

Enrichment of Traditional Paniyaram Incorporated with Foxtail Millet

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Abstract: Foxtail millet is highly nutritious, non-glutinous, non-acid forming food and easy to digest. An attempt was made to develop a value added fermented product named Paniyaram by incorporating Foxtail millet. The basic traditional paniyaram recipe was modified by substituting a percentage of rice with foxtail millet. The ratio of rice: black gram dal: foxtail millet for Basic traditional Paniyaram recipe was 2:1:0, Variation-1 was 1:1:1 and Variation-2 had a ratio of 1:0.5:1.5. Two variations in Sweet and Savory were developed. Sensory attributes such as Color, Texture, Flavor, Taste, after taste and Overall acceptability (n=70) revealed that the Savory variation (8.44 ±0.6) was more acceptable than the Sweet variation (8.0±0.9) Among the three variations, Basic and Variation-1 was found to be equally acceptable and had better sensory characteristics compared to Variation-2. The statistical analysis was done using ANOVA which revealed that Savory and Sweet Paniyaram showed a non-significant difference for Basic with Variation-1 and Basic with Variation-2, whereas a high significant difference was observed between Variation-1 and Variation-2 (P < 0.05). The physical characteristics of fermented foxtail millet batter were determined. An increase in the total volume of batter and a decrease in the weight of the batter at 5th, 9th and 12th hourly during the process of fermentation were observed. So, it can be concluded that the proportions of cereal, millet and pulse ratios in Variation-1 best suits to produce a desirable traditional fermented product paniyaram using foxtail millet with acceptable sensory properties.

Keywords: Fermentation, Foxtail millet, Paniyaram, Savory, Sweet, Sensory evaluation

1. Introduction

In this era of global industrialization and advancement of technologies, the life style of the people has changed a lot. In this changing life style, the demand for ready to eat foods like junk food forms an important part of an average Indian diet which is rich in refined carbohydrates, starch, fat and energy but extremely low in dietary fiber. Dietary fiber is describes a variety of plant substances that are resistant to digestion by alimentary enzymes in humans and most animals. In the diets of humans, fiber sources include fruits, vegetables, grain products, legumes, nuts and concentrated plant sources such as oat and wheat bran. The benefits of consuming foods rich in fiber are numerous, ranging from improved large bowel function to slowed digestion and absorption of carbohydrate and fat (Ali et al., 1982, Schneeman and Tietyen 1994)

Millets are one of the cereals besides the major wheat, rice, and maize. Foxtail millet, like most millets, is also a good source of crude fiber, helps in the digestive process and helps to induce bowel movement, thus producing a laxative effect that is beneficial for a healthy digestive system (Bernard, R.W.1996) In addition to its nutritional properties, foxtail millet has also shown to possess several health benefits like prevention of cancer, hypoglycemic, and hypolipidemic effects (Zhang, A.2015) It has higher protein, crude fiber and fat content (USFA). It is rich in B-complex vitamins like thiamine, minerals especially Ca, P and Fe, certain amino acids like threonine, methionine and is low in phytic acid (Gopalan et al., 2004)

The term fermentation of food is a complex mixture of carbohydrate, proteins, fats etc., undergoes modifications simultaneously under the action of variety of micro-organisms and enzymes present (Deepa M. Madalageri; 2012) Fermentation produces textural changes, increases the nutritive value and these foods are easily digestible and possess high degree of acceptability. Fermented foods are

associated with 'good bacteria' referred to as probiotics. Probiotics are beneficial bacteria in that they favorably alter the intestinal micro flora balance, inhibit the growth of harmful bacteria, promote good digestion, boost immune function and increase resistance to infection (Helland et al., 2004)

Traditionally, Paniyaram is a fermented dish which upon cooking has a golden brown, traditional fermented acidic (leavened), soft, spongy texture. It is a shallow fat fried cake made out of fermented rice pulse batter with or without fenugreek seeds. Paniyaram is principally prepared from a combination of rice and different types of pulses in 4:1 ratio. Hence, present study was carried out to develop a value added fermented product named Paniyaram by incorporating Foxtail millet (FM) and replacing the traditional rice component in the batter.

2. Materials and Method

The foxtail millet required for the preparation of the product was procured from a super market situated at Mehdiapatnam, Hyderabad. Other ingredients such as black gram dal, rice, and jaggery were procured from the local market at Nampally, Hyderabad. The raw ingredients such as rice, urad dal and foxtail millet were sieved and washed properly before soaking.

Formulation of the recipe

The basic traditional paniyaram recipe was modified by substituting a percentage of rice with foxtail millet. The basic traditional paniyaram recipe has a cereal (rice): pulse (black gram dal) ratio of 2: 1. In Variation 1, half of the rice was substituted with foxtail millet in the ratio of 1:1. In variation 2, more than half of the rice was substituted with foxtail millet in the ratio of 1:1.5. Two variations in sweet and savory version were formulated and developed. Jaggery was incorporated in the sweet variation and grated vegetables and salt were added in the savory variation. The

raw ingredients selected for the preparation of Sweet and Savory paniyaram were standardized to be 100 g of the product.

Table 1: Formulation of Sweet and Savory Paniyaram

Ingredients	Sweet Paniyaram			Savory Paniyaram		
	Basic	Variation -1	Variation -2	Basic	Variation -1	Variation -2
Rice (g)	15	7.5	7.5	15	7.5	7.5
Black gram dal (g)	7.5	7.5	5	7.5	7.5	5
Foxtail millet (g)	-	7.5	10	-	7.5	10
Onion (g)	-	-	-	5	5	5
Carrot (g)	-	-	-	5	5	5
Jaggery (g)	20	20	20	-	-	-
Ghee (g)	5	5	5	-	-	-
Oil (ml)	-	-	-	5	5	5

3. Method of preparation

Traditional Recipe of Paniyaram:(Combination of Rice &Urad dal)

For the batter: Wash and soak rice and urad dal separately for 6 hours. Drain the water and grind soaked urad dal with little water until a thick paste is formed. Grind rice with little water until smooth in texture. Mix both together and set aside in a warm place to ferment for at least for 6-8 hours. Use the prepared batter as mentioned below.



Figure 1: Preparation of Sweet Paniyaram

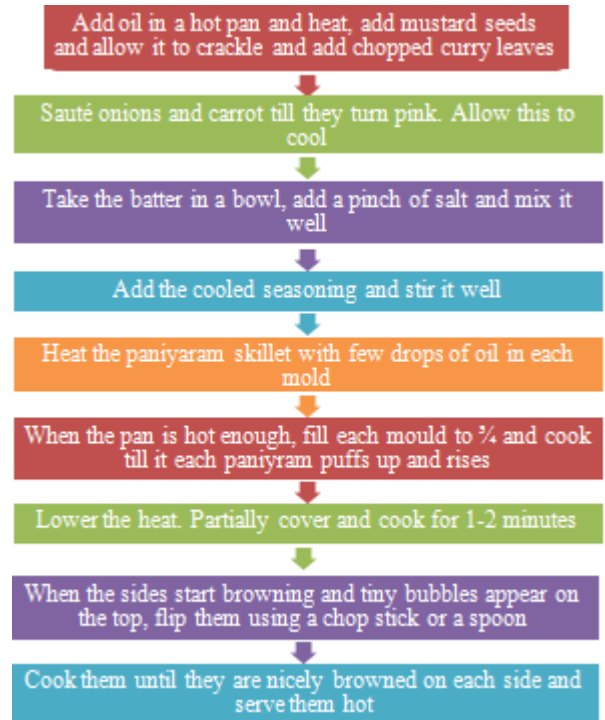


Figure 2: Preparation of Savory Paniyaram

Sensory evaluation of the product:

The sensory evaluation was carried out on six developed products i.e. Sweet and Savory paniyaram with basic and 2 variations each using a 9 point hedonic scale. Panelists (n=70) were asked to evaluate the samples based on Color, Flavor, Texture, Taste, After taste and Overall acceptability and score them on hedonic scale as 9- like extremely, 8- like very much, 7- like moderately, 6- like slightly, 5- neither like nor dislike, 4- dislike slightly, 3- dislike moderately, 2- dislike very much and 1- dislike extremely.



Plate 1: Sensory evaluation of sweet Paniyaram



Plate 2: Sensory evaluation of savory Paniyaram

Statistical analysis of the developed product:

The sensory analysis was statistically analyzed. Mean and standard deviation were calculated individually for scores obtained for all sensory attributes for each product. The

ratings obtained for all the products were statistically analyzed using ANOVA (Analysis of variance) test.

Mineral estimation:

Estimation of the mineral content was performed for calcium (Ca) and iron (Fe) using ash solution. The calcium content was performed using titrimetric method and the iron content was performed using Wong’s method (Raghuramulu.N et al; 2003)

Physical characteristics of paniyaram batter during the process of fermentation:

The physical characteristics of the paniyaram batter like volume and weight were studied by standard methods before and after fermentation.

a) Increase in volume:

A 20 ml aliquot of freshly prepared batter was transferred to respective 50 ml measuring cylinders and covered with aluminum foil then these measuring cylinders were kept at temperature, 30-35°C for 12 hours. And increase in the volume was noted in ml (Deepa M. Madalageri; 2012)

Net increase in volume:

Net increase in volume = Final volume – Initial volume

Percent increase in volume:

$$\text{Percent increase in volume} = \frac{\text{Final volume} - \text{Initial volume} \times 100}{\text{Initial volume}}$$

b) Weight of the batter:

Weight of the batter was measured by transferring freshly prepared batter to previously weighed container. Weight of the batter before and after fermentation was noted at 5th, 9th and 12th hourly of fermentation using an electronic weighing balance.

Hence, weight of the batter was calculated using the following equation:

a = Weight of the container

b = Weight of the container + Weight of the batter

Weight of the batter (g) = a-b



Plate 3: Volume of the batter before Fermentation



Plate 4: Volume of the batter after fermentation

4. Results and Discussions

Sensory attributes of the product:

Sensory characteristics of all the six products (i.e., sweet and savory paniyaram with basic and 2 variations each) were determined by a group of 70 semi-trained panelists. The mean sensory scores for Sweet and Savory version of Paniyaram for Basic, Variation 1 and Variation 2 are presented in Table 2 and Table 3.

Table 2: Sensory scores for Sweet paniyaram

Samples	Color	Texture	Flavor	Taste	After taste	Overall acceptability
Basic	8.12 ±1.0	8.1 ±1.0	8.28 ±0.8	8.12 ±0.9	8.1 ±0.9	8.21 ±0.8
Variation-1	8.18 ±0.8	8.04 ±1.0	8.07 ±0.9	8.0 ±1.1	7.85 ±1.1	8.04 ±0.9
Variation 2	8.01 ±0.9	7.87 ±0.9	8.07 ±0.9	7.9 ±0.9	7.8 ±1.0	8.0 ±0.9

Table 3: Sensory scores for Savory paniyaram

Samples	Color	Texture	Flavor	Taste	After taste	Overall acceptability
Basic	8.3 ±0.9	8.4 ±0.7	8.32 ±0.7	8.45 ±0.6	8.47 ±0.6	8.52 ±0.6
Variation-1	8.3 ±0.8	8.35 ±0.7	8.35 ±0.6	8.41 ±0.7	8.4 ±0.6	8.48 ±0.6
Variation 2	8.25 ±0.8	8.24 ±0.7	8.28 ±0.7	8.32 ±0.7	8.28 ±0.8	8.44 ±0.6

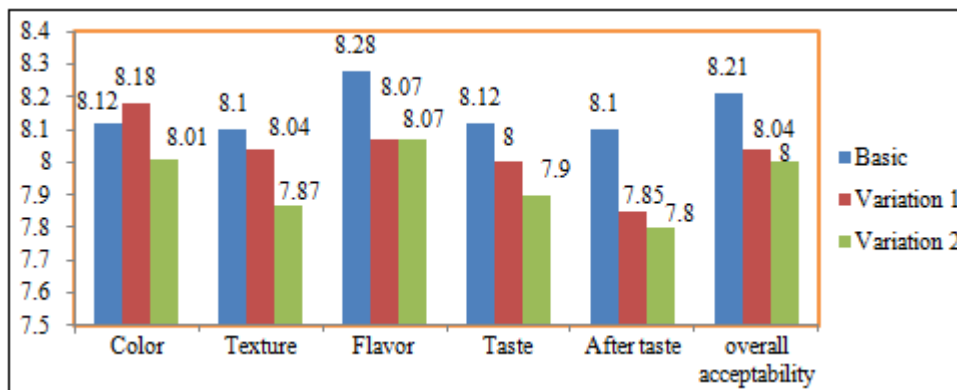


Figure 3: Sensory scores for Sweet Pniyaram

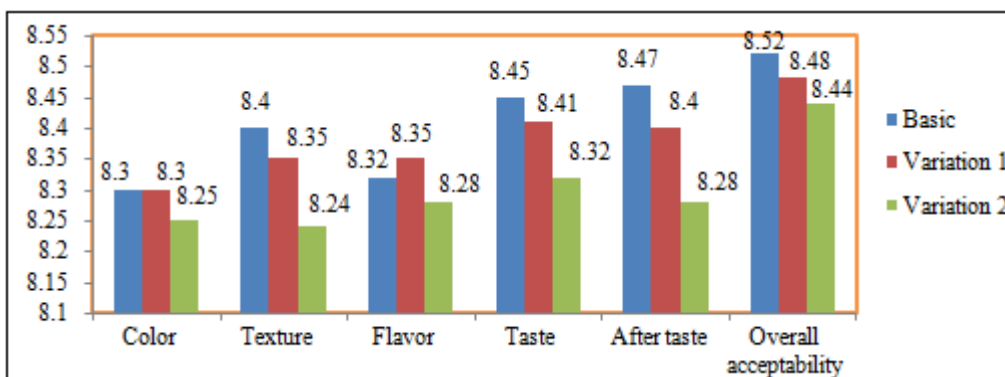


Figure 4: Sensory scores for Savory Pniyaram

From the results, it was found that the Savory version was more acceptable than the Sweet version. The mean scores for all the sensory attributes i.e. Color, Texture, Flavor, Taste, After taste and Overall acceptability was greatest for Basic, followed by Variation 1 and the least acceptable was Variation 2.

Estimation of mineral content

Estimation of calcium using titrimetric method:

Calcium is prepared as oxalate and is titrated with standard potassium permanganate.

Table 4: Comparison between Calculated nutritive value and Analyzed values for Calcium content in Sweet and Savory version Pniyaram

Variations	Nutritive value calculation for calcium as per nutritive value of Indian food composition tables 2017 (mg/ 100 g of product)		Calcium content of product analyzed in lab (mg/ 100 ml ash solution)	
	Sweet	Savory	Sweet	Savory
Basic	26.69	8.04	15.3	4.8
Variation 1	28.46	9.80	20.2	6.2
Variation 2	27.84	9.18	18.1	5.2

Estimation of Iron using Wong’s method:

Iron (Fe) is determined calorimetrically with ferric iron which gives a blood red color with potassium thiocyanate.

Table 5: Comparison between Calculated nutritive value and Analyzed values for Iron content in Sweet and Savory version Pniyaram

Variations	Nutritive value calculation for Iron as per nutritive value of Indian food composition tables 2017(mg/ 100 g of product)		Iron content of product analyzed in lab (mg/ 100 ml ash solution)	
	Sweet	Savory	Sweet	Savory
Basic	1.37	0.5	0.76	0.15
Variation 1	1.53	0.6	1.0	0.3
Variation 2	1.48	0.61	0.92	0.3

Statistical analysis for the developed products:

The sensory analysis was statistically analyzed. Mean and standard deviation were calculated and the observations obtained for overall acceptability of all the products were analyzed statistically using ANOVA (Analysis of variance) test.

Table 6: Comparison of overall acceptability of F calculated value vs. F table value (ANOVA)

Variations	F calculated value for Sweet Pniyaram	F calculated value for Savory Pniyaram	F table value at 5% level
Basic vs. Variation 1	1.25	1.2	3.9
Basic vs. Variation 2	1.88	1.72	3.9
Variation 1 vs. Variation 2	15.16**	62.4**	3.9

**= Highly significant

From Table 6, it was observed that at 5% level of significance, $\gamma_1 = 1$ and $\gamma_2 = 138$, the F table value is 3.9.

Since the calculated value of F for basic with variation 1 and basic with variation 2 i.e. 1.25 and 1.88 for Sweet version and 1.2 and 1.72 for Savory version, is less than the table value i.e. 3.9, no significant difference is observed (P < 0.05) Thus no variation is observed between basic and variations. As the calculated value of F for variation 1 with variation 2 i.e. 15.16 for Sweet version and 62.4 for Savory version, is more than the table value 3.9, a high significant difference is observed between the two variations at 5% level of probability.

Physical characteristics of paniyaram batter during the process of fermentation:

Increase in volume:

Table 7: Increase in volume of batter

Variations	Increase in volume (ml)		Net increase in volume (ml)	Percent increase in volume (%)
	BF	AF		
Basic	10	16	6	60
Variation 1	10	19	9	90
Variation 2	10	17	7	70

BF= Before fermentation; AF= After fermentation

Table 7 depicts the increase in the volume of paniyaram batter. From the data, it was found that the initial volume of the batters (10 ml) increased with the increase in fermentation hours. The maximum increase was observed in the volume of variation 1 (19 ml) followed by Variation 2 (17ml)and the least was observed in basic (16 ml) The percent increase in volume of the batter for basic, variation 1 and variation 2 was 60%, 90% and 70% respectively.

Weight of the batter:

Table 8: Weight of the batter

Variations	Weight of the batter (g)			
	BF	AF		
		5 hours	9 hours	12 hours
Basic	92.29	92.16	91.09	91.01
Variation 1	97.87	97.54	97.23	97.15
Variation 2	93.58	93.38	93.15	92.04

BF= Before fermentation; AF= After fermentation

From the Table 8 it was found that the weight of the batter decreased with varying hours of fermentation (5th, 9th and 12th hourly) The maximum weight of the batter before fermentation was observed in variation 1 (97.87) followed by variation 2 (93.58) and the least was observed in the basic sample (92.29) From the data it was found that the weight of the batter decreased with varying hours of fermentation.

Nutritive value

Paniyaram enriched foxtail millet is a rich source of energy, proteins, dietary fiber and micronutrients. Hence these energy dense foods will help to prevent nutritional problems such as malnutrition, protein energy malnutrition and iron deficiency anemia of a community.

Table 9: Nutritive value calculations of Sweet and Savory Paniyaram (100g- 4 pieces)

Nutrient	Sweet Paniyaram			Savory Paniyaram		
	Basic	Variation 1	Variation 2	Basic	Variation 1	Variation 2
Energy (kcal)	194.6	193.4	194.3	128	127.3	127.9
Protein (g)	3.28	3.61	3.34	3	3.37	3.1
Fat (g)	5.23	5.51	5.57	5.22	5.5	5.56
Carbohydrate (g)	32.5	31.19	31.4	16.4	15	15.3
Fiber (g)	1.31	1.7	1.6	1.57	1.96	1.86
Moisture (g)	1.37	1.53	1.48	0.5	0.66	0.61
Calcium (mg)	26.69	28.46	27.84	8.04	9.8	9.18

5. Conclusion

Present research was an attempt to develop a value added fermented product named Paniyaram by incorporating Foxtail millet and partially replacing a part of the traditional Rice component in the batter. Fermentation process improves the softness of the batter that helped to retain higher amount of CO₂ produced during fermentation, consequently increase the volume of the batter and giving a desirable soft, spongy texture to the product. The ratio of rice: black gram dal: foxtail millet for Basic traditional Paniyaram recipe was 2:1:0, Variation-1 was 1:1:1 and Variation-2 had a ratio of 1:0.5:1.5. Two variations in Sweet and two variations in Savory version were developed. Results for sensory analysis revealed that the Savory version was more acceptable than Sweet version. Among the variations, Basic and Variation-1 had better sensory characteristics compared to Variation-2. Higher incorporation of foxtail millet in variation 2 was responsible for its decreased sensory scores. Hence 1:1 proportion of rice and foxtail millet was considered as optimum addition of ingredients as, complete substitution of rice with foxtail millet will increase the hardness due to increase infiber content, thereby effecting the textural properties of the product. Therefore, this study provides an opportunity for partial substitution of rice with foxtail millet, for making a popularly consumed traditional breakfast food, paniyaram. The developed product is a healthier version than the traditional recipe that was devoid of fiber.

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