Texture and Sensory Characteristics of Little Millet Based RTC (*Ready-To-Cook*) Noodles"

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Abstract

Millets are a group of small-seeded grasses, widely grown around the world as cereal crops/ grains. Ready to cook (RTC), and instant foods have become very common largely due to today's life style and the demand for quick-to-serve foods. The millet was collected and pre-processing done to develop the ready to cook mixes. Millet was Cleaned and washed under running water and soaked millet grains for (30 min) Parboiling of soaked grains (10-12 min). Parboiled grains were dried to14% moisture .The grains passed Ground to flour and sieved as Millet powder. The millet powder analysed for physical and nutritional properties. The formulations of millet at (60%, 70%, 80%) level the recipe such as noodles were prepared and the physical, nutrient, textural, sensory properties of the developed product were determined. The result concluded that form the nutrient analysis of millet and noddles it is well nutritious, especially fibre content and texture of noodles the skickness, chewiness is better for all variations in texture analysis and for sensory analysis RTC instant noodles 80%level well accepted by panel members. The finding studies are good nutritious product and recommend the nutritious break fast food.

Keywords-millet, RTC, readymix, instant noodle and organoleptic, texture

1. INTRODUCTION

Little millet is well known for its drought tolerance and is considered as one of the least water demanding crops. Being the first crop to be harvested in the season, it produces the much needed food grain among the tribal and is staple food for millions in many parts of the world. It is a good source of protein (7.7g/ 100 g), very rich in carbohydrate (67.0 g/ 100 g), fat (4.79 g/100 g), minerals and vitamins and should be considered as essential food for nutritional security (Nirmalakumari *et al*, 2010).Little millet has fat (4.7 g), crude fiber (7.7 g), iron (9.3 mg) and phosphorus (220 mg) per 100 g which is comparable to cereals and other millets (Gopalan et al. 2010). Dietary fiber content of little millet is the contributing factor for its low glycaemic index and a recent study conducted on little millet indicated that it exhibits hypoglycaemic effect due to its higher proportion of dietary fiber (Itagi et al. 2013)

Dietary fiber content of little millet is the contributing factor for its low glycaemic index and a recent study conducted on little millet indicated that it exhibits hypoglycaemic effect due to its higher proportion of dietary fiber (Itagi et al. 2013). It has a significant role in providing significant amounts of antioxidants and phytochemicals in the diet (Ushakumari and Malleshi 2007)considering the growing awareness among the consumers regarding the health benefits of millet, there is a need to meet the diversified demands for millet based food products.The Indian "*Ready to Eat*" (RTE) and "*Ready to Cook*" (RTC) food segment has emerged from its early days of being a fringe alternative to home cooked meal or to eating out. A fast-paced urban lifestyle, increasing prevalence of nuclear family structure, rising disposable income, increasingly larger number of globe-trotting Indians with an experimentative palate are all favorable demographic factors spurring the adoption of RTE and RTC foods in India. Further, the growth of modern retail has provided unprecedented brand and category visibility to convenience foods. (Rahman Tazyn,2012),(Henry C.J.K,1993) in his article stated that Convenience foods can be broadly defined as "Foods that have undergone major processing by the manufacturer such that they require little or no secondary processing and cooking before consumption". This means, apart form warming, thawing, cooking, frying, diluting and reconstitution, the food is ready-to-eat.

Noodles are widely consumed throughout the world and their global consumption is second only to bread. Instant noodles are widely consumed throughout the world and it is a fast growing sector of the noodle industry (Owen, 2001). This is because instant noodles are convenient, easy to cook, low cost and have a relatively long shelf-life. Wheat flour which is usually used to make instant noodles is not only low in fibre and protein contents but also poor in essential amino acid, lysine. Flour of hard wheat (*Triticum aestivum* L.) is the main primary ingredient (Fu, 2008). Pasta is a staple food product that is produced mainly by mixing durum wheat semolina and water. Pasta is widely consumed throughout the world and their global consumption is second only to bread. Instant fettuccine are widely consumed throughout the world and it is a fast growing sector of the pasta industry (Owen, 2001). The major objectives of the study are as follows: To study the physical-chemical and nutritional composition of little millet, to develop little millet ready to cook (RTC) convenience foods and study their organoleptic acceptability and texture evaluation and nutritional composition of the RTC noodles.

2. MATERIAL AND METHODS

2.1. Collection of samples

The selected millet namely little millet, were procured from local market Salem, Tamil Nadu, India. The millets were cleaned properly and stored in sealed containers till their use in different processing methods. The remaining raw ingredients such as wheat flour, egg, salt, were purchased from local market for the preparation of convenience food mixes.

2.2. Analysis of functional, chemical, anti-nutritional properties of selected little millet flours

2.2.1. Physical characterization of selected little millet

Physical appearance of grain is an important characteristic which determines consumer acceptability and hence the study of physical characteristics of the grains becomes a basic step in any research. Physical characteristics such as thousand grain weight, thousand grain volume, hydration capacity and index, swelling capacity and index, cooking quantity/characteristics were analyzed using standard procedures in triplicates.

2.2.2. Functional properties of little millet

The functional properties such as bulk density, water absorption capacity, oil absorption capacity, swelling power, solubility, solid loss was analyzed using little millet.

2.2.3. Nutritional properties of little millet

The Nutritional properties of millet such as pH, total titratable acidity, Moisture, Carbohydrate and Energy value, crude protein, , Ash, total starch, Amylose content, soluble amylose, total sugar , dietary fibre and mineral composition were determined using standard procedures.

2.2.4 Anti-Nutritional properties of little millet

The Anti-Nutritional properties of millet such as tannin, total phenolics and trypsin inhibitor were determined using standard procedures.

2.2. Standardization and development of millet based RTC (*Ready-to-cook*) noodles

Convenience also decides to a greater extent when, where, what and how to eat foods (Costa *et al.*, 2007) the dry milling process started with the cleaning of grains. The millet undergone certain process is discussed bellow:

Millet grains (little millet)

↓

Cleaned and washed under running water

↓

Soaked millet grains (5-6 hrs)

↓

Parboiling of soaked grains (10-12 min)

↓

Parboiled grains were dried to14% moisture

↓

Milling

↓

Millet Flour

Flow chart of preparation of millet processing

2.3. Preparation of RTC instant noodles from processed little millet flour

Three variations of Instant noodle were prepared by incorporating little millet and wheat flour at different levels. Wheat flour in the ratios 0:100 (standard), other three variations of instant noodles at 60%, 70%, 80% level of millet flour. The table-I shows the composition of different ingredients for Instant noodles preparation. The samples were cooled, packed in containers and stored at normal condition.

Table 1: Variations for the preparation of RTC instant noodles

S. No.	Ingredients	Control	V1	V2	V3
1	Refind wheat flour (g)	100	40	30	20
2	Millet flour Little millet (g)	-	60	70	80
3	Egg (no)	1	1	1	5
4	Water(ml)	40	40	40	40
5	salt(g)	2	2	2	2
6	Gram masala (g)	3	3	3	3
7	Red chilli powder (g)	2	2	2	2

Preparation method for millets RTC (*Ready-to-cook*) instant noodles

Noodles processed in a noodle making machine.
↓
Millet flour + refined flour
↓
Dough prepared with the required level of water
↓
Roller compressed: Dough passed through the noodle extruder
↓
Sheeting
I Stage (4 mm thickness)
II Stage (2 mm thickness)
↓
Cutting: dough sheet passed through noodles cutting machine
↓
Noodles steamed for 15 minutes at 100°C
↓
Noodles cooled to room temperature
↓
Added taste maker pouch
↓
Packed and sealed in polyethylene pouches

Method to cook

Boiled 200ml water in a pan and added instant noodles and taste maker in boiling water Cook noodle under low flame after noodle get cook removed from the flame and served hot.

2.4. Physical analysis of the developed noodles

a) Cooking Properties of the developed noodles

Cooking Properties of Noodle Cooking time of noodle was determined as described by [14]. Noodle (10g) was cooked in 200 ml of boiling distilled water until disappearance of core as judged by squeezing between two glass slides. Cooked noodle was rinsed with cold water and drained for 1 min, and immediately weighed. Cooking water after determining cooking time was evaporated and dried at 105°C to constant weight.

b) **Cooking loss and water absorption of the developed noodles**

Cooking loss and water absorption were measured according to the AACC method [15] with some modification. Cooking loss (%) and water absorption (%) were calculated as follows equation of [16]. Cooking loss (%) = (Weight of dried residue in cooking water/ Weight of uncooked noodle) × 100 Water absorption (%) = ((Weight of cooked noodle - Weight of uncooked noodle)/Weight of uncooked noodle) × 100

c) Analysis of cooking time of the noodles

The degree of cooking can be observed either by eye or image analysis (Sozer et al., 2007) standard method by AACC (2000)

d) Analysis of length of the noodles

The length of the prepared noodles before and after cooking is measured using vernier caliper

2.5. Nutrient composition of the developed millet based RTC (*Ready-to-cook*) noodles

The developed millet based noodles were analysed for its nutrient profile. The major nutrients such as energy, protein, carbohydrates, fat, fibre, soluble and insoluble fibre were calculated for all the developed recipes using the standard procedures (Gopalan et al., 2011).

2.6. Organoleptic evaluation of the developed millet based RTC (*Ready-to-cook*) noodles

Organoleptic quality evaluation of the product plays an important role in the acceptance and preference of foods. The sensory evaluation is done in the all the variation. The sensory quality is the different senses of preparation of prepared noodles. All the developed RTC foods were evaluated for their acceptability by a semi trained panel of ten judges. Products were evaluated for sensory quality on the basis of appearance, colour, flavour, taste, texture and overall acceptability using a 9 point Hedonic scale by a panel of 10 judges (Larmond, 1977) score card with scores ranging from 9 to 1, where 1 = dislike extremely, 5= neither like nor dislike and 9= like extremely was used. Samples were coded and presented in a random sequence to the panellists.

2.7. Texture evaluation of developed millet based RTC (*Ready-to-cook*) noodles

Texture is a very important quality characteristic which makes a significant contribution to the overall quality acceptance of food products. It was one of the three main acceptability factors used by consumers to evaluate food, the other two being appearance and flavour (Bourne, 1990). All the variations of noodles will be subjected to texture analysis using a Texture Analyzer (TVT-300XP, Perten Instruments, Sweden) after the preparation. The parameter such as springiness, cohesiveness, chewiness, stickiness will be measured from the Texture Profile Analysis (TPA) according to the software provided by the company. All measurements for the texture analyses for each sample were performed more than three times, and the mean values were obtained.

2.8. Statistical Analysis

The data are compiled and analysed using statistical methods such as mean, SD, ANOVA. All these are performed and the results separated, using the Multiple Range Duncan Test ($P < 0.05$) and using the statistical software of SPSS 16.

3. RESULT AND DISCUSSION

Physical properties of little millet

Physical characteristics such as thousand grain weight, thousand grain volume, hydration capacity and index, swelling capacity and index, cooking quantity/characteristics were discussed bellow:

Table-2 Physical properties of little millet

Physical Parameter	Little millet
Thousand grain weight (g)	2.59±0.005
Thousand grain Volume (ml)	3.06±0.1
Hydration Capacity (g/1000 seeds)	1.61±0.02
Hydration Index (%)	61.5±0.05
Swelling Capacity (ml/1000 seeds)	0.21±0.01
Swelling Index (%)	6.71±0.02
Cooking Quantity	193.3±11.9

Values are mean ± standard deviations.

The table-II shows the thousand grain weights of little millet were 2.59 g respectively. The thousand grain volume of little millet was 3.06 ml. Grain volumes change significantly and most often, regularly at varying moisture contents. The hydration capacities of the little millet were 1.61 g/1000 seeds with the hydration index of 61.5% respectively. The little millet grain was found to have swelling capacity of 0.21

ml/1000 seeds (Phattanakulkaewmorie, 2011) stated that the presence of high protein, lipid, fiber and larger amount of amylose-lipid complex in flour could inhibit the swelling of starch granules.

Functional properties of little millet

The functional properties such as bulk density, water absorption capacity, oil absorption capacity, swelling power, solubility, and solid loss discussed bellow table-3

Table-3 Functional properties of little millet

Functional Parameter	Little millet
Bulk Density (g/ml)	0.44±0.005
Water Absorption Capacity (g/g)	0.94±0.02
Oil Absorption Capacity (g/g)	1.09±0.02
Swelling Power (g/g)	5.5±0.45
Solubility Per gram (%)	6.4±0.95
Solid Loss Per gram (%)	30.8±1.05

Water absorption capacity is important in the development of ready to eat foods, and high absorption capacity may assure product cohesiveness (Housson P, 2002). Water absorption capacity is about 0.94g and oil absorption capacity is1. 09g.Variation in fat absorption may be due to the variation in protein concentration, degree of interaction with water and oil and conformational characteristics (Butt MS, 2010). Swelling power, solubility, solid loss is 5.5g, 6.4g, 30.8 g respectively.

Nutritional properties of little millet

The Nutritional properties of developed recipes were discussed bellow table-4

Table-4 Nutritional properties of little millet

S:NO:	Parameters	Little millet
1.	pH	6.9±0.1
2.	Ash(g)	6.9± 0.1
3.	Total titrable Acidity	24.6±0.20
4.	Moisture(g)	9.8±0.20
5.	Crude Protein(g)	13.6±0.1
6.	Crude Fibre(g)	5.0±0.1
7.	Carbohydrates(g)	65±1.0
8.	Fat(g)	1.9±0.1
9.	Energy (Kcals)	331.5±0.58
10.	Total Starch(g)	18.5±0.15

11.	Amylose content(g)	28.4±0.1
12.	Sodium(mg)	16±1.0
13.	Potassium(mg)	347±1.0
14.	Iron (mg)	9.2±0.1
15.	Calcium(mg)	43±1.00
16.	Phosphorus(mg)	265±1.00

The table-4 shows that the nutrient content such as protein (13.6g), high fibre content (5.0), and calcium (43). The iron content is 9.2 g, amylose content is 28.4 g. The highest amount of energy source was noticed in little millet (331.5kcals) The process of germination greatly attributed protein increase to protein synthesis due to inclusion of microbial cells in to the flour. (Srichuwong et al., 2005)

Anti-Nutritional properties of little millet

The Anti Nutritional properties of developed recipes were discussed bellow:

Table-5 Anti- Nutritional properties of little millet

1.	Tannin (mg)	0.34±0.01
2	Total Phenolics (mg)	48.8±0.1
3.	Trypsin (mg)	0.24±0.01

The tannin content is 0.34gand phenolics 48.8.gand the trypsin inhibitors are 0.24mg in millet. Cooking by boiling, germinating and frying resulted in a significant reduction in the trypsin inhibitor content of tomatoes (Sahlin E et al., 2004).

Physical properties of developed Noodles

The cooking properties of the developed Noodles such cooking yield is given in the table-6

Table-6 cooking properties of the noodles

Variation	Cooking yield (%)	Cooking loss(%)	length of the noodles
Standard	166	150	15
Varation-1(60%)	266	148	10
Varation-2(70%)	283	147	8
Varation-3(80%)	300	149	7

From the above table it shows that the developed Noodles cooking yield for standard 166% and in varation-3(80%) there is increase cooking yield because of the water absorption capacity of millet the other varation-1(266%), varation-2(283%).The cooking loss is various in all variation of prepared noodles and length is decrease in varation-3 because of the presence of fiber content in millet.

Nutrient Analysis of developed Noodles

The Nutrient Analysis of the developed Noodles is given in the table-7

Table-7 Nutrient analysis of RTC developed Noodles

Nutrients	Standard noodle	Varation-1	Varation-2	Varation-3
Available carbohydrate	35.39 ± 0.80	31.46 ± 0.52	33.02 ± 0.67	35.30 ± 0.75
Protein	5.38 ± 0.11	6.59 ± 0.30	6.94 ± 0.04	7.31 ± 0.13
Total Fat	9.81 ± 0.02	9.34 ± 0.02	9.27 ± 0.03	9.07 ± 0.01
Total fibre	4.92 ± 0.28	5.40 ± 0.12	7.51 ± 0.05	8.07 ± 0.15
Soluble fibre	4.49 ± 0.45	4.22 ± 0.03	4.36 ± 0.08	4.53 ± 0.25
Insoluble fibre	1.43 ± 0.18	1.18 ± 0.03	1.95 ± 0.01	1.94 ± 0.03

Values are mean ± standard deviations.

As can be seen from table-V that available carbohydrate content (34.3g) High protein content (7.51g) and the high fibre content (8.07g). The soluble and insoluble fibre content in standard (4.49g, 1.43g) V1 (4.2g, 1.18g), V2 (4.36g, 1.95) V3(4.36g,1.94g). Nutritional evaluation of the selected fibre rich food items revealed that the fibre rich product have good nutritional value and found to be a good source of minerals (Bora and kulshrestha, 2014) The amount of fat content was found in standard noodle (9.81g) is high when compare to other variations. Similar results were reported by sambavi et al. (2015)

Organoleptic evaluation of RTC Noodle

Table-8Mean organoleptic scores of RTC Noodle

Type of variation	Appearance	Colour	Flavour	Texture	Taste	Overall acceptability
Standard	8.9000±.6500[a]	8.9000±.9000[a]	8.3000±.3000[a]	8.3000±.3000[b]	8.0500±.0500[a]	8.2000±.2000[a]
V_1	8.6500±.9000[b]	9.0000±.9000[a]	8.0000±.8.000[a]	7.7500±.7500[a]	8.5000±.5000[b]	8.8000±.5000[b]
V_2	9.0000±.9.000[b]	8.9000±.0000[a]	8.2000±.8.200[a]	8.8000±.8000[c]	8.5000±.5000[b]	8.5500±.5500[c]
V_3	9.0000±9.000[b]	8.9000±.9000[a]	8.8500±.2112[a]	8.9000±.9000[c]	8.9000±.9000[c]	8.9500±.9500[c]

Values are the means ± standard errors of means (SEM) of four (3) determinants. Means with same superscript are not significantly different using Duncan's Multiple Range Test ($P < 0.05$).

The noodle formulation (V3) prepared from 80% little millet flour, scored highest scores for all the sensory characters viz., colour and appearance (9.00), taste (8.90), flavour (8.85), texture (8.90), after taste (8.90) and overall acceptability (8.95) as compared to other modified combinations. This might be due to addition of fine little millet flour in appropriate combination resulting good colour, nice taste and fine texture of noodle. In appearance there is significance difference between the group and for other parameter such as flavour, colour, and taste texture and overall acceptability their is non-significance difference between the group.(Himabindu P.,2015) in his study that among all the formulations tried, noodle sample prepared from 70:30 flour combinations had same sensory score as that of control in wheat and malted kodo millet flour enriched noodles.

Textural characteristics of RTC Noodle

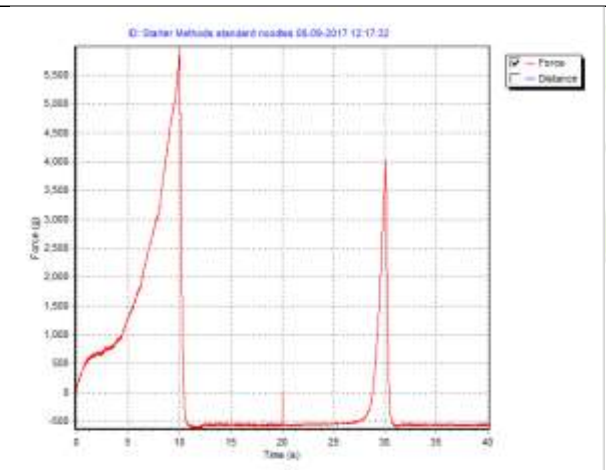
Textural characteristics of little millet incorporated RTC noodle is shown in table -9.

Table -9Textural characteristics of RTC Noodle

S.No	Sample	Cohesiveness (Ratio)	Springiness (S)	Stickiness (N)	Chewiness (C)
1	Standard	0.61±0.01	0.19±0.37	-62±0.27	44±0.42
2.	Varation-1(60%)	0.41±0.01	0.12±0.041	-65±0.67	84±0.89
3.	Varation-2(70%)	0.11±0.02	0.11±0.02	-98±0.64	62±0.45
4	Varation-3(80%)	0.90±0.21	0.10±0.040	-105±1.42	19±0.07

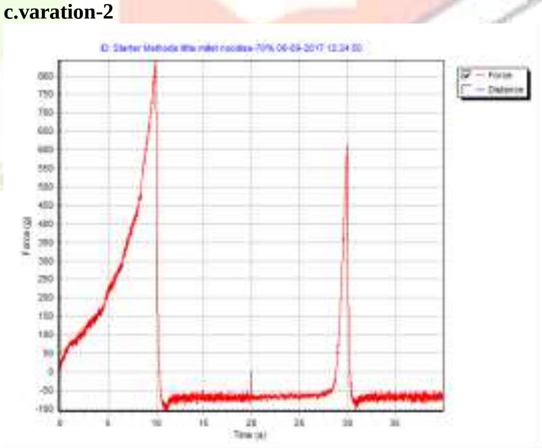
Cohesiveness is defined as the ratio of the positive force area during the second compression to that during the first compression. Cohesiveness is minimum (0.11) for the varation-2 and maximum (0.90) for the varation-3. The maximum springiness and chewiness shows in varation-3(80%) and the minimum for springiness in varation-3.In this study, minimum stickiness was present in varation-1(60%) (Shown in figure 1).apart from its energy contribution, starch content is the major factor which governs the texture of noodle and as a result, to the organoleptic properties of food.

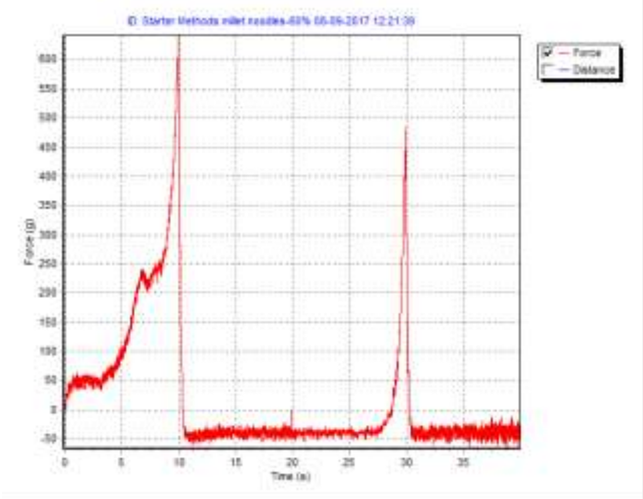
Figure-1Texture evaluation of RTC Noodle



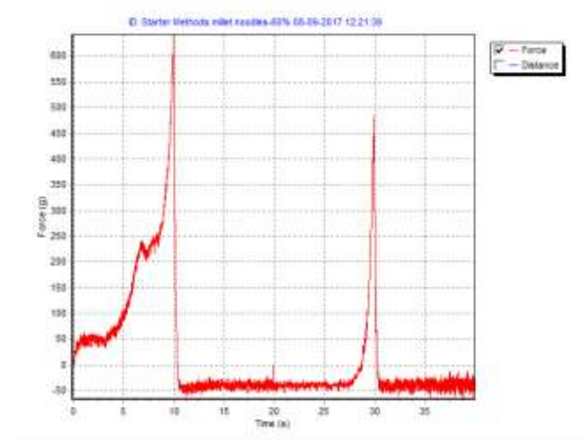
a.standard noodle

c.varation-2





b.varation-1



d.varation-3

4. CONCLUSION

To increase little millet utilization and add to diversification in the market, which is mostly dependent on products from wheat and rice. Therefore, an attempt was made to develop Ready-to-cook recipe from little millet by incorporating different levels of raw little millet (*Panicum Miliare L*.). A developed noodle is best substitutes for people who seek varieties and want foods with high fibre and low fat for good health. The increasing participation of women in working force and the interest of consumers in health foods has increased the demand for instant foods, ready-to eat snacks and ready-to-cook products with good nutritional profile. The millet is highly nutritious and rich in fibre content. The prepared ready-to-cook noodle is more nutritious and highly accepted by panel members. The texture is excellent for all variations of noodle. The mix is recommended for all the age group for nutritious breakfast because of the presence of fiber content in noodle. The findings of this study were useful and easy to carry journey food.

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