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Kola Rachana Sri
Department of Foods and Nutrition, Post Graduate & Research Center, PJTS Agricultural University, Rajendranagar, Hyderabad, Telangana, India

B Anila Kumari
Department of Foods and Nutrition, Post Graduate & Research Center, PJTS Agricultural University, Rajendranagar, Hyderabad, Telangana, India

Jessie Suneetha W
Krishi Vigyan Kendra, PJTSAU, Wyra, Khammam district, Telangana, India

R Neela Rani
ACRIP WIA, Post Graduate & Research Center, PJTS Agricultural University, Rajendranagar, Hyderabad, Telangana, India

Corresponding Author:
Kola Rachana Sri
Department of Foods and Nutrition, Post Graduate & Research Center, PJTS Agricultural University, Rajendranagar, Hyderabad, Telangana, India

Standardization and sensory evaluation of minor millets based baked spicy sticks

Kola Rachana Sri, B Anila Kumari, Jessie Suneetha W and R Neela Rani

Abstract
Snacking has become the most common habit among the individuals now a days due to their pace of life style changes which leads to life style disorders. Millets commonly known as nutri cereals were consumed by rural people in India, which contributes to nutrition, food security and health. Minor millets are rarely used grains among millets for snacking. In this study wheat flour, foxtail millet (*Setaria italic*) flour and proso millet flour (*Panicum miliaceum*) were used to develop baked sticks with various proportions. SPFM1 (80:10:10), SPFM2 (60:20:20), SPFM3 (40:30:30), SPFM4 (20:40:40), SPFM5 (0:50:50) and CTRS6 (100:0:0). All formulations were evaluated on basis of sensory attributes. Among all the formulations SPFM3 got highest score (91.8%) for acceptability index. SPFM4 with 91.38% was selected, as that formulation has greater millet percent compared to SPFM3.

Keywords: Millet snacks, proso millet, foxtail millet, baked sticks

Introduction
The term "millet" refers to a wide variety of small-seeded grasses having origin in Asia or Africa. They frequently have a great degree of adaptability and can function in almost any situation. In terms of global agricultural output, millet ranks as the sixth cereal crop and one of the most significant drought-resistant crops. In addition, compared to other main grains, millet has a shorter growing season, greater yield during droughts, and greater resilience to pests and illnesses. (Devi, *et al*., 2011) [4]. These millets have nutritional values that are relatively similar to those of rice and wheat. There is a lack of ready-to-use forms of refined and processed millets, thus they are limited to traditional customers as well as to those from lower socioeconomic classes. Because of their abundance in calcium, dietary fibre, polyphenols, and protein, millets stand out among cereals (Verma, *et al*., 2015) [14].

The oldest millet crops include foxtail (*Setaria italica*) and proso millets (*Panicum miliaceum*), which are frequently grown as an alternative to maize since they are more tolerant of dry and barren soils than most other crops. They are preferable than rice and wheat, so they are given to the underprivileged and who have a great need for these protein, minerals, and vitamins. Foxtail and proso millets, provide nutritional advantages in addition to certain phytochemicals that have antinutrient effects. These phytochemicals may prevent the effective utilisation, absorption, or digestion of nutrients, lowering their nutrient bioavailability and nutritional quality. (Devisetti *et al*., 2014) [5].

Foxtail millet, can be traced between 7,400 and 7,900 years ago back to the Yellow River Valley in northern China's province of Cishan and Peiligang (Doust, *et al*.,2009) [6]. In India, foxtail millet is also referred to as Kangni (Hindi), Kang (Gujrati), Navane (Kannada), Kaon Dana (Bengali), Kavalai and Tenai (Tamil), Korralu (Telugu) and Kangam (Oriya). States that mostly cultivate foxtail millet in India include Rajasthan, Karnataka, Maharashtra, Andhra Pradesh, and Chhattisgarh. After being sown in the late spring, the grains will be harvested in 75 to 90 days. Foxtail millet is neither glutenous nor acid-forming, it may be readily digested and has a calming effect. It aids people with type 2 diabetes and weight loss due to its resistant starch, complex carbs, water soluble gums, and beta-glucan found in foxtail millet can. The dietary fibre present in it includes hexose, pentose, cellulose, and pectinacious substance. (Namitha, *et al*., 2019) [10].

Proso millet often known as *Panicum miliaceum* L., is a significant cereal and an essential part of the human nutrition, particularly in underdeveloped nations. The crop may be grown in a variety of soil types and in challenge growing environments since it is resistant of salt, alkali, cold, and drought. These grains are mostly consumed as decorticated food (Wang *et al*., 2005) [15].

Proso millet is nutritionally superior to popular grains like wheat, rice and maize because it has more protein than other forms of millet (Saleh *et al.*, 2013) [13].

Leucine, isoleucine, and methionine were much more abundant in proso than wheat, despite the grain's equal protein level (11.6% of dry matter). As a result, proso had greater protein quality (51%) (Essential Amino Acid Index) than wheat. The limiting amino acid, lysine, was present in the proso grain at an amount of around 3.3 g per kg (Kalinova and Moudry, 2006) [7].

In the past, the nutritional value of it, such as its starch and crude protein levels, has been used to assess its quality. According to epidemiological research, consuming more proso millet and its derivatives is linked to a lower chance of developing chronic conditions such raised blood cholesterol, cardiovascular disease, type II diabetes, and liver damage. This distinct photochemical profile has been linked to these health advantages (Kumari and Thayumanavan 1998; Denery *et al*., 1999; Nishizawa *et al.*, 2002) [8, 2, 11]. The prolamin content in proso millet will help in planning a gluten free diet to celiac patients (Aubrecht, 1998) [1].

One of the most popular cuisines in India is snacks. People all around the nation enjoy delicious cuisine with a variety of snacks. Foreign businesses and food chains are entering the Indian market with their food and snacks as a result of the growing customer base and changing eating patterns, particularly in metropolitan areas (Nora, 2015) [12].

Although millet's nutritional benefits have been extensively documented, only traditional consumers in tribal cultures utilise it as food. This is mostly because there aren't consumer-friendly, ready-to-use or ready-to-eat millet products as of other cereals. Millets have drawn attention recently, mostly due to their high fibre content, and attempts are being made to give them to customers in convenient ways (Deshpande and Poshadri, 2011) [3]. Many traditional meals and beverages, including bread (fermented or unfermented), porridge and snack foods, are created with millet, which is a significant food component.

The crunchy minor millet based baked snack- millet sticks were developed and evaluated on sensory basis. This product is made through baking, so it contains less fat compared to the traditional millet murukku and it contains all the nutrients. Minor millet sticks is one among the healthy snacks.

Materials and Methods

Procurement of raw materials: Proso millet and foxtail millet were procured from millet processing and incubation centre, PJTSAU, Rajendranagar, Hyderabad. Other ingredients were brought from Hyderabad local market.

Development of baked millet spicy sticks

Table 1: Millet baked sticks formulations with different proportions

Ingredients	Proportions per 142 grams					
	CTRS6	SPFM1	SPFM 2	SPFM 3	SPFM 4	SPFM 5
Wheat flour(refined)	100	80	60	40	20	-
Foxtail millet	-	10.0	20	30	40	50
Proso millet	-	10.0	20	30	40	50
Baking soda	2.0	2.0	2.0	2.0	2.0	2.0
Cumin seeds	4.0	4.0	4.0	4.0	4.0	4.0
DryFenugreek leaves	1.0	1.0	1.0	1.0	1.0	1.0
Salt	5.0	5.0	5.0	5.0	5.0	5.0
Chilli powder	5.0	5.0	5.0	5.0	5.0	5.0
Oil	15.0	15.0	15	15	15	15
Urad dal powder	-	5.0	5.0	5.0	5.0	5.0
Green gram dal powder	-	5.0	5.0	5.0	5.0	5.0

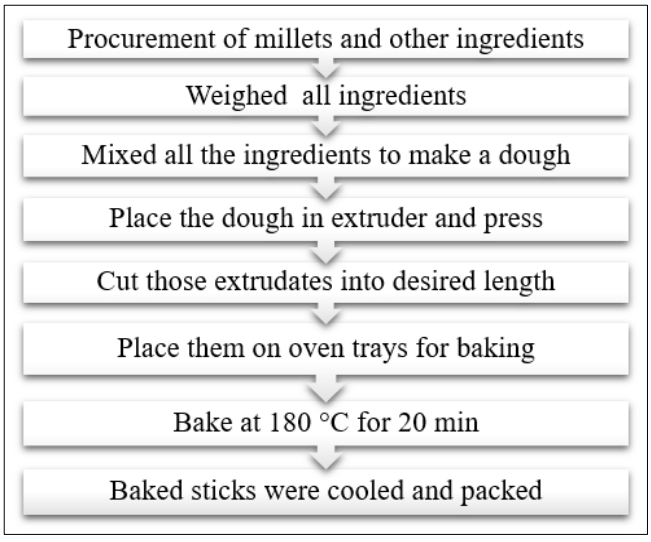

Fig 1: Steps for sticks preparation

CTRS6: Control sticks with refined wheat flour, proso millet flour and foxtail millet flour (100:0:0)

SPFM1: Millet spicy sticks with refined wheat flour, proso millet flour and foxtail millet flour (80:10:10)

SPFM2: Millet spicy sticks with refined wheat flour, proso millet flour and foxtail millet flour (60:20:20)

SPFM3: Millet spicy sticks with refined wheat flour, proso millet flour and foxtail millet flour (40:30:30)

SPFM4: Millet spicy sticks with refined wheat flour, proso millet flour and foxtail millet flour (20:40:40)

SPFM5: Millet spicy sticks with refined wheat flour, proso millet flour and foxtail millet flour (0:50:50)

Sensory evaluation of minor millet based baked sticks

Baked sticks with different proportions were developed and subjected to sensory evaluation by 20 semi trained panellist. 9 point hedonic scale was used for evaluation where 1- dislike extremely, 2- dislike very much, 3- dislike moderately, 4- dislike slightly, 5- neither like nor dislike, 6- like slightly, 7- like moderately, 8- like very much and 9- like extremely (Meilgaard, 1999) [9]. Acceptability index was calculated to select best accepted product. It was calculated by total score (sum of appearance, taste, texture, shape, after taste, overall

accepatability) divided by maximum score (63) and multiplied by 100.

$$\text{Acceptability index} = \frac{\text{Total score}}{\text{Maximum score}} \times 100$$

Results and Discussion

Organoleptic evaluation of millet baked sticks:

The mean sensory scores of the formulations are presented in Table 2. Appearance is the first trait of acceptability in that SPFM4 scored high mean score (8.55) and least was for SPFM5 (6.60) because it got broken into pieces due to high temperature during baking. For color the order of acceptance was SPFM4>SPFM2>SPFM3>CTRS6>SPFM1>SPFM5. Acceptance to texture was more for CTRS6 (8.30) and among millet proportions SPFM2 (8.25) scored high. There was less acceptance of texture for SPFM5 (6.45). Control sticks (CTRS6) got highest mean score of 8.30 for taste and least was to SPFM5 (6.30). For after taste trait CTRS6 (8.35) showed highest score and least was for SPFM5 (6.00) among all formulations, least score might be due to manual error. SPFM3 and SPFM4 (8.45) were showed equal and high score for shape. The least mean score was for CTRS6 (6.75), as that was made with refined wheat flour the shape was not retained and for SPFM5 (6.30), that might be due to the fragile nature of product the length parameters were differed among all millet formulations. Overall acceptability of formulated sticks in a sequence was CTRS6>SPFM3>SPFM2>SPFM4>SPFM1 >SPFM5. But SPFM4 was considered as final formulation it has more millet content compared to other formulations and it got more acceptance for appearance, colour and shape traits.

Table 2: Mean scores of formulated baked sticks

Sample	Appearance	Color	Texture	Taste	After Taste	Shape	Overall Acceptability
SPFM1	$7.80^{b}\pm0.83$	$7.9^{b}\pm0.85$	$8.20^{b}\pm0.41$	$7.95^{a}\pm0.75$	$8.05^{a}\pm0.51$	$7.50^{ab}\pm0.88$	$7.65^{b}\pm0.74$
SPFM2	$8.05^{b}\pm 0.51$	$8.3^{a}\pm0.57$	$8.25^{a}\pm0.44$	$8.10^{a}\pm0.78$	$8.10^{a}\pm0.44$	$7.90^{a}\pm0.96$	$8.15^{a}\pm0.58$
SPFM3	$8.05^{b}\pm0.60$	$8.2^{a}\pm0.69$	$8.20^{b}\pm0.41$	$8.20^{a}\pm0.78$	$8.30^{a}\pm0.65$	$8.45^{a}\pm0.60$	$8.35^{a}\pm0.48$
SPFM4	$8.55^{a}\pm0.51$	$8.6^{a}\pm0.59$	$8.05^{c}\pm0.51$	$8.10^{a}\pm0.44$	$7.80^{a}\pm0.61$	$8.45^{a}\pm0.51$	$8.10^{a}\pm0.30$
SPFM5	$6.60^{d}\pm0.88$	$6.6^{c}\pm1.27$	$6.45^{d}\pm1.05$	$6.30^{b}\pm1.12$	$6.00^{b}\pm1.74$	$6.30^{c}\pm0.87$	$6.45^{c}\pm1.14$
CTRS6	$7.00^{c}\pm0.91$	$8.1^{a}\pm0.64$	$8.30^{a}\pm0.57$	$8.3^{a}\pm0.65$	$8.35^{a}\pm0.67$	$6.75^{bc}\pm1.16$	$8.30^{a}\pm0.57$
Mean	7.67	7.95	7.90	7.83	7.76	7.55	7.83
S.E	0.08	0.09	0.08	0.09	0.10	0.16	0.08
C.D	0.45	0.50	0.38	0.49	0.55	1.06	0.43
C.V %	9.51	10.17	7.69	10.05	11.48	22.53	8.83

Note: Mean within the same column followed by a common letter do not differ significantly at ($p \leq 0.05$).

SPFM1: Millet spicy sticks with refined wheat flour, proso millet flour and foxtail millet flour (80:10:10).

SPFM2: Millet spicy sticks with refined wheat flour, proso millet flour and foxtail millet flour (60:20:20).

SPFM3: Millet spicy sticks with refined wheat flour, proso millet flour and foxtail millet flour (40:30:30).

SPFM4: Millet spicy sticks with refined wheat flour, proso millet flour and foxtail millet flour (20:40:40).

SPFM5: Millet spicy sticks with refined wheat flour, proso millet flour and foxtail millet flour (0:50:50).

CTRS6: Control sticks with refined wheat flour, proso millet flour and foxtail millet flour (100:0:0).

Acceptability indices of all formulations

The acceptability indices of all the formulations are graphically represented in Figure.2. The acceptability indices of baked sticks in descending order was SPFM4>SPFM3> SPFM2>SPFM1>CTRS6>SPFM5. The Scores ranged from 71.11% to 91.8%. SPFM3 has highest acceptability index but SPFM4 was selected among all proportions as that formulation has more millet percent compared to SPFM3 (Fig. 2).

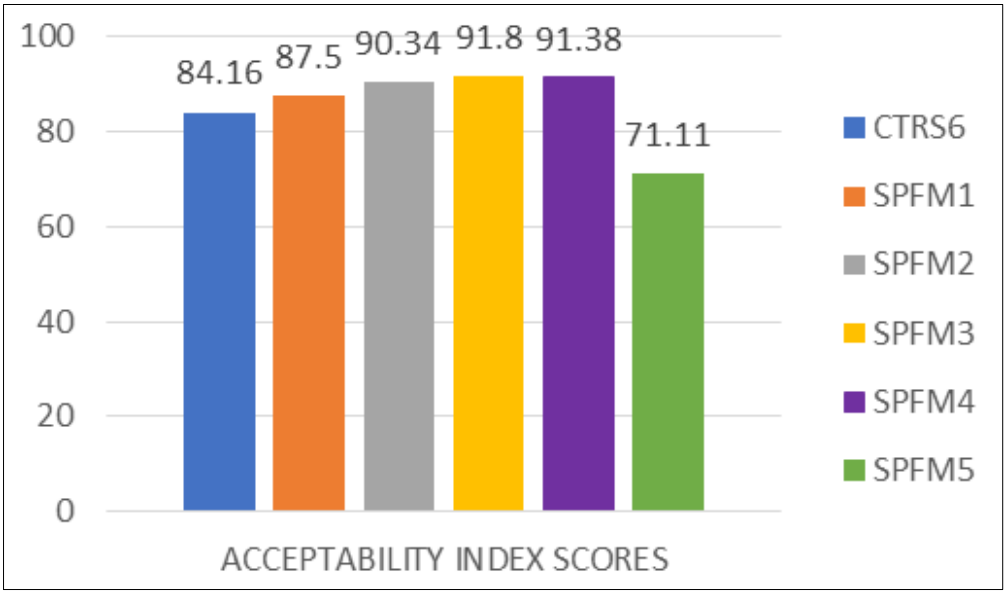

Fig 2: Acceptability index scores of all formulations

Comparison of mean sensory scores between control sticks and minor millet sticks

Average scores for sensory attributes of millet sticks (SPFM4 Plate. 2) in comparison to control sticks (CTRS6 Plate.1) are depicted in Figure. 3. There was a significant difference in appearance between millet baked sticks (SPFM4) and control sticks (CTRS6). Colour is a sensory trait that can be correlated with quality attributes. Among those two sticks SPFM4 scored more (8.6) when compared to control sticks (8.1). Food intake and nutrition are greatly influenced by texture, which is an important factor in determining food quality. There was no significant difference between SPFM4 (8.05) and CTRS6 (8.3) for texture. For taste average scores were SPFM4 (8.1) and CTRS6 (8.3). There was a significant difference for after tast``e, this might be due to more dry fenugreek leaves quantity in CTRS6. SPFM4 scored more when compared to CTRS6 for shape. As the control sticks were made with refined wheat flour it might not retain the shape of dye used in extruder. For overall acceptability there is no much difference in mean sensory scores.

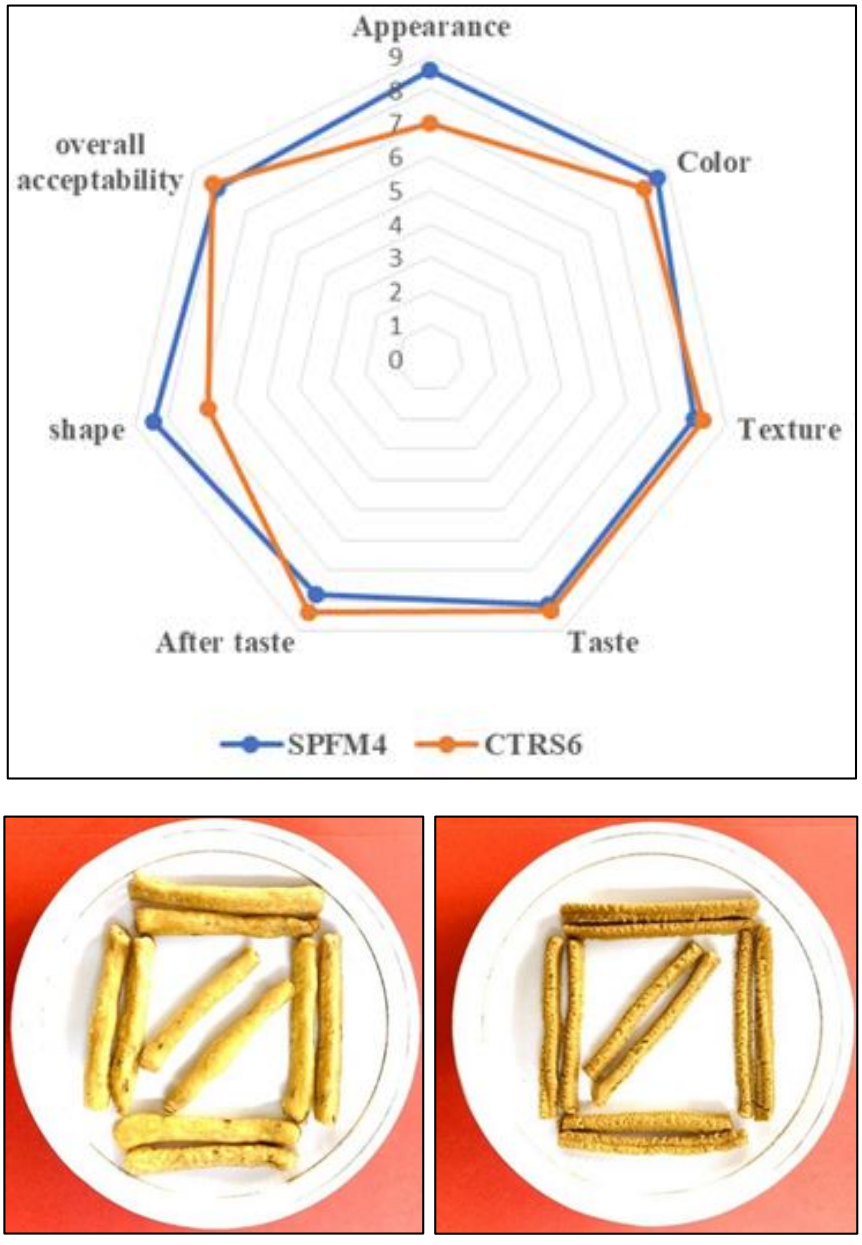

Fig 3: Comparison of sensory parameters between SPFM4 and CTRS6

Conclusion

Millets are known for their nutritional importance. The results showed that SPFM4 that was prepared with 80 percent millets and other ingredients has the highest percentage in acceptability index that included all the sensory characteristics. It showed high mean scores for shape, appearance and colour sensory characteristics. There was no significant difference between control sticks (CTRS6) and minor millet baked sticks (SPFM4) and millet sticks will be a healthy snack.

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