Nutrient Analysis and Shelf life Evaluation of Rice Flakes Incorporated Nutri Ball Formulated for Sports Persons

MahalakshmiSangeetha K. [1]*, Lalitha Ramaswamy[2]**, Jency Koshy Mathew[3]***

[1,3] Dept of Foods and Nutrition, RVS College of Arts and Science, Coimbatore, India
[2] Dept of Nutrition and Dietetics, PSG College of Arts and Science, Coimbatore, India

* Corresponding author: mahalakshimisangeetha@yahoo.com

ABSTRACT

Over the last years, physical education specialists and physicians have turned their attention to sports hematology. Reviews suggest that iron deficiency has a negative effect on the physical activity and performance of athletes. The aim of the present study was to formulate iron rich snack using locally available low cost foods namely rice flour, rice flakes, bajra, samai, soyabean and gingelly seed. Of the three different variants the organoleptically accepted variant was analysed for nutrient content and studied for shelf life. One hundred grams of Nutri Ball contains 361.59 K cal of energy, 71.86 g of carbohydrates, 7.72 g of protein, and 4.74 mg of iron. Microbial and sensory evaluation showed acceptable shelf life of up to 6 days.

Key words: millets, rice flakes, shelf life, organoleptic evaluation

INTRODUCTION

Blood components, particularly red blood cells (RBC) and hemoglobin, are primarily responsible for transferring oxygen and nutrients to active tissues and carrying wastes and carbon dioxide to the lungs to be eliminated.Blood components may vary with physical exercises. Some of these changes may result in anemia, commonly caused by iron deficiency[1]. An iron deficiency will impair sports performance because oxygen isnot transported effectively to working muscles, which causes a buildup of lactic acid. Symptoms of iron-deficiency anemia include muscle burning, shortness of breath during exercise, nausea, frequent infections, respiratory illnesses and a pale, washed-out claimed as a good source of protein, fat and carbohydrate [9] . Rice flakes,a traditional rice

appearance. Over 50 percent of female endurance athletes have depleted iron stores which suggest dietary intervention may be necessary to prevent anemia[2,3,4,5].

A study[6] concluded that dietary iron interventions using a staple cereal product offer an alternative way of improving dietary iron intake and favourable affecting overall iron status in physically active females

All over the world cereals are used as staple foods [7]. Rice flakes are the most common breakfast cereal used all over the country round the year[8]. Rice flakes is locally known by many names like aval, avalakki, poha, chivda and beaten rice, which are prepared from paddy and has been basedproduct of India is rich in iron (20 mg) and calories (346 kcals)[10].The percentage of available

iron in rice flakes of four different thicknesses was ranged from 7% to 26% [11]. Iron supplementation in form of salty rice flakes preparation was equally helpful as elemental iron in managing anemia during pregnancy[12].The purpose of the study was i) to formulate rice flakes incorporated iron rich balls (Nutri balls) ii) to study the nutritional composition of the Nutri Ball and iii) to evaluate the shelf life of the Nutri ball.

MATERIALS AND METHODS

Formulation of Iron Rich Products

Identification of Raw Materials

Rice Flour (*Oryza sativa*), Rice flakes (*Oryza sativa*), bajra (*Pennisetumtyphoideum*), samai *(Panicummiliare)*, soyabean (*Glycine max Merr*), gingelly seed (*Sesamumindicum*) and jaggery (*Saccharumoffinarum*) were incorporated in three different variations in the formulation of nutri ball. Jaggery was added for taste. The proportions of the ingredients were chosen such that iron content ishigh. Rice flakes (20 mg iron) were used as the major ingredient for the formulation of the Nutri ball.

Blending Formulations

The ingredients necessary for formulation of nutri ball including rice, rice flakes, bajra, samaisoyabean, gingelly seed and jaggery were procured from a reputed grocery shop. The whole grainsnamely rice, bajra, samai, soybean and

Carbohydrates   and iron in the most acceptable proportion of nutri ball. The energy

gingelly seeds were pulverized in a blender and roasted till a pleasant aroma evolved. Jaggery syrup was prepared and other ingredients were measuredaccording to Table 1 and made into lime sized balls while hot. The balls were then coded and subjected to evaluation.

Table 1
Varying Levels of Ingredients used in Formulation of Iron Rich Ball

Ingredients	Variant A$_1$	Variant A$_2$	Variant A$_3$
Rice flour (g)	50	40	30
Rice flakes (g)	10	20	30
Bajra (g)	5	5	5
Samai (g)	5	5	5
Soyabean (g)	5	5	5
Gingellyseed (g)	5	5	5
Jaggery(g)	20	20	20
Total	100	100	100

Conduct of Sensory Analysis

The three variants of nutri mix were coded and subjected to organoleptic evaluation. A group of thirty semi trained panelist evaluated the quality factors such as appearance, colour, texture, flavorand taste using a score card. The quality parameterswere quantified and the mean scores were calculated.

Nutrient Analysis

The nutrient content was determined for the various nutrients like energy, proteins, value was determined by the bomb calorimeter, protein by the Microkjeldals method, while

MahalakshmiSangeetha K. ,LalithaRamaswamy, Jency Koshy Mathew

carbohydrates were determined by Anthrone method and iron was determined by Wong's method.

Shelf Life Evaluation

The Nutri balls were packed in aluminium foil container to minimize the moisture transfer and restrict product deterioration mainly rancidity development. Based on the moisture content and ea se of spoilage, the microbial (total plate count) and sensory qualities were studied every fortnight for Nutri ballkept at room temperature in a cool dry place.

Statistical Analysis

The collected data was consolidated, tabulated and analyzed statistically using mean, standard deviation, ANOVA, Duncan's test and t-test.

RESULTS AND DISCUSSION

Sensory Analysis of Iron Rich Products

The effect of incorporation of rice flakes on sensory characteristics of Nutri Ball is given in Figure 1.

The mean scores obtained for appearance by Variant A_1 was maximum (4.73±0.45) followed by A_2 (4.43±0.50) and A_3 (4.10±0.31). On increasing the quantity of rice flakes, the appearance of the ball decreased. The mean scores obtained for colour by Variant A_1 was maximum (4.83±0.38) followed by A_2 (4.73±0.45) and A_3 (4.33±0.55). The higher the rice flakes content, the darker the formulations. Similar trend was observed for texture, flavor and taste. It is observed that the mean overall acceptability of Variant A_1 was 4.78±0.41, Variant A_2 was 4.52±0.51 and Variant A_3 was 4.27±0.49. Variant A_1 had higher mean overall acceptability score than A_2 and A_3.
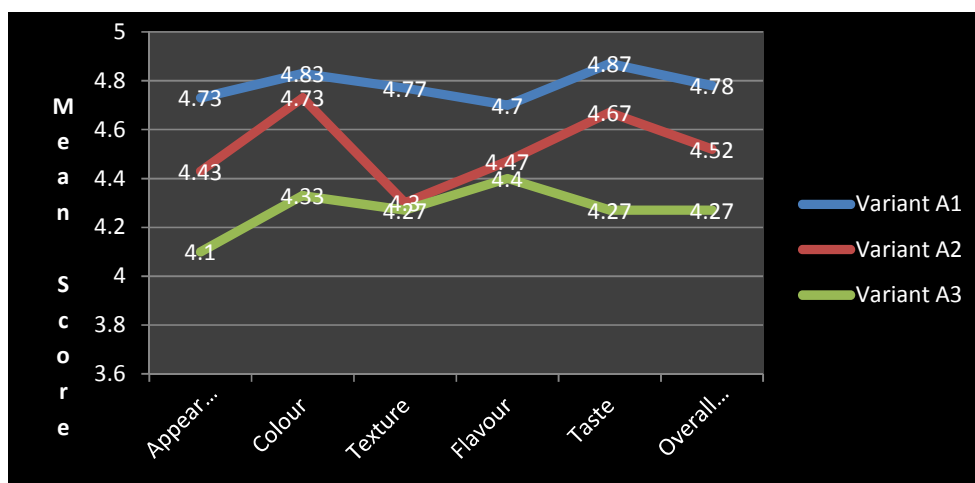
Mean Organoleptic Scores Obtained by Nutri BallIncorporated with Different Levels of Rice Flakes

Fig. 1

The above results are in accordance with previous study [10]which concluded possible opportunity for use of deoiled coconut meal and rice flakes mixturein confectionery products and formulation of complementary foods.

Rice flakes and herbs were utilized in formulation of a value added snack[9]. The prepared herbal rice flakes mix was found to be acceptable in both sensory and nutritional quality.

The results of ANOVA comparing the sensory scores of Nutri Ball prepared with varying proportions of rice flakes are given in Table 2. Statistical analysis revealed that there was a significant (p<0.01) difference between treatments for sensory attributes of appearance, color, texture, taste and overall acceptability.

Posthoc test was carried out by Duncan's method to see multiple comparison between varying proportions of rice flakes incorporated nutri ball are presented in Table 3.

Post–Hoc Duncan's test revealed that the product with incorporation of10g of rice flakes gained highest score, whereas 30g of rice flakes earned the least score for all the selected attributes with significant difference; on increasing the quantity of rice flakes the colour, texture and taste were altered but with reduced acceptability.

Table 2

ANOVA comparing the Mean Organoleptic Scores Obtained by Nutri BallIncorporated with Different Levels of Rice Flakes

Criteria	Sources of Variation	Sum of Squares	df	Mean Square	F value	Significance
APPEARANCE	Between Groups	6.022	2	3.011	16.441**	0.000
	Within Groups	15.933	87	0.183		
	Total	21.956	89			
COLOUR	Between Groups	4.200	2	2.100	9.770**	0.000
	Within Groups	18.700	87	0.215		
	Total	22.900	89			
TEXTURE	Between Groups	4.689	2	2.344	9.472**	0.000
	Within Groups	21.533	87	0.248		
	Total	26.222	89			
FLAVOR	Between Groups	1.489	2	0.744	3.089 NS	0.051
	Within Groups	20.967	87	0.241		
	Total	22.456	89			
TASTE	Between Groups	5.600	2	2.800	11.073**	0.000
	Within Groups	22.000	87	0.253		
	Total	27.600	89			
ACCEPTABILITY	Between Groups	96.289	2	48.144	24.230**	0.000
	Within Groups	172.867	87	1.987		
	Total	269.156	89			

** - Significant at 1%   NS - Not significant

Table 3
Duncan's test comparing the Mean Organoleptic Score Obtained by Nutri BallIncorporated with Different Levels of Rice Flakes

Criteria	VARIANT	N	Subset for alpha = .05		
			1	**2**	**3**
Appearance	A_3	30	4.1000		
	A_2	30		4.4333	
	A_1	30			4.7333
Colour	A_3	30	4.3333		
	A_2	30		4.7333	
	A_1	30		4.8333	
Texture	A_3	30	4.2667		
	A_2	30	4.3000		
	A_1	30		4.7667	
Flavor	A_3	30	4.4000		
	A_2	30	4.4667	4.4667	
	A_1	30		4.7000	
Taste	A_3	30	4.2667		
	A_2	30		4.6667	
	A_1	30		4.8667	
Overall acceptability	A_3	30	21.3667		
	A_2	30		22.6000	
	A_1	30			23.9000

Table 4
Nutrient Content of Nutri Ball (per 100g)

S No	Nutrients(per 100g)	Nutri Ball
1	Energy (K Cal)	361.59
2	Carbohydrates (g)	71.86
3	Protein (g)	7.72
4	Iron (mg)	4.74

Nutrient Analysis of Nutri Ball

Variant A_1 with 10g of rice flakes showing better organoleptic properties was selected for further study. The nutrient content of the selected proportion of Nutri ball is given in Table 4.

It is observed that 100g of nutri ball provides 361.59 K cal of energy, 71.86g of carbohydrates, 7.72g of protein and 4.74mg of iron. It is noted that consumption of 120 g of nutri ball by males and 150g of nutri ball by females will provide one third of their daily iron requirement.

An attempt to formulate low cost nutritive complementary food [13]showed an improvement in the nutrient quality of the formulated

complementary foods with good acceptability comparable to the commonly used products. Complementary foods from local staple foods were formulated [14]and it was found to be nutrient-dense with good functional and sensory properties.

3.3 Shelf Life Study of Nutri Ball

3.3.1 Microbial Analysis of Nutri Ball on Storage

Microbial proliferations in foods need certain conditions – namely available water (water activity), proper pH, right temperature and nutrients and time. By controlling these conditions one can prevent microbial growth and extend the shelf life of a food [15].The results of the total plate count showed that there was no microbial growth soon after preparation (SAP) and on day 3, the microbial count was $2x10^2$. On the 6th day of storage, $4x10^2$

colonyforming units were found which was within the permissible limits. It can be concluded that nutri ball has a shelf life of six days at room temperature.The shelf life may be extended if stored under refrigerated conditions.

Sensory Evaluation of NutriBall on Storage

The details regarding changes in the sensory attributes of Nutriball on storage is given in Table 5.The mean organoleptic score obtained by Nutri ball for appearance was 4.73±0.45 which decreased slightly to 4.53±0.51 and 4.27±0.50 on 3rd day and 6th day of storage respectively. A similar trend was observed with a negligible decrease in attributes including colour, texture, flavor and taste of the product.Statistical t test showed that there was a significant decrease in the organoleptic scores of

Table 5   Mean Organoleptic Scores Obtained by Nutri Ball on Storage

S No	Criteria	Max Score	Mean± SD			Groups compared	t value	Significance
			SAP I	Day 3 II	Day 6 III			
1	Appearance	5	4.73±0.45	4.53±0.51	4.27±0.50	I and II	2.693*	0.012
						I and III	5.037**	0.000
						II and III	3.247**	0.003
2	Colour	5	4.83±0.38	4.70±0.53	4.33±0.55	I and II	1.439[NS]	0.161
						I and III	4.349**	0.000
						II and III	4.097**	0.000
3	Texture	5	4.77±0.43	4.40±0.67	4.03±0.72	I and II	3.266**	0.003
						I and III	5.809**	0.000
						II and III	4.097**	0.000
4	Flavour	5	4.70±0.47	4.43±0.68	4.07±0.58	I and II	2.504*	0.018
						I and III	6.238**	0.000
						II and III	4.097**	0.000
5	Taste	5	4.87±0.35	4.63±0.49	4.03±0.56	I and II	2.536*	0.017
						I and III	6.530**	0.000
						II and III	6.595**	0.000
	Overall acceptability	5	4.78±0.41	4.54±0.58	4.15±0.57	I and II	3.598**	0.001
						I and III	8.819**	0.000
						II and III	6.791**	0.000

** (p<0.01)   * (p<0.05)   [NS] –Not Significant

nutri ball on storage. However, from the mean values, it is observed that the scores were ranged between very good to excellent and therefore the formulated products were fit for human consumption.The mean organoleptic score obtained by Nutri ball for appearance was 4.73±0.45 which decreased slightly to 4.53±0.51 and 4.27±0.50 on 3rd day and 6th day of storage respectively. A similar trend was observed with a negligible decrease in attributes including colour, texture, flavor and taste of the product.Statistical t test showed that there was a significant decrease in the organoleptic scores of nutri ball on storage. However, from the mean values, it is observed that the scores were ranged between very good to excellent and therefore the formulated products were fit for human consumption.

CONCLUSION

The formulated Nutri ball was acceptable organoleptically. Incorporation of rice flakes had a good impact on the nutritive value of the products by increasing energy, carbohydrate, protein and ironcontent of the products. The results of the microbial analysis of Nutri ball show that there was a slight increase in the microbial load over differentstorage periods, but within the acceptable limits.The results of the organoleptic evaluation revealed a significant ($p<0.01$) decrease in the sensory scores of nutri ball between different storage periods yet within the acceptable limits. It can be concluded that the formulated product would

be an effective food based approach in combating micro nutrient deficiencies.

REFERENCES

1. Dubnov G. and Constantine N., 2004. Prevalence of iron depletion and anemia in top level basketball players. Int J sport NurExercMetab. 14(1): 30-37.
2. Beard J. and Tobin B. Iron status and exercise. Am J ClinNutr. 72(2):2000, Pp 594S-597S.
3. Malczewska J., Raczynski G. and Stupnicki R., 2000. Iron status in female endurance athletes and in non-athletes. Sport NutrExercMetab. 10: 260-276.
4. Schena F., Pattini A. and Mantovanelli S., 1995. Iron status in athletes involved in endurance and in prevalently anaerobic sports. In: Kies C., Driskell JA., eds. Sports Nutrition:Minerals and Electrolytes. Philadelphia,PA:CRC Press. 65-69
5. Clarkson P. andHaymes EM., 1995. Exercise and mineral status of athletes: calcium, magnesium, phosphorus, and iron. Med Sci Sports Exerc. 27: 831-843.
6. Alaunyte I., Stojceska V. and Plunkett A. and Derbyshire E., 2014. Dietary iron intervention using a staple food product for improvement of iron status in female runners. J IntSoc Sports Nutr. 11(1): 50.
7. Neumark SD., Story M., Ackard D., Moe J. and Perry C., 2000. The 'Family Meal':Views of Adolescents. J Nutr Educ. 32: 329-334.
8. Pollitt E., Gersovitz M. and Gargiulo M., 1978. Educational benefits of the United States school feeding program: a critical review of the literature. Am J Public Health. 68: 477-481.
9. Gupta E., Sinha J. and DubeyRP., 2012. Utilization of Dehydrated Herbs in the Formulation of Value Added Snack "Rice Flakes Mix". J Food Process Technol.S1-002.
10. Sivakami PLS. and SarojiniKS.,2013. Formulation of Value Added Biscuits Using Defatted Coconut Flour. American Journal of Food Technology. 8: 207-212.
11. Suma R C., Sheetal G., Lakshmi A. Jyothia and Jamuna Prakash, 2007. Influence of phytin phosphorous and dietary fibre on in vitro iron

and calcium bioavailability from rice flakes, International Journal of Food Sciences and Nutrition. 58(8): 637-643

12. Agarwal T., Kochar G K. and Goel S., 2008. Impact of Iron Supplementation on Anemia During Pregnancy, Ethno-Med. 2(2): 149-151

13. Anigo KM., Ameh DA., Ibrahim S. and Danbauchi SS., 2010. Nutrient composition of complementary food gruels formulated from malted cereals, soybeans and groundnut for use in North-western Nigeria African Journal of Food Science. 4(3): 65-72.

14. OnojaUS.,Akubor PI., Gernar DI. andChinmma CE., 2014. Evaluation of Complementary Food Formulated from Local Staples and Fortified with Calcium, Iron and Zinc. J Nutr Food Sci. 4: 326. doi: 10.4172/2155-9600.1000326.

15. IbeanuVN.,Ene-Obong, HN., Peter-Ogba GU. andOnyechi UA., 2015. Microbiologicalevaluation and shelf life of seed flour mixes used for infant feeding in rural northern Nigeria. African Journal of Biotechnology. 14(20): 1718-1723.