLS and PSL managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JALSI/2020/v23i1030191

Editor(s):

- (1) Dr. Martin Koller, University of Graz, Austria.
(2) Dr. Vasil Simeonov, University of Sofia, Bulgaria.

Reviewers:

- (1) Owo Gogo James, Federal University, Nigeria.
(2) Botau Dorica, University of Agricultural Sciences and Veterinary Medicine, Romania.
Complete Peer review History: <http://www.sdiarticle4.com/review-history/62318>

Original Research Article

Received 16 August 2020
Accepted 21 October 2020
Published 02 November 2020

ABSTRACT

Aims: To standardise ready to eat millet based nutri flakes and to evaluate nutritional and shelf life qualities.

Study Design: Completely randomized design

Methodology: In the present study 5 treatments along with one control with 3 replications were standardized. Finger millet flour was used as the major ingredient and used in varying proportions starting from 50 to 80% along with 10 – 50 % of tapioca flour and 10 per cent other ingredients The best treatment were selected through sensory evaluation The selected treatment were evaluated for nutritional and shelf life qualities. The observations were tabulated and analysed statistically as completely randomized design (CRD).

Results: Among various treatments, highest scores of organoleptic qualities was observed for finger millet based nutri flakes added with tapioca flour (T₃-60% FM + 30% TF +10% other ingredients) and it was selected as the best treatment with mean score of 7.92 for overall

*Corresponding author: E-mail: riyakzacharia12@gmail.com;

acceptability. The prepared product was nutritionally superior and highly acceptable throughout the storage.

Conclusion: Nutri flakes based on 60% finger millet flour (FM) along with 30% TF was found to be the best combination for the preparation of nutri flakes and secured the highest mean score of 7.92 for overall acceptability. These nutri flakes were nutritionally superior and were shelf stable for 3 months.

Keywords: Convenient foods; nutri flakes; finger millet flour; tapioca flour; organoleptic; nutritional quality; shelf life.

1. INTRODUCTION

Convenient foods are commercially prepared processed foods, which are designed for the ease of preparation and consumption. Utilisation of millets is restricted due to non-availability of processed foods in ready to eat form. Millets can be effectively utilised for developing value added products which can improve the overall diet quality. The changes in life style and dietary pattern, increasing awareness about healthy food habits has made healthy convenient foods a perfect choice. As a major source of energy, cereals have important role in our daily diets. Millets are small seeded cereals known as nutri cereals which represent rich sources of phytochemicals and micronutrients.

Millet grain is now receiving increasing interest from food scientists and nutritionists because of their important contribution to food security and potential health benefits. Supplementation of millet grains with natural food products to enhance their nutritive value is promising and cost-effective strategy to combat micro nutrient deficiencies. Millets contain carbohydrates (60-70%), proteins (7-11%), fat (1.5-5%), and crude fibre (2-7%) and are also rich in vitamins and minerals. They are excellent source of B vitamins, magnesium and antioxidants [1]. The present study entitled 'Standardisation and quality evaluation of finger millet based nutri flakes' was carried out to develop nutri flakes using finger millet and to evaluate the organoleptic, nutritional and shelf life qualities.

2. MATERIALS AND METHODS

2.1 Collection of Ingredients

Finger millet (*Eleusine coracana*) was selected as the major ingredient for developing nutri flakes and were collected from local market. The finger millet were soaked for 10 hr and tied in moist cloth. After germination in 24hrs the millets were

dried, powdered and sieved to get a uniform flour. Tapioca flour were also used in combination with finger millet flour for developing nutri flakes. Tapioca and defatted soya flour, cocoa powder and rice bran were used as the other ingredients which were collected from local market.

2.2 Standardisation of Finger Millet Based Nutri Flakes

Nutri flakes based on finger millet was standardised with finger millet flour, tapioca flour, and other ingredients under following treatments. In standardisation, control set as 100 g of finger millet flour and composite flour were prepared with 80 g of finger millet flour 10 g of tapioca flour and 10 g of other ingredients and it were made into dough with required amount of water. The treatments varies with 80 to 40 g of finger millet flour, 10 to 30 g of tapioca flour and the details are given below.

The other ingredients were kept in a fixed proportion (10%) which comprises 5% defatted soya flour, 2% rice bran and 3% cocoa powder.

All the ingredients were measured and mixed well with hot water, A dough was prepared with desirable consistency, then rolled and pressed to get sheets. Then it is steamed in steam cooker and cut into small pieces, Further the cut pieces were dried in a cabinet dryer (70°C for 20 min) and puffed through puffing machine. The method of preparation of nutri flake represented in flow chart

2.3 Organoleptic Evaluation

A series of acceptability trials were carried out using simple triangle test at the laboratory level and selected a panel of fifteen judges between the age group of 18- 35 years as suggested by [2]. The organoleptic evaluation of the nutri flakes were carried out. The reconstituted nutri spreads

were evaluated organoleptically by the judges using a 9 point hedonic scale.

2.4 Nutrient Analysis of the Nutri Flakes

The nutritive qualities like, carbohydrate, protein, fat [3], energy [4], calcium, iron [5], sodium and potassium [6] of selected finger millet based nutri flakes were determined initially. Analyses were carried out in triplicate.

2.5 Shelf Life Studies

The selected treatments of nutri flakes were packed in laminated aluminium

pouches (250 gauge) and were kept in ambient conditions. The finger millet based nutri flakes with tapioca flour were stored for 3 months. Sensory qualities and enumeration of total microflora [7] were studied initially and at the end of the storage.

2.6 Statistical Analysis

The scores obtained for organoleptic evaluation were evaluated by Kendall's Coefficient of Concordance (W).

Table 1. Combinations of finger millet Based Nutri flakes

Treatments	Combinations
T ₀ (control)	100% Finger millet flour
T ₁	80% FM + 10% TF + 10%OI
T ₂	70% FM + 20% TF+ 10% OI
T ₃	60% FM + 30% TF + 10% OI
T ₄	50% FM + 40% TF + 10 %OI
T ₅	40% FM + 30% TF + 10 %OI

FM – Finger millet flour, TF- Tapioca flour, OI – Other ingredients

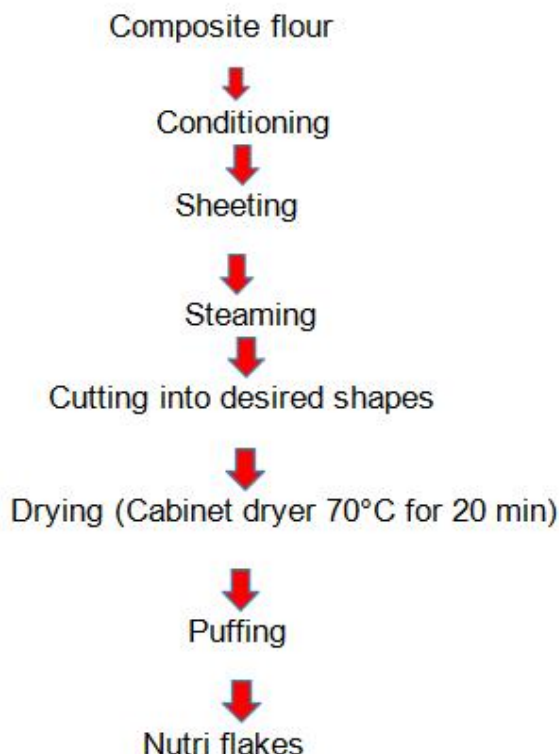


Fig. 1. Preparation of finger millet based nutri flakes

3. RESULTS AND DISCUSSION

3.1 Organoleptic Evaluation

The nutri flakes based on finger millet flour were standardised with different proportions of tapioca flour. The mean scores and the mean rank scores for different organoleptic qualities of finger millet based nutri flakes are presented in Table 2.

The mean scores and mean rank scores for appearance of finger millet based nutri flakes with tapioca flour varied from 7.46 (T₅) to 7.88 (T₃) and 3.07 to 4.40 respectively. The mean scores for colour varied from 7 (T₁) to 8.02 (T₅). The highest mean rank score for colour obtained were 4.9 for treatment T₃. Malted finger millet flour provided chocolate brown colour which is an acceptable appearance and colour to the nutri flakes. The developed finger millet based composite flour. were dark in colour and was highly acceptable by the consumers [8]. Increased in the level of finger millet flour in *roti* decreased the scores for colour and appearance slightly [9].

The mean scores for flavour varied from 7.22 (T₅) to 7.85 (T₃). The mean rank scores for flavour was the highest in T₃ (4.30). The texture of finger millet based nutri flakes obtained a mean scores from 7.21 (T₅) to 8.08 (T₃) with mean rank scores in the range of 1.48 to 4.70. The mean scores for texture was the highest in T₃ (8.08). Developed extrudates with 95 per cent of tapioca flour and 5 per cent of pigeon pea flour which provided hard to crisp texture and good

flavour to the product and showed good physico chemical and sensory qualities [10].

The mean scores for taste varied from 6.77 (T₅) to 7.84 (T₃). The highest mean rank score for taste obtained was 4.72 for treatment T₃. The mean scores for overall acceptability varied from 7.22 (T₅) to 7.92 (T₃) with mean rank scores in the range of 1.90 to 4.48. Germination of finger millet improves carbohydrate digestibility and sweetness which showed high mean score of taste in finger millet based nutri flakes and overall acceptability. Among various treatments, the highest mean scores of 7.88 (appearance), 8.02 (colour), 7.85 (flavour), 7.84 (taste), 8.08 (texture), and 7.92 (overall acceptability) were obtained for T₃ (60% finger millet flour and 30% tapioca flour). Considering highest scores of organoleptic qualities finger millet based nutri flakes added with tapioca flour (T₃-60% FM + 30% TF +10% other ingredients) was selected as the best treatment for further studies.

3.2 Nutrient Analysis of Nutri Flakes

Based on sensory evaluation, in nutri flakes based on finger millet flour, the treatments T₃ (60% FM+ 30% TF + 10% OI) was found to be the best and subjected to nutritional analysis. The nutritive value of selected finger millet flour based nutri flakes prepared with tapioca flour observed to have carbohydrate (44.32 g /100 g), protein (7.73 g /100 g), fat(1.26 g /100 g), energy (219 g /100g), calcium (199 mg /100 g), iron (5.58 mg /100 g), sodium (13 mg /100 g) and potassium (395 mg /100 g).

Table 2. Mean scores for organoleptic qualities of finger millet based nutri flakes

Treatments	Sensory attributes					
	Appearance	Colour	Flavour	Texture	Taste	Overall acceptability
T ₀	7.53 (3.17)	7.00 (2.20)	7.73 (4.50)	7.64 (3.03)	7.57 (4.43)	7.64 (2.90)
T ₁	7.68 (3.77)	7.62 (3.07)	7.57 (3.00)	7.91 (3.70)	7.46 (3.38)	7.64 (2.90)
T ₂	7.75 (4.00)	7.75 (3.63)	7.68 (3.44)	8.02 (4.40)	7.56 (3.72)	7.74 (4.25)
T ₃	7.88 (4.40)	8.02 (4.90)	7.85 (4.30)	8.08 (4.70)	7.84 (4.72)	7.92 (4.48)
T ₄	7.64 (3.33)	7.68 (3.70)	7.53 (3.63)	7.26 (1.53)	7.17 (2.72)	7.54 (3.50)
T ₅	7.46 (3.03)	7.34 (2.57)	7.22 (2.19)	7.21 (1.48)	6.77 (1.75)	7.22 (1.90)
Kendall's W value	0.81*	0.251**	0.238**	0.413**	0.404**	0.278**

Developed ready to use millet flakes which contain 70.06 per cent of total carbohydrate [11]. Malted ragi flour contain 7.60 g / 100 g of protein [12]. The study reported a reduction in protein content in millet flakes during processing. The high heat induced in millard reaction in presence of reducing sugars, which make lysine unavailable, and reduce the protein quality [13]. Developed millet flakes contain 0.85 g / 100 g of fat content, energy value around 254 kcal/100 g, calcium content in ragi flakes ranged from 19.29 mg/100 g to 222 mg/100 g and iron content around 0.19 to 16.92 mg/100 g [14]. Popping the millets, decreased calcium content to 10 mg/100 g of total calcium content [15]. Calcium and iron content of ragi ranged from 58 mg /100 g to 364 mg/100 g [16]. Mean sodium content of small millets ranged from 0.58 to 0.69 g/ 100 g and mean potassium content of small millets ranged from 4.5 to 9.82 g /100 g [17].

3.3 Organoleptic Qualities of Finger Millet Based Nutri Flakes during Storage

Nutri flakes incorporated with tapioca flour were kept for three months of storage and it were packed in laminated aluminium pouches The organoleptic qualities of the selected nutri flakes during storage are given in Table 4. The mean scores for the appearance of finger millet based nutri flakes incorporated with tapioca flour was observed as 7.88 initially, which gradually decreased into 7.66 at the end of storage. Initially, the mean score for colour was observed as 8.02 which decreased to 7.83 at the end of the storage. The mean scores for flavor and texture of finger millet based nutri flakes incorporated with tapioca flour were initially observed as 7.73 and 8.08 respectively which

decreased to 7.5 and 7.66. The mean score for taste was observed as 7.84 initially, which decreased to 7.16. The mean scores for overall acceptability was observed as 7.92 and at the end of the storage, which decreased to 7.78. Slight decrease was observed in all organoleptic parameters at the end of the storage.

Sensory qualities of kodo millet based pasta (60 per cent kodo millet and 40 per cent wheat flour) stored for a period of 3 months. Mean score for overall acceptability was 7.62 initially which decreased to 7.40 at the end of the storage [18]. Developed pasta by incorporating 5 to 10 per cent of cereal pulse blend and evaluated the organoleptic qualities initially and after 180 days. The prepared product was highly acceptable throughout the storage [19].

3.4. Enumeration of Microflora

As revealed in Table 5, initially the bacterial count was noticed as 0.28×10^5 cfu/g in finger millet based nutri flakes incorporated with tapioca flour which increased gradually to 0.85×10^5 cfu/g. Initially, fungal count were not detected in finger millet based nutri flakes incorporated with tapioca flour Later by the end of the storage, the fungal count was found to be 0.35×10^3 cfu/g in finger millet based nutri flakes Yeast growth was not detected in the selected nutri flakes throughout the storage period.

Food with low moisture content and low water activity along with hygienic handling of the product reduce the the microbial contamination [20]. Microbial analysis of millet based pasta showed that yeast and moulds were not observed for a period of four months [21].

Table 3. Nutrient analysis of the selected nutri flakes

Finger millet nutri flakes (60% FM+ 30 % TF+ 10 % OI)	CHO (g/100 g)	Protein (g /100 g)	Fat (g/100 g)	Energy (kcal/100g)	Calcium (mg /100 g)	Iron (mg/100 g)	Sodium (mg /100 g)	Potassium (mg/100 g)
	44.32	7.73	1.26	219	199	5.58	13	395

Table 4. Mean score for organoleptic qualities of finger millet based nutri flakes

Month	Sensory qualities					
	Appearance	Colour	Flavour	Texture	Taste	Overall acceptability
Initial	7.88	8.02	7.73	8.08	7.84	7.92
Final	7.66	7.83	7.5	7.66	7.16	7.78

Table 5. Total microbial count of finger millet based nutri flakes

Month	Microbial population (cfu /g)		
	Bacteria (10 ⁻⁵ cfu / g)	Fungi (10 ⁻³ cfu / g)	Yeast (10 ⁻³ cfu / g)
Initial	0.28	ND	ND
Final	0.85	0.35	ND

4. CONCLUSION

Nutri flakes based on finger millet flour (FM) were standardised with different proportions of tapioca flour (TF) along with other ingredients (OI). Among different treatments, T₃ (60% FM + 30% TF+ 10% OI) secured the highest mean score of 7.92 for overall acceptability. The selected nutri flakes were nutritionally superior and maintained an acceptable level at the end of storage period. The developed nutri flakes can be used as functional foods for people who lead demanding and hectic lifestyles and also prefer for nutritious convenient foods. It can be included in the daily diet and is also suitable for combating micro nutrient deficiencies. This will trigger positive inspiration among millet growers and for millet based entrepreneurship development too

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

- Singh KP, Mishra A, Mishra HN. Fuzzy analysis of sensory attributes of bread prepared from millet-based composite flours. *Int. J. Food Sci. Technol.* 2012;48:276-282.
- Jellinek G. Sensory evaluation of food: theory and practice. Ellis Horwood, Chichester, England. 1985;596.
- Sadasivam S, Manickam. A. biochemical methods (2nd Ed.). New Age International private limited, New Delhi and Tamil Nadu Agricultural University, Coimbatore. 1997;254.
- Gopalan C, Sastri BVR. Balasubramanian SC. Nutritive value of Indian Foods. NIN, Hyberabad. 1989;161.
- Perkin-Elmer. Analytical methods for atomic absorption Spectrophotometry. Perkin-Elmer Corporation, USA. 1982;114.
- Jackson ML. Soil chemical analysis. Prentice Hall of India Private Ltd, New Delhi. 1973;299.
- Agarwal GP, Hasija SK. Microorganisms in the laboratory. Print House India Ltd., Lucknow. 1986;155.
- Verma V, Patel S. Value added products from nutri-cereals: Finger millet (Eleusinecoracana). *Emirates J. Food Agric.* 2013;25(3):169-176.
- Giridhar P. Preparation and sensory evaluation of finger millet Khakhra. *J. Food Sci.* 2019;2(1):61-64.
- Rampersad R, Badrie N, Comissiong E. Physico-chemical and sensory characteristics of flavored snacks from extruded cassava/pigeonpea flour. *J. Food Sci.* 2003;68(1):363-367.
- Lenkannavar R. Development and quality evaluation of barnyard millet flakes. MSc. (Home Science) thesis, University of Agricultural Sciences, Dharwad. 2010;80.
- Kulkarani SS, Desai AD, Ranveer RC, Sahoo AK. Development of nutrient rich noodles by supplementation with malted ragi flour. *Int. Food Res. J.* 2012;19(1):309-313.
- Tamanna N, Mahmood N. Food processing and maillard reaction products: effect on human health and nutrition. *Int. J. Food Sci.* 2015;6.
- Takhellambam RD, Chimmad BV, Prkasam JN. Ready-to-cook millet flakes based on minor millets for modern consumer. *J. Food Sci. Technol.* 2016; 53(2):1312-1318.
- Krishnan R, Dharmaraj U, Malleshi NG. Influence of decortication, popping and malting on bioaccessibility of calcium, iron and zinc in finger millet. *LWT-Food Sci. Technol.* 2012;48(2):169-174.
- Longvah T, Anantan I, Bhaskarachary K, Venkaiah K, Longvah T. Indian food composition tables. National Institute of Nutrition, Indian Council of Medical Research, Hyderabad. 2017;501.
- Pasha VK, Ratnavathi CV, Ajani J, Raju D, Kumar MS, Beedu SR. Proximate, mineral composition and antioxidant activity of traditional small millets cultivated and consumed in Rayalaseema region of south

- India. J. Sci. Food Agric. 2018;98(2):652-660.
18. Devi GS, Palanimuthu V, Arunkumar HS, Naveenkumar DB. Studies on development and storage of kodo millet based pasta. Intl. J. Processing Post Harvest Technol. 2014;5(1):33-40.
 19. Karpagavalli B, Amutha S. Development of pasta products using cereal pulse blends. Asian J. Dairy Food Res. 2015;34(3):213-218.
 20. Shobha D, Prasanna kumar, Puttaramanaik MK, Sreemasetty TA. Effect of antioxidant on the shelf life of quality protein maize flour. Ind. J. Fund. App. Life Sci. 2011;1:129-140.
 21. Gull A, Prasad K, Kumar P. Optimization and functionality of millet supplemented pasta. Food Sci. Technol. 2016;35(4):625-632.

© 2020 Zacharia et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
<http://www.sdiarticle4.com/review-history/62318>