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Development and Sensory Parameter Evaluation of the Multi Millet (Proso, Kodo and Barnyard) Convenience Noodles

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ABSTRACT: Noodles are popular convenient wheat-based food consumed throughout the world. As, the millets based products consumption was very low, the study was carried out to increase consumption of millets with common product Noodles. In this study, multi millet flours (proso, kodo and barnyard millet) incorporation in proportions (20:20:20) was used to reduce refined flour in the production of noodles by extrusion technology. The study reports the effect of the multi millet flour incorporation on the sensory properties of the noodles. Variations in proportions of wheat flour replaced resulted in significant changes in the sensory properties of noodles. Among the multi millet convenience noodle formulations MMNF1 was sensorially best accepted in all the sensory attributes having colour score of (7.46±0.16), flavour score of (7.46±0.19) and overall acceptability score of (7.33±0.12). Among the multi millet convenience noodles MMNF1 had higher acceptability index percentage score (79.96). The biggest challenge is product development that may be the absence of gluten in the multi millet flour, color and texture of the millet noodles vary from wheat noodles that challenges the acceptance. The study contributes the nutritional quality, a good alternative for celiac patients with replacement of wheat and also increases the scope of product development.

Keywords: Sensory, Formulations, Guar gum, Multi millet, Proso millet, Kodo millet, Barnyard millet, Convenience.

INTRODUCTION

An increase in urbanization, westernization and mechanization in countries had led to a sedentary lifestyle and a diet having high energy foods patterns are contributing to several chronic degenerative diseases. Hypoglycemic effect of minor millets (viz., foxtail millet, little millet, kodo millet, proso millet and finger millet) with their high crude fibre, antioxidant, low carbohydrate content, low digestibility and presence of β-glucans which are water soluble gums is helpful in repairing glucose metabolism and related diseases (Subbulakshmi and Malathi 2020**)**.

Noodles are convenient, simple to prepare, fast-cooking, relatively cheaper with a long shelf life. Noodles are widely consumed throughout the world and their global consumption is next to consumption of bread. Global demand for the product is estimated to be nearly 100 billion servings. As the world market is expanding, it is important to conduct studies for the development and improvement of noodles quality by satisfying consumer demands World Instant Noodles Association (WINA, 2016).

The primary ingredient is wheat flour in noodles production, which has low levels of protein, fibre and necessary amino acid lysine. As a result, need to replace wheat flour with a variety of substances had grown in recent years. Utilizing flours from alternative indigenous crop sources such as millets are being used

as potential wheat flour substitutes for noodle making adding variety and functionality to the product (Lebot, 2009).

Noodles can be prepared from wheat, rice, buckwheat and starches derived from cereals, potato and pulses (Li *et al*., 2012). Every region and culture has their own preferences for noodles, this leads to the development of wide range of noodle products being served in different styles (Hatcher, 2001). Colour, texture and product styles must be taken into consideration while making noodles, as these can influence consumer acceptance (Hou, 2001; Crosbie and Ross 2005).

Millets have great potential for being utilized in different food systems by virtue of their nutritional quality and economic importance. There is a wide scope of their exploitation in different food products including bakery products, instant mixes and convenience food mixes (Subbulakshmi and Karpagavalli 2017). Millets have increased production per hectare and are resistant to diseases and pests. Millets can thus give a solution to obesity, malnutrition and chronic health issues (Kumar *et al*., 2018).

Due to their positive health effects, such as a low glycemic index, lowered risks of celiac disease and decreased likelihood of allergic reactions by consuming wheat-based products higher demand was created to gluten-free products by the consumers (Torbica *et al*., 2010). Rice noodles lack the cohesiveness and extensive textural qualities of gluten, to enhance the quality of rice noodles so that they are comparable to wheat-based noodles, such as the addition of other starches, flours and other components such as hydrocolloids, emulsifiers and stabilizers (Yalcin and Basman 2008; Inglett *et al*., 2005), which may serve to attenuate the impact of gluten.

In India, variety of traditional foods made from small millet grains, form staple diet for many rural and urban households (Vidyavati *et al*., 2004). Numerous technologies had been developed to enhance utility and commercial value of these small grains (Sowbhagya and Ali 2001). Since people are becoming health conscious by having high fiber low fat content in their diet, noodles from millets can provide such nutritional value (Vidyavati *et al*., 2004). Consumer awareness about the health and the shift towards consuming lower glycemic alternatives such as whole grains was gaining popularity (Wee and Henry 2019). Therefore, the aim of the present study was to sensorially evaluate the developed multi millet (proso, kodo and barnyard) noodles in comparison with the refined wheat flour noodles.

Hydrocolloids are widely used as functional ingredients in the food industries. Starches and gums (hydrocolloids) are often used together in food systems to provide proper texture, control moisture, water mobility, improve overall product quality and stability, reduce cost or facilitate processing (Akanksha *et al*., 2016).

Previously several attempts were made by authors to prepare ragi noodles (Shukla and Srivastava 2014); however, the addition of ragi flour was limited to 30% based on sensory attributes. Dissanayake and Jayawardena (2016) developed a method for preparing 50% and 100% finger millet (FM) noodles and reported that noodles recovery was low, and breakage was high when compared to control rice.

MATERIAL AND METHODS

The present research study was conducted in Post Graduate and Research Center (PGRC), Professor Jayashankar Telangana State agricultural University (PJTSAU), Rajendranagar, Telangana District. The study was conducted on "Sensory evaluation of Multi Millet convenience noodles compared with control noodles". The main ingredients (multi millet flours) used in the development of multi-millet convenience noodles were purchased from millet dealers and distributors and the other ingredients like refined wheat flour, hydrocolloid guar gum was procured from local market. The convenience noodles were developed by using extrusion technology following the procedure of (Nilusha *et al*., 2019).

Table 1: Formulations for multi millet convenience noodles.

Sample	Proso Flour (g)	Kodo Flour (g)	Barnyard Flour (g)	Refined Flour (g)
MMNF1	20	20	20	40
MMNF2	35	17.5	17.5	30
MMNF3	20	40	20	20
MMNF4	22.5	22.5	45	10
MMNF5	33.3	33.3	33.3	-
CN	-	-	-	100

Note: All the formulations were repeated three times

MMNF1: Proso, kodo and barnyard millet (1:1:1) incorporated noodles

MMNF2: Proso, kodo and barnyard millet (2:1:1) incorporated noodles

MMNF3: Proso, kodo and barnyard millet (1:2:1) incorporated noodles

MMNF4: Proso, kodo and barnyard millet (1:1:2) incorporated noodles

MMNF5: Proso, kodo and barnyard millet (1:1:1) noodles, CN: Control Noodles

Procedure for the preparation of multi-millet noodles. All ingredients such as refined wheat flour, millets flour (*i.e*., proso, kodo and barnyard), were weighed as shown in Table 1. The weighed flours were sieved together using BSS 60 sieve to get uniform particle size. Hydrocolloid (guar gum) powder (2gm) was mixed with 10ml of hot water to make into a gel like consistency and was mixed uniformly to the weighed flours, flour mix was conditioned for 15 minutes by adding 250 ml of water (45˚C) and was transferred to the mixing vat of cold extruder (La Monferrina Pasta making machine, Agaram Industries, Hyderabad), thoroughly mixed for 10 minutes and was extruded using noodles die (1.5mm diameter). The extruded noodles were dried in tray drier (Thermo control systems, Hyderabad) for 7 hours at 60˚C to attain moisture content below 10% using the procedure (Hymavathi *et al*., 2019). The dried and cooled multi-millet noodles were packed in low density poly propylene (LDPE) covers. The raw and cooked multi millet convenience noodle products were presented in Plate 1 and 2.

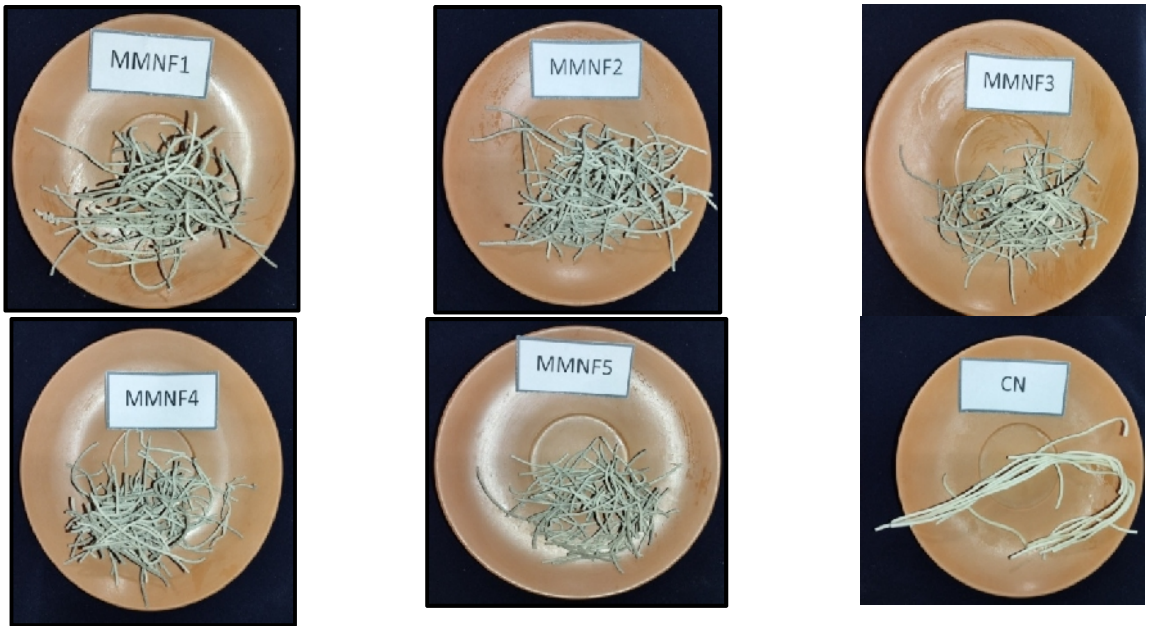


Plate 1. Raw multi millet noodle formulations.

Plate 2. Cooked multi millet noodles formulations.

Sensory evaluation: A semi-trained panel of 15 members from PGRC, PJTSAU using 9 point hedonic scale evaluated the colour, texture, flavour, taste and overall acceptability of cooked multi millet convenience noodles**.** The samples were presented in individual booths in the sensory evaluation lab as shown in Plate 3. Panelists rinsed their mouth with water after testing each sample. Scores were based on a 9 point hedonic scale of 1 to 9 where: 1=I dislike extremely (very bad) and 9=I like extremely (excellent) (Meilgaard *et al.,* 1999).

Plate 3. Sensory evaluation of Convenience noodle formulations.

Statistical Analysis: Statistical analysis was carried out analyzed to test the significance of the results using percentages, means and standard deviations (Snedecor and Cochran 1983). All the analysis was performed in triplications and the results were presented as mean ± standard deviation. Difference between the variables was tested for significance by (ANOVA) using SAS version 9.1.

RESULTS AND DISCUSSION

Sensory evaluation of standardized multi millet convenience noodles. Multi millet convenience noodles were developed using millet flours (proso millet, kodo millet, barnyard millet) and refined wheat flour in proportions and labeled as (MMNF1-20:20:20:40, MMNF2-35:17.5:17.5:30, MMNF3-20:40:20:20, MMNF4-22.5:22.5:45:10, MMNF5-33.3:33.3:33.3:0 and CN- 0:0:0:100). The sensory scores of multi millet convenience noodles was statistically analyzed for colour, flavour, taste, texture and overall acceptability were in the range from 8.33 to 4.00, 8.26 to 4.06, 8.26 to 4.00, 8.13 to 4.46 and 8.33 to 4.20 as shown in Table 2.

Table 2: Mean sensory scores of convenience noodle formulations.

Sample	Colour	Flavor	Taste	Texture	Overall acceptability
MMNF1	7.46^{b}±0.16	7.46^{b}±0.19	6.93^{b}±0.15	6.80^{b}±0.20	7.33^{b}±0.12
MMNF2	6.13^{c}±0.27	6.13^{c}±0.16	6.26^{c}±0.18	6.06^{c}±0.20	6.26^{c}±0.11
MMNF3	5.93^{c}±0.33	5.46^{d}±0.16	5.60^{d}±0.21	5.73^{c}±0.18	6.00^{c}±0.16
MMNF4	5.00^{d}±0.23	5.00^{d}±0.27	4.73^{e}±0.22	5.13^{d}±0.32	4.93^{d}±0.06
MMNF5	4.00^{e}±0.32	4.06^{e}±0.22	4.00^{f}±0.27	4.46^{e}±0.27	4.20^{e}±0.22
CN	8.33^{a}±0.15	8.26^{a}±0.15	8.26^{a}±0.11	8.13^{a}±0.19	8.33^{a}±0.12
Mean&SE	6.14±0.18	6.06±0.17	5.96±0.16	6.05±0.15	6.17±0.15
CD	0.51	0.53	0.42	0.59	0.41
CV (%)	1.58	1.05	9.73	1.47	5.23

Note Values are expressed as mean ± standard deviation for all the six determinants.
Means within the same column followed by common letter do not significantly differ at $p \leq 0.05$.
MMNF1: Proso, kodo and barnyard millet (1:1:1) incorporated noodles
MMNF2: Proso, kodo and barnyard millet (2:1:1) incorporated noodles
MMNF3: Proso, kodo and barnyard millet (1:2:1) incorporated noodles
MMNF4: Proso, kodo and barnyard millet (1:1:2) incorporated noodles
MMNF5: Proso, kodo and barnyard millet (1:1:1) noodles
CN: Control noodles

Colour scores of noodle formulations. The primary deciding factor for the acceptance of any product is colour. The multi-millet convenience noodles colour scores showed that the control noodles had highest score (8.33±0.15) compared to multi millet noodle products and among the multi millet noodle products MMNF5 (4.00±0.32) had lowest scores. The mean colour scores of multi millet convenience noodles in the decreasing order was MMNF1 (7.46±0.16) > MMNF2 (6.13±0.27) > MMNF3 (5.93±0.33) > MMNF4 (5.00±0.23) > MMNF5 (4.00±0.32). The multi millet convenience noodles are significantly differed and among the convenience noodles developed, 60% multi millet incorporation MMNF1 (7.46±0.16) had highest score next to control and least was observed in MMNF5 (100%) incorporation. The percentage change in colour of multi millet formulations compared to control given in Fig. 1 showed that MMNF1 had decreased percent change (10.44), whereas the percentage change of other multi millet noodle formulations was at a range of (-26.41 to -51.98) compared to control.

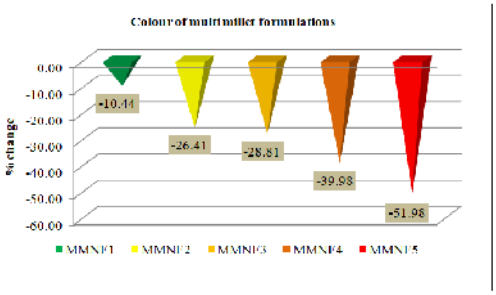


Fig. 1. Percentage change in colour scores of convenience noodle formulations.

Flavour scores of convenience noodle formulations. Mean sensory evaluation scores of convenience noodles showed that the control had highest score (CN-8.26±0.15) compared to all the multi millet products and the decreasing order of flavour scores was MMNF1 (7.46±0.19) > MMNF2 (6.13±0.16) > MMNF3 (5.46±0.16) > MMNF4 (5.00±0.27) > MMNF5 (4.06±0.22). Fig. 2 showed that the percentage change ranged from (-9.69 to -50.85) in which MMNF5 had

greatest percentage change of (50.85%) compared to control noodles.

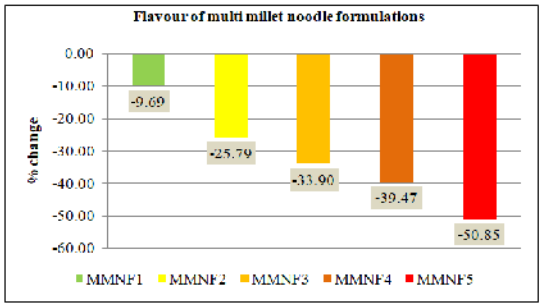


Fig. 2. Percentage change in flavour multi millet noodle formulations.

Taste scores of convenience noodle formulations. Compared to all the multi millet convenience noodles, control noodles had the highest taste attribute (CN-8.26±0.11). The taste score results of convenience noodles revealed that among multi millet formulations MMNF1 had the highest mean scores (6.93±0.15) compared to other multi millet noodles such as MMNF2 (6.26±0.18), MMNF3 (5.60±0.21), MMNF3 (5.60±0.21), MMNF4 (4.73±0.22), MMNF5 (4.00±0.27). The percentage scores given in Fig. 3 showed that MMNF1 had lowest percentage change (16%) for taste compared to noodles control.

Texture scores of convenience noodle formulations. The control noodle had the highest scores (CN-8.13±0.19) for texture compared to multi millet noodles. The multi-millet convenience noodles containing 60% multi millet flour i.e., MMNF1 had highest score for texture with mean score (6.80±0.20), MMNF2 (6.06±0.20), MMNF3 (5.73±0.18), MMNF4 (5.13±0.32) and MMNF5 (4.46±0.27). Percentage change of the texture attribute of multi millet noodles given in Fig. 4 showed that MMNF1 had decreased by (16.36) and MMNF5 had decreased by (45.14) compared to control.

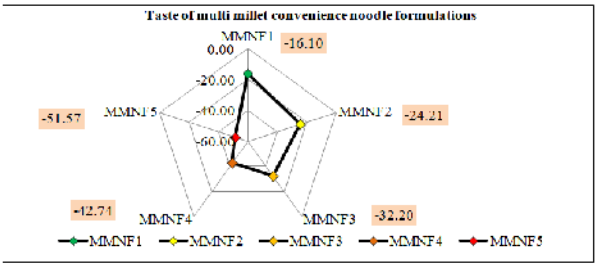


Fig. 3. Percentage change in the taste component of multi millet noodle formulations.

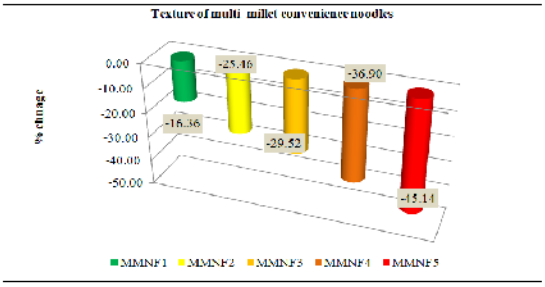


Fig. 4. Percentage change in textural attribute of multi millet noodle formulations.

Overall acceptability scores of convenience noodle formulations. The mean overall acceptability scores of convenience noodles was in the order of control noodles (8.33±0.12) > MMNF1 (7.33±0.12) > MMNF2 (6.26±0.11) > MMNF3 (6.00±0.16) > MMNF4 (4.93±0.06) > MMNF5 (4.20±0.22). The overall acceptability score was highest for control convenience noodles compared to multi millet noodles. Among the multi-millet convenience noodles MMNF5 had 49% decrease in percentage change compared to control overall acceptability as given in Fig. 5.

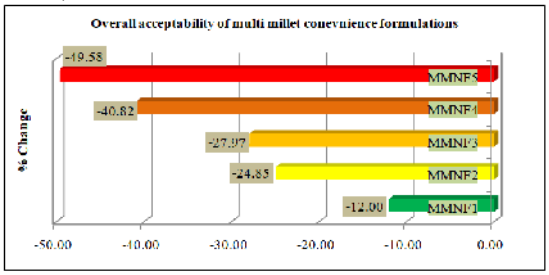
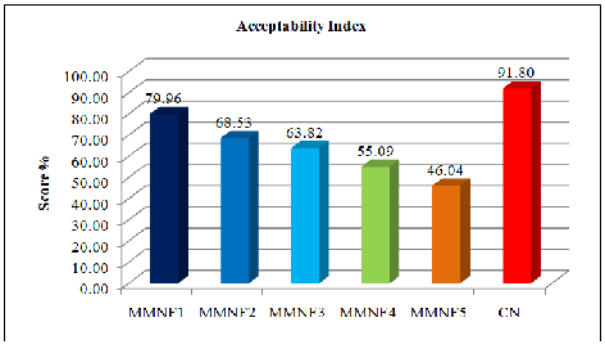


Fig. 5. Percentage change in overall acceptability of multi millet noodle formulations.

Almahi (2018) prepared noodles from wheat flour mixed with sorghum and millet and sensory scores of millet-noodle revealed that, the mixture of 10% scored between 5.50 (color) to 7.10 (taste) and the mean overall acceptability of 6.10 (about fairly good), while the mixture of 20% scored between 5.80 to 7.20 and the mean overall acceptability of 6.40 and the noodles of 30% scored between 6.00 to 7.00 and the mean overall acceptability of 6.30. Whereas the sensory scores of MMNF1 ranged from 6.80 to 7.46.

Sensory evaluation of noodles containing FMF (finger millet flour) revealed that noodles from 70:30 ratio of RWF (refined wheat flour) and FMF was liked very much, obtained score of 8.70 on the 9 point Hedonic scale. That noodles obtained similar preference score as control RWF noodles (8.66). Sensory evaluation of FMIN (finger millet incorporated noodles) by score card method revealed that 30% FMIN obtained significantly higher scores for colour, appearance, flavour, taste, texture, after taste and over all acceptability than 40 and 50% FMIN. Non significant difference was found between 30% FMIN and control noodles with regard to colour, flavour, taste, texture, after taste and over all acceptability except appearance (Shukla and Srivastav 2014).

Acceptability Index (%): Acceptability index (%) scores given in Fig 6 showed that control noodles had (91.80) highest score followed by MMNF1 (79.96), MMNF2 (68.53), MMNF3 (63.82), MMNF4 (55.09) and MMNF5 (46.04) which had least acceptability index.



Note: MMNF1: Proso, kodo and barnyard millet (1:1:1) incorporated noodles
MMNF2: Proso, kodo and barnyard millet (2:1:1) incorporated noodles
MMNF3: Proso, kodo and barnyard millet (1:2:1) incorporated noodles
MMNF4: Proso, kodo and barnyard millet (1:1:2) incorporated noodles
MMNF5: Proso, kodo and barnyard millet (1:1:1) noodles, CN: Control noodles

Fig. 6. Acceptability index (%) of convenience noodles.

Almahi (2018) studied the sensory evaluations of millet-noodles prepared with wheat, sorghum and millet revealed that, mixture of 10% ranged from 5.50 (colour) to 7.10 (taste) and the mean overall acceptability was 6.10 (fairly good). The 20% of the mixture scored between 5.80 and 7.20 and the mean overall acceptability was 6.40 and the noodles of 30% scored between 6.00 to 7.00 and the mean overall acceptability of 6.30. In contrast the multi millet convenience noodles of the present study, MMNF1 (60%) multi millet flour incorporation had sensory ratings varied from 6.80 to 7.46.

CONCLUSION

All the sensory properties showed significant difference at ($p \leq 0.05$). The results of sensory evaluation and acceptability (%) index revealed that MMNF1 that is prepared with 60% multi millet flour incorporation had highest mean sensory scores and acceptability index percentage (79.96) for all the sensory attributes due to their improved taste and texture when compared to other multi millet convenience noodle formulations (MMNF2-MMNF5).

FUTURE SCOPE

— The multi millet noodles can be blended with different vegetable purees in order to improve the sensory parameters.

— Usage of natural emulsifiers and binders like egg also increases the sensory and nutritional quality of multi millet noodles.

— Usage of different starch isolates to improve the textural attributes of noodles.

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Conflict of Interest. None.

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