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Development and Quality Evaluation of Ready-To-Cook (RTC) Foxtail Millet Based Savoury Snack Mix

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Abstract

Millets are recognized as nutrient dense 'Smart foods' owing to their superior nutritional profile, functional properties and health benefits. Among them, foxtail millet (*Setaria italica*) is rich in dietary fibre, protein, minerals and bioactive compounds, making it suitable for the development of convenient functional foods. The present study was undertaken to evaluate the suitability of foxtail millet for the development of an instant savoury snack mix. Foxtail millet grains were subjected to soaking (12, 18, 24 and 30h and germination (12, 24 and 36h) to enhance nutritional quality, digestibility and functional properties. Based on germination efficiency, soaking for 24 hours followed by germination for 36 hours was found to be optimal. The processed millet flour was incorporated at varying levels (50, 60, 70 and 80%) along with rice flour, besan, refined flour and spices to formulate ready-to-cook (RTC) savoury snack mixes. Sensory evaluation using a 9-point hedonic scale revealed that the formulation containing 70 per cent foxtail millet flour received significantly higher scores for appearance, texture, taste, flavour and overall acceptability. Functional properties such as bulk density, water absorption capacity, oil absorption capacity and colour parameters differed significantly with respect to control and milletsnack mix. Nutritional analysis indicated that the foxtail millet snack mix contained significantly higher protein (13.15g/ 100 g), crude fibre (2.79g/ 100 g), fat (3.59g/ 100 g), ash (4.67g/ 100 g) and mineral content compared to control. Consumer acceptability studies showed a higher preference for taste, ease of preparation and willingness to purchase. The study indicated that foxtail millet is highly suitable for the development of nutritionally rich, acceptable and convenient instant savoury snack mix health.

Keywords : Savoury snack mix, Germination functional quality, Consumer acceptability

Millets are termed as 'smart food' 'superfoods', which have high levels of desirable nutrients, easily digestible, distinct flavour, non-acid forming, gluten-free and non-allergic grains with unique food properties (Hema *et al.,* 2022). Millets are the most nutrient dense crops rich in nutrients and offer a number of health benefits. Since millets are more nutritious than conventional staples like wheat and rice, the Indian government has taken step to list them as nutricereals (Suman & Chandra, 2025).

India is leading in main streaming millets to put them on the plate of the average person, especially in view

of the rising significance of millets throughout the world and the United Nations General Assembly's announcement of the International Year of Millets-2023. They are a great option for under nutrition fortification since they are calorie rich as it contains 75.2 per cent of carbohydrates, 10-12 per cent proteins, 2.38-5 per cent fat and 351kcal of energy per 100gm of millet (Amadou *et al.,* 2013). Micronutrients including calcium, iron, zinc, dietary fiber and nutraceuticals like flavonoids and polyphenols contribute to their functional qualities in addition to macronutrients. Phytochemicals including phenolic acids, flavonoids, phytic acids and phytosterols have been discovered to be abundant in millets. Many disorders, including diabetes, cardiovascular disease and cataractogenes is prevented by consuming dietary fiber and phenolic substances (Chauhan *et al*., 2018).

Foxtail millet (*Setara italica*) has been identified as a major millet in terms of worldwide production, as it is the sixth yielding grain. It is a one of the easily cultivated cereal grain belonging to the *Setaria* genus, *Poaceae* family and subfamily *Panicoideae*. It is one of the world's oldest cultivated crop. At present, foxtail millet is being cultivated in 26 countries and ranks second in world production of millets (Amadou *et al.* 2013). Since, 2700 B.C. it is believed to have been one of the five sacred plants of ancient China. It is used as a food grain in Asia, South Eastern Europe and North Africa and is the most important minor millet in Japan. It is widely grown in India, Bangladesh, China and Japan. It contains significant levels of protein, fiber, minerals along with phytochemicals. Anti-nutrients such as phytic acid and tannin are also present in this millet but can be reduced to negligible levels by using suitable processing methods.

The foxtail millet is also reported to possess hypolipidemic, low-glycemic index and antioxidant characteristics (Sharma and Niranjan. 2018). However, low carbohydrate content in foxtail millet (60.9g/100g) has been reported by Ballolli *et al.* (2014). Apart from major nutrients, it is rich source of fiber and minerals. The fiber content varies from 7- 8 g and minerals 3-4g per 100g. Particularly it is rich source of zinc (40.4 ppm) and iron (27.19 ppm) among other millets (Chandel *et al.,* 2018). The nutritional profile of foxtail millet is also superior to the staple cereals such as rice and wheat and possess comparable contents of protein (12-19%), fat (5-9%), soluble fiber (3-4%), minerals (3.3mg%), iron (2.8mg%) and calcium (31mg%). It is also a greater source of vitamins like riboflavin, thiamine, niacin, folacin and β-carotene (Sunil and Venkatachalapathy, 2017). Foxtail millet has shown significant results in preventing cancer, hypo glycaemic and hypolipidemic effect. Foxtail millet is receiving commercial and research attention, as its cultivation is not very challenging from the point of agricultural inputs and can be grown in rough terrains (Sharma and Niranjan 2018). The Moscow Institute of Hygiene and Nutrition reported that foxtail millet contains a good concentration of linolic, linolenic and arachidonic acids which are essential fatty acids with many health benefits (Turalieva *et al*., 2021).

Now-a-days foxtail millet is available in many forms as dehulled grains, grits, semolina, rice, flour, Ready-to-Cook (RTC) mixes, Ready-to-Eat (RTE) products and instant foods. Unlike the olden days these foods are convenient and tasty, in addition to its health qualities. Convenience food consumption has increased in India due to factors including urbanization, a fast-phased lifestyle, more income and extensive travelling. Many functional foods which suits local tastes and preferences are the only factors influencing the present-day consumers. To drive the demand, more technologies are required for recipes tailored to the continental as well as foreign markets. Diversifying into new markets such as plant protein, functional foods and dietary fiber is essential for meeting today's consumers needs and also bringing millets up to the level of rice and wheat.

A wide range of recipes can be prepared with foxtail millets such as foxtail millet kheer, cutlet, pasta and flakes. Ready-to-cook (RTC) mixes or instant mixes are those which are normally in dry form need to be mixed with water before consumption which needs few minutes of cooking in water or steaming or frying and requires very less time for their preparation (Shobha and Ravishakarl 2017*)*. In this line

millet based beverage prepared out of processed grains or millets such as foxtail millet is already developed. Another effort has been made to develop foxtail millet instant snack mix and evaluate its quality parameters.

Material and Methods

The study was carried out at ICAR-AICRP on 'Post Harvest Engineering and Technology', University of Agricultural Sciences, GKVK Bengaluru. Foxtail millet was procured from AICRP (Small millets) and other ingrédients were procured from the local market in a single lot and refrigerated until further use.

Pre-treatment of Millet and Pulses for the Development of Instant Foxtail Millet Savoury Snack Mix

Foxtail millet were subjected to pre-treatment for diffčrent time duration of soaking and germination for the development of Instant mix as depicted in Table 1. As per the research paper by Bhuvaneshwari *et al*. (2020) the different millet grains were soaked and germinated for 12 to 24 hr. However, in this study germination was tried up to 36 hrs in order to check, whether longer duration will lead to better result.

Table 1

Germination trials of Foxtail Millet grains

Variation	Soaking (hrs)	Germination (hrs)	Germination percentage (%)
T1	12	12	19.00
		24	22.00
		36	47.20
T2	18	12	32.00
		24	54.30
		36	68.20
T3	24	12	45.60
		24	76.20
		36	85.70
T4	30	12	43.00
		24	46.20
		36	37.00

Formulation of Instant Foxtail millet Savoury Snack Mix

Foxtail millet savoury snack mix was standardized using 50, 60, 70 and 80 per cent of pre-treated foxtail millet flour (FMF). The other ingredient (OI) used for the preparation of savoury snack mix were roasted flours (besan flour, rice flour and refined flour) while chilli powder, salt, ajwain and jeera were kept constant for all the variations. Composition of Foxtail millet savoury snack mix are shown in Table 2 and the procedure for preparation has been mentioned in Fig. 1.

Sensory Analysis of developed Instant Foxtail millet Savoury Snack

The sensory evaluation of Snack was carried out using 9-point hedonic scale. Snack was evaluated

Table 2

Variation of ingredients for Instant Foxtail millet Savoury Snack Mix

Ingredients (g)	T1	T2	T3	T4
Foxtail millet flour	35	42	49	56
Rice flour	35	28	21	14
Besan flour	10	10	10	10
Maida	10	10	10	10
Chilli powder	4	4	4	4
Salt	2	2	2	2
Ajwain	2	2	2	2
Jeera	2	2	2	2
Total quantity	100	100	100	100

T1 -50:50 Foxtail millet flour (FMF): Other ingredients (OI), T2 -60:40 (FMF: OI), T3 -70:30 (FMF: OI) and T4 -80:20 (FMF: OI)

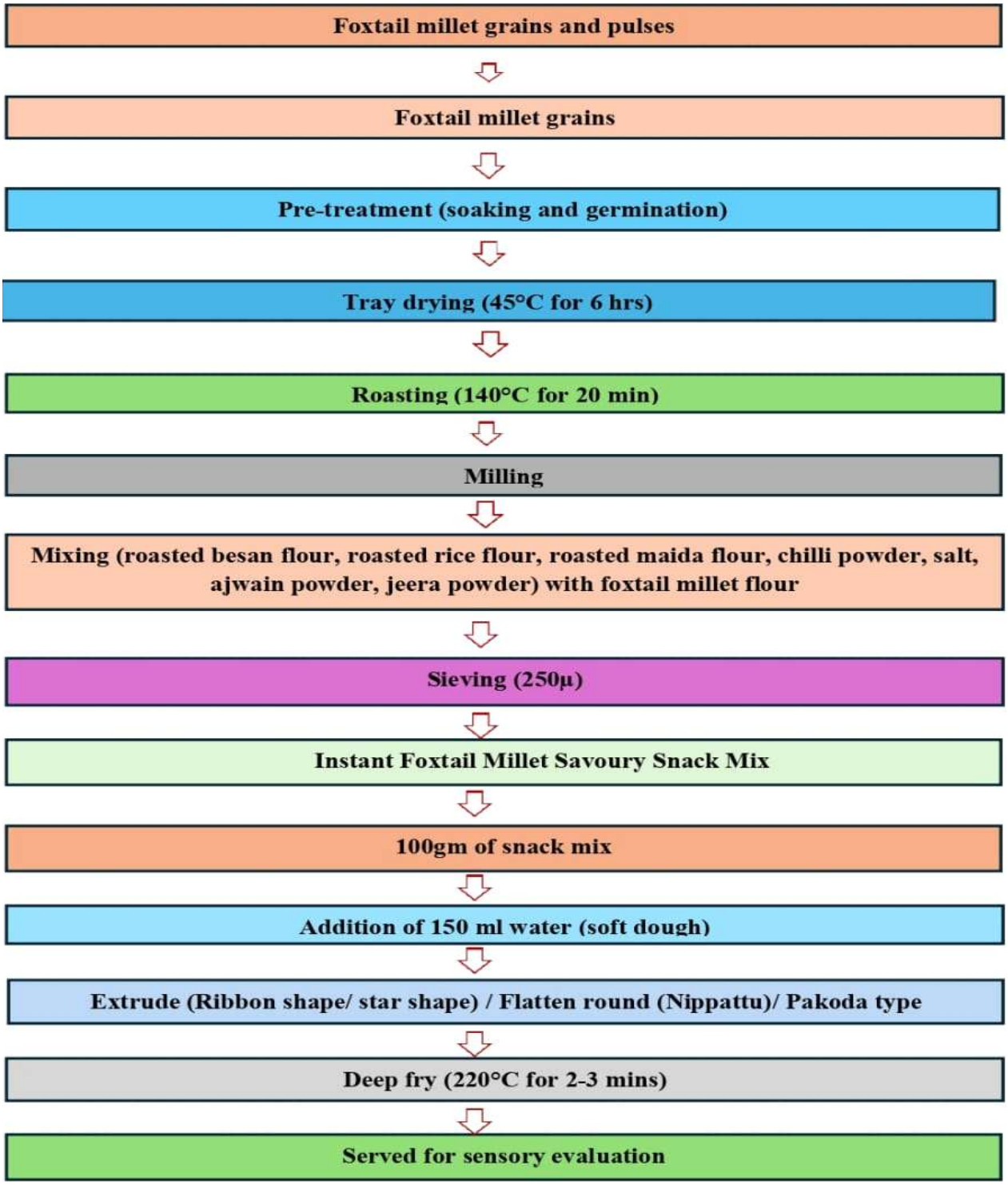

Fig. 1 : Flow chart for the preparation of RTC Foxtail Millet Savoury Snack Mix

for appearance, colour, texture, flavor, taste and overall acceptability. The analysis was carried out by 21 semi-trained judges comprised of Post graduate students and faculty of Department of Food Science and Nutrition who had previous knowledge in sensory evaluation.

Analysis of Functional Properties and Colour Parameters of Developed Instant Foxtail Millet Savoury Snack Mix

Developed instant foxtail millet snackmix was analyzed for bulk density (g/ml) was determined following the procedure described by Goula and Adamopoulos (2008). In this method, a known weight of the sample is gently poured into a graduated cylinder or a measuring container without compacting it. The volume occupied by the sample is then recorded and water and oil absorption capacity was carried out according to the methods described by Bhat and Yahya (2014), where in weight of the sample is mixed with a known amount of water or oil, then allowed to stand for a specific time period before centrifugation or settling. The amount of water or oil absorbed is then measured.

Colour analysis was carried out by using spectrophotometer (Konica Minolta Instrument, Osaka, Japan; Model-CM 5). It is a lightweight, compact tristimulus colour analyzer for measuring the reflected light of sample. After initial calibration of the instrument observation was done with a white colour standard, then the samples were placed on the measuring head and the colour was measured in terms of *L* a** and *b**. The samples from each treatment and replication were measured for L* (*i.e.* [-] to [+] lightness coordinate), a* (*i.e.*, green [-] to red [+]) and b* (*i.e.*, blue [-] to yellow [+]).

Nutritional Composition of Developed Instant Foxtail Millet Savoury Snack Mix

Developed mix was analyzed for moisture, protein (Kjeldhal method), fat, ash and crude fiber contents by AOAC, (2005) standard procedure. Carbohydrate content was computed by using differential method and energy was calculated using the formula

Carbohydrate (g/100g) = 100 - [protein (g) + fat (g) + fiber (g) + ash (g) + moisture (g)

Energy (Kcal) = [Protein (g) × 4] + [Carbohydrate (g) × 4] + [Fat (g) × 9]

For mineral estimation, the samples were prepared by dissolving the ash obtained after ashing the samples in a muffle furnace in dilute hydrochloric acid (1:1 v/v). Major minerals such as calcium, iron, zinc, copper, manganese, phosphorus, sodium and potassium were estimated. Titration method was used for the estimation of calcium and magnesium. Atomic Absorption Spectrophotometer (Model: Pinnacle 900F) is used for the estimation of zinc, iron, copper and manganese. Flame Photometer (Model: Systronic Flame Photometer 128µ) is used for estimation of sodium, potassium and phosphorus.

Consumer Acceptability of developed Instant Foxtail Millet Savoury Snack

The general acceptability of the developed instant foxtail millet snack mix was carried out by serving the snack to different age group people (200) such as children, adolescents and adults and asked them to put (√) mark against the parameters given in kannada format indicating their opinion towards the product whether they like, dislike or neutral towards the product.

Statistical Analysis

Analysis of the data was carried out in triplicates. The data was analyzed statistically for the Mean, Standard Deviation and ANOVA was used to test the significance among different levels of foxtail incorporated product using Analysis of Variance test at 0.5 per cent significance level.

Results and Discussion

Foxtail millet grains were pre-treated with soaking and germination to increase their nutritional value, digestibility, cooking quality and hydration in order to prepare Instant snack mix.

The effect of soaking time and germination time on germination quality in terms of per cent germination was assessed in order to select the best treatment with good germination percentage, as shown in Table 1. Foxtail millet grains were kept in a seed germinator at a constant temperature (24.73°C) and relative humidity (90%) for 12, 18, 24 and 36 hours after being soaked for 12, 18, 24 and 30 h. The soaking time and germination time were standardized with modification

from Bhuvaneshwari *et al.* (2020) as foxtail millet grains are having harder seed coat than finger millet, hence soaking time and germination time were varied for longer duration of time based on filler trials. Further, the soaking time and germination time varies with in the variety or genotype, seed dormancy, age of the seed and storage conditions. Similar type of trials was also reported by Swami *et al* (2013). Grains that were soaked for 12 and 18 hours and then germinated at 12, 24 and 36 hours showed signs of partial germination, with the shorter soaking time showing delayed sprouting. Higher and more consistent germination rate (85.7%) was seen in the grains that were soaked for 24 hours and followed by germination for 36 hours, suggesting ideal duration for sprouting. But soaking beyond 30 hours resulted into too hydrated and spoiled grains. The outcomes made it abundantly evident that soaking and germination time have a significant impact on sprouting quality. Hence, further value addition is being studied for treatment T3, which involves soaking foxtail millet for 24 hours followed by germination for 36 hours which resulted into better germinated grains for the development of instant mix.

The best combination of soaking and germinated millet was dried in a tray dryer for 6 h @ 45 °C, dried grains were roasted at 140 °C for 20 mins and then grind to make fine flour followed by pulverizing. As per the formulation, all the ingredients were mixed properly and sieved in 250µ to obtain instant foxtail millet snack mix (Fig. 1). Similar study by Bhuvaneshwari *et al*. (2020) reported that millets such as little millet, foxtail millet, pearl millet, finger millet and kodo millets, soaked for 12 and 24 hours followed by germination for 12 and 24 hours result into better germinated grains. The most effective treatment for improving nutritional quality was soaking for 24 hours and germination for 24 hours. Similar study by Swami *et al.* (2013) developed finger millet malt revealed that millet was steeped at room temperature for 4 hrs followed by germination for 8, 12, 16, 20 and 24 hrs in a moist cloth as per the author, among all the treatments, finger millet soaked for 4 hrs followed by germination for 24 hrs was best accepted for making malt.

Standardization of Instant Foxtail Millet Savoury Snack Mix

In India, rice flour, besan flour and spices are typically combined to make traditional savoury snacks of varying taste and shapes. In this study, processed foxtail millet flour, rice flour, besan flour and refined flour were combined with salt, ajwain, jeera and chilli powder in right amounts to create a foxtail millet savoury snack mix (FSSM). Different ratios of processed foxtail millet flour and rice flour were used to formulate different variations such as 50:50 (Foxtail millet flour (FMF): other ingredients (OI)), 60:40 (FMF: OI), 70:30 (FMF: OI) and 80:20 (FMF: OI). The final mix was then mixed with spices in order to make it ready to cook (RTC) mix. While preparing snack, the mix need to be mixed with appropriate quantity of water (175ml/100gm) and kneaded into a soft dough. The dough maybe extruded into ribbons or flattened to get nippattu. The produced mix was used to make *ribbon* and *nippattu*, which were then deep-fried in hot oil for 2 to 3 minutes till they turned golden brown and crisp and were subjected to sensory evaluation.

Sensory Evaluation of Prepared Instant Foxtail Millet Savoury Snack Mix

Perusal of Table 3, indicated that the sensory evaluation of snack prepared with varying amounts of pre-treated foxtail millet incorporation. Among all the variations tested, T3 (70:30 FMF: OI) had significantly higher overall acceptability score. It was also rated significantly higher scores for appearance (8.71), colour (8.63), texture (8.73), taste (8.78) and overall acceptability (8.74). According to these ratings, T3 combination of foxtail millet flour (70:30) and other ingredients produced a pleasing texture and flavour that increased the customer preference. However, all the formulations were within an acceptable range, according to statistical analysis, which showed substantial variations among treatments for sensory measure. Statistically, the treatment T3 was the most accepted formulation for savoury ribbon/Nippattu preparation. Similar study by Rani *et al*. (2019) developed quick puttu

TABLE 3

Mean sensory scores of Ready-to-Cook (RTC) Instant Foxtail millet Savoury Snack

Variations	Appearance	Colour	Texture	Flavour	Taste	OAA
Control	8.66 ± 0.24	8.53 ± 0.21	8.67 ± 0.31	8.71 ± 0.29	8.55 ± 0.32	8.62 ± 0.31
T1	7.89 ± 0.26	7.95 ± 0.32	8.53 ± 0.38	8.62 ± 0.33	8.43 ± 0.27	8.42 ± 0.36
T2	8.3 ± 0.31	8.10 ± 0.41	7.43 ± 0.22	7.88 ± 0.36	7.73 ± 0.31	8.52 ± 0.27
T3	8.71 ± 0.37	8.63 ± 0.28	8.73 ± 0.29	8.78 ± 0.31	8.64 ± 0.46	8.74 ± 0.31
T4	7.98 ± 0.42	7.65 ± 0.29	7.04 ± 0.42	7.42 ± 0.43	7.64 ± 0.25	7.54 ± 0.45
F- value	*	*	*	*	*	*
SEm±	0.13	0.08	0.14	0.11	0.13	0.11
CD at 5%	0.36	0.39	0.43	0.41	0.42	0.35

* Significant at (5%), Values are mean ± standard deviation,CSS- 50:50 Rice flour (RF): Other ingredients (OI), T1- 50:50 Foxtail millet flour (FMF): Other ingredients (OI), T2- 60:40 (FMF: OI), T3- 70:30 (FMF: OI) and T4- 80:20 (FMF: OI)

mix using finger millet and foxtail millet. In order to create the formulations, different percentages of finger millet and foxtail millet were combined with additional ingredients at 25, 50, 75 and 100 per cent. The instant millets puttu mix with a 50:50 ratio of finger and foxtail millets was determined to be superior in terms of general acceptability (8.21), appearance (8.73), taste (8.17), flavour (8.10) and texture (8.17) among all the variations tested. Similar study by Shobha and Ravishankar (2017) on development of multi purpose mix using 50, 60 and 70 per cent *ragi* flour in addition to other ingredients to develop multipurpose mix which can be used for preparation of traditional dishes like *dosa, thalipattu* and *vada*. A panel of 21 semitrained judges assessed for items like *vada, dosa* and *thalipattu*, indicated 50 per cent *ragi* flour-incorporated multipurpose mix was shown to have significantly higher sensory scores than the other two levels of ragi flour incorporation (60% and 70%). The *dosa* (4.00), *vada* (3.80) and *thalipattu* (3.60) had an overall acceptability (OAA) on 5- point hedonic scale. Similar study by Dhumketi *et al*. (2017) formulated upma mix which composed of foxtail millet semolina and wheat semolina with ratios of (0:95, 75:20, 65:30, 55:40, 45:50, 95:0). Among these variations, 75 per cent foxtail millet semolina, 20 per cent wheat semolina and 5 per cent soy grits received the highest sensory scores across all attributes, including color and appearance (8.42), taste (8.25), flavour (8.63), texture (8.30) and overall acceptability (8.42) respectively.

Functional Properties and Colour Analysis of the Instant Foxtail Millet Savoury Snack Mix

The functional properties of the control savoury snack mix (CSSM), which was made with rice flour and the RTC foxtail millet savoury snack mix (FSSM) differed significantly ($p<0.05$). The FSSM (0.54 g/ml) had higher bulk density compared to CSSM (0.52 g/ml) was caused by the smaller particle size and improved packing ability of millet flour (Subramanian and Viswanathan 2007) and the greater soluble fiber and damaged starch in the millet, which improved water binding, as evidenced by the increased water absorption capacity of FSSM (136.09%) as compared to CSSM (130.68%), As per Abedin *et al*. (2025). The higher oil absorption capacity of CSSM (83.16%) than FSSM (78.40%) is attributed to more hydrophobic protein sites which repel water and entrap oil which is similar to the findings of Mohamed *et al.* (2009). Similar line of work by Yadagouda and Ravindra (2022) reported the functional properties of the foxtail millet composite mix. The bulk density

TABLE 4

Functional quality and colour analysis of Instant Foxtail millet Snack Mix

Parameters	Control	FSSM	t-value
Bulk density (g/ml)	0.52 ± 0.03	0.54 ± 0.01	*
Water absorption capacity (%)	130.68 ± 0.04	136.09 ± 0.08	*
Oil absorption capacity (%)	83.16 ± 0.11	78.40 ± 0.10	*
*L**	78.91 ± 0.06	76.6 ± 0.04	*
*a**	5.96 ± 0.04	5.79 ± 0.07	*
*b**	14.61 ± 0.02	12.37 ± 0.05	*

Note : Values are mean of three replications, Values are mean ± standard deviation
* Significant at (5%), *L**: Lightness, *a**: redness, *b**: yellowness

TABLE 5

Nutritional composition of Foxtail Millet Savoury Snack Mix

Nutrients	CSSM	FSSM	t-value
Moisture (%)	5.70 ± 0.1	5.07 ± 0.11	*
Protein (g)	12.36 ± 0.12	13.15 ± 0.13	*
Fat (g)	2.48 ± 0.02	3.59 ± 0.03	*
Ash (g)	4.16 ± 0.03	4.67 ± 0.05	*
Crude fibre (g)	2.05 ± 0.12	2.79 ± 0.11	*
Carbohydrates (g)	71.25 ± 0.2	68.62 ± 0.9	*
Energy (Kcal)	356	359	*
Calcium (mg)	40.2 ± 0.5	49.6 ± 0.7	*
Phosphorus (mg)	142.8 ± 0.06	240.1 ± 0.09	*
Magnesium (mg)	54.6 ± 0.3	83.2 ± 0.4	*
Sodium (mg)	80.01 ± 0.3	97.02 ± 0.5	*
Potassium (mg)	302.4 ± 0.8	375.2 ± 0.7	*
Copper (mg)	0.24 ± 0.12	0.31 ± 0.13	*
Manganese (mg)	1.50 ± 0.09	1.60 ± 0.04	NS
Iron (mg)	2.08 ± 0.11	2.87 ± 0.12	*
Zinc (mg)	1.40 ± 0.16	2.08 ± 0.11	*

Values are mean ± standard deviation, *: Significant at (5%), NS: Non-significantCSSM: Control savoury snack (70:30 rice flour: other ingredients), FSSM: Foxtail millet savoury snack (70:30 foxtail millet flour: other ingredients)

(0.90g / ml), solubility (0.85 %), swelling power (4.12%), water and oil absorption capacity were 1.29 and 1.05 g / ml, respectively. Similar study by Gull *et al.* (2015) reported that bulk density of pearl millet and finger millet flours ranged from 0.67g/ml and 0.54g/ml. Finger millet flour's oil absorption capacity (OAC) was 1.93 per cent, whereas pearl millet flour's OAC was 1.60 per cent respectively.

One of the most important aspect which influencing the product's shelf life and food acceptability is the

colour, which indicates the type of processing the product has undergone. The hue of the mix was noted using the *L*, a** and *b**values.

The best accepted foxtail millet savoury snack (FSSM, 76.60) was less brighter than CSSM (78.91), as foxtail millet had a greater fibre and phenolic content which tend to limit brightness hence, the millet based mix had a darker tint or less lightness. The redness value dropped in CSSM (5.96) compared to FSSM (5.79), presumably as a result of the millet flour diluting the reddish hue of the rice flour used in the control mixture. The yellowness value was also greater in CSSM (14.61) than in FSSM (12.37), which might be explained by the millet pigments masking effect which lessens the stronger yellow tones that rice flour provides. Study by Yadagouda and Ravindra (2022) evaluated the foxtail millet composite mix and revealed that the lightness value (78.97), a* (-0.98) and b* (23.7) indicating a slight green colour of the mix due to millet addition.

Nutritional Composition of the Instant Foxtail Millet Savoury Snack Mix

The nutritional composition of RTC mixes (both macro and micro nutrients) was assessed in the current study is presented in Table 5.

The results of the study revealed that the incorporation of foxtail millet had significantly influenced the nutritional quality of the developed savoury snack mix when compared with the control.

The FSSM sample contained significantly higher amounts of minerals such as calcium (49.6 mg), phosphorus (240.1 mg), magnesium (83.2 mg), s odium (97.02 mg), potassium (375.2 mg), copper (0.31 mg), manganese (1.60 mg), iron (2.87 mg) and zinc (2.08 mg) when compared to CSSM, which contained calcium (40.2 mg), phosphorus (142.8 mg), magnesium (54.6 mg), sodium (80.01 mg), potassium (302.4 mg), copper (0.15 mg), manganese (1.50 mg), iron (2.08 mg) and zinc (1.40 mg), respectively. Similar study by Shaivya and Sunita (2016) on the nutritional content of value added product using pearl millet, quinoa and prepared ready to use *upma mixes*. The nutrition composition of pearl millet *upma mix* indicated that it contained protein (13.29%), fat (23.17%), carbohydrates (53.49%), calcium (23.9 mg) and vitamin C (19.5 mg) while the nutritional composition of quinoa *upma mix* is found to contain protein (13.29%), fat (23.17%), carbohydrates (53.49%), calcium (27.96 mg) and vitamin C (14.69 mg) per 100 gram of product/ mix. Similar study by Selvi *et al.* (2013) on development of nutrient rich instant pittu mix by adding standardized proportions of kodo millet and barnyard millet. The proximate composition of the milletbased instant pittu mix significantly more in moisture (10.70), protein (7.30), starch (51.80), fat (1.00), crudefibre (3.10) respectively.

Consumer Acceptability

Consumer acceptance is a crucial factor in product development. Aligning products with consumer needs is a priority for market oriented firms, as consumer acceptability often drives repeated purchases and contributes to longterm business success (Resano *et al.,* 2010). Understanding consumer preferences is essential for product development and quality control. Incorporating consumer feedback can provide a competitive advantage, ensure sustained market presence and prevent detrimental changes in product quality and acceptability. RTC snack product (Ribbon) was served to 200 different age group consumers including children and adults (male and female) of University of Agricultural Sciences, GKVK, Bengaluru.

The results of Table 6 indicated that consumer acceptability ratings of foxtail millet savoury snack was in 88 per cent of consumers (children and adults) liked that the taste was delicious and in terms of appearance, it scored less (85 %). This may be due to consumers are used to regular ricebased ribbons for a long time. About 87 per cent of consumers were willing to buy the product and 84 per cent of

TABLE 6

Consumer acceptability of foxtail millet savoury snackfrom RTC mix (n=200)

Consumer acceptability ratings	Like		Dislike		Neutral	
	No	%	No	%	No	%
Food tasty/delicious	176	88	16	8	8	4
Product appearance is good	170	85	20	10	10	5
Easy to prepare/cooked at home	168	84	16	8	16	8
Willing to buy	174	87	20	10	6	3
Over all product is good	166	83	22	11	12	6

consumers agreed to prepare it at home. The overall product was accepted by 83 per cent of consumers. Similar study by Shobha and Brundha (2019) on development and quality evaluation of *Popcorn Nutri Bar* along with other ingredients indicated that popcorn nutri bar stored in PET jars was acceptable upto six weeks at room temperature. The consumer acceptability scores revealed that about 84-92 per cent of the children rated the *Popcorn Nutri Bar* as 'very good'. Similar study by Brundha *et al.* (2022) on development of ready-to-cook (RTC) bisibele bath mix using Response Surface Methodology (RSM) indicated that 84 per cent of the consumers, including those from rural and urban areas, rated the little millet bisibele bath as 'very good'. Similar study by Shobha and Ravishankar (2017) evaluated consumer preference for products prepared out of multipurpose mix such as *vada, thalipattu* and *dosa*forms. Children and adolescents preferred vada the most (43.34% and 43.12%), followed by *thalipattu* (33.33% and 36.20%) and dosa (3.33% and 20.68%), while adults favoured *thalipattu* (37.31%), over *vada* (32.84%) and *dosa* (29.85%). Overall, *vada* and *thalipattu* had the highest acceptability across age groups.

Overall millets are gaining popularity due to their health benefits. The nutritional composition of the foxtail millet savoury snack mix which can be used for the preparation of Ribbon/Nippattu or vada by just frying in oil was superior in terms of protein, mineral and crude fiber contents. The instant foxtail millet savoury snack mix was found to be nutritionally rich, offering good amounts of fibre, protein and essential minerals. Colour analysis showed appealing visual properties. Among the formulations, the 70 per cent foxtail incorporation along with other ingredients was most preferred combination scoring significantly more scores for taste and overall acceptability. Sensory evaluation of the RTC savoury snack mix confirmed strong consumer acceptance, especially among adults, likely due to increased health awareness. The product successfully combines nutrition, sensory quality and convenience, making it suitable for time scarcity and health conscious consumers across all age groups.

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