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Original Article

Flour and Dough Quality of Millets and Their Suitability for Preparation of Traditional South Indian Roti

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Abstract

Background: India is a land of millets. Millets are the most nutritious grains. India contributes to world's 35% production but the consumption of millet and their products is limited.
Objectives: The present study is to determine the flour and dough quality of different milletsand their Suitability for Preparation of Traditional South Indian Rotis (*viz*., Finger Millet, Kodo Millet, Foxtail Millet, Pearl Millet, Barnyard Millet, Little Millet, Proso Millet and Sorghum).
Materials and Methods: Eight varieties of millets were procured from local market of Kolar and utilized for the study.
Results: Among the eight varieties millets roti, the Little Millet roti scored highest among all and was at par with control sample. The appearance of Sorghum roti and flavor of foxtail millet roti was found as on par with the control sample.
Conclusion: Hence it can be concluded from the sensory evaluation of among the eight millets roti samples overall acceptability was found in Little Millet roti.
Key Words: Millets, bulk density, Swelling capacity, Rollability,

Introduction

Millets are an alkaline forming grain that is gluten-free. Millets are also rich sources of phytochemicals and micronutrients that play many roles in the body's immune system. Millets have nutraceutical properties in the form of antioxidants which prevent deterioration of human health such as lowering blood pressure, risk of heart disease, prevention of cancer and cardiovascular diseases, diabetes, decreasing tumor cases etc. Other health benefits of millets are increasing in time span of gastric emptying and provides roughage to gastro intestine. Millet is an alkaline forming food. Alkaline based diet is often recommended to achieve optimal health. [1] FAO reported that traditional food processing (such as decortications, milling, germination, fermentation, malting, roasting etc.) is commonly used for preparation of food products of millets to improve their edible, nutritional, and sensory properties.[2] Millets can be source of value-added healthy food-products with different varieties for traditional and nontraditional millet users.[3]

Nutritive value of these millets is quite comparable to wheat and rice. The non availability of refined and processed millets in ready- to- use form has limited their wider use and acceptability. Millets are therefore confined to traditional consumers and also to the people of lower economic strata. [4] Millets serve as a major food component specifically among the non affluent segments in their respective societies. Various traditional foods and beverages such as roti, bread (fermented or unfermented), porridge, snack and fast foods, baby foods, millet wine, millet nutrition powder etc are made up of millets.[5] The major factor discouraging the cultivation and consumption of few types of millets with improvement in living standard or urbanization is the drudgery associated with its processing. However, there is a need to restore the lost interest in millets that deserves recognition for its nutritional qualities and potential health benefits. Even though the nutritional qualities of millets have been well recorded, its utilization for food is confined to the traditional consumers in tribal populations, mainly due to non-availability of consumer friendly, ready-to-use or ready-to-eat products as are found for rice

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and wheat. [4] In recent years, millets have received attention, mainly because of their high fiber content and efforts are under way to provide it to consumers in convenient forms. [6] In many African and Asian areas, millets serve as a major food component and various traditional foods and beverages, such as bread (fermented or unfermented), porridges, and snack foods are made of millet, specifically among the non affluent segments in their respective societies. [7] Different studies on processing of millets have yielded promising results in their successful utilization for various traditional as well as convenience health foods. Accordingly different researchers have tried to develop processed products like popped, flaked, puffed, and extruded and roller dried products; fermented, malted and composite flours; weaning foods, etc. For example, exploratory studies on popping and milling of millets have been promising. [8] In India, because of their potential contribution to national food security, millet grains as a food resource receiving increasing attention from agriculture and food security policymakers. This study was conducted to explore the flour and dough quality of different millet and their Suitability for Preparation of Traditional South Indian Rotis.

Materials and Methods:

Test Material: Eight varieties of millets were procured from local market of Kolar and utilized for the study. The different millets that were procured are Finger Millet, Kodo Millet, Foxtail Millet, Pearl Millet, Barnyard Millet, Little Millet, Proso Millet and Sorghum. Grains were cleaned and were pulverized in a laboratory model Wiley mill and the whole flour was used to determine the flour and dough quality of millets and also to test the sensory qualities of traditional south Indian roti.

Flour Quality of millets:

Bulk Density:

Bulk density was determined as per the method as described. [9]

Swelling Capacity: Swelling Capacity of flour was found by standard procedure. [10] To determine the swelling capacity of flour, 0.5g flour was weighed into a 15 mL graduated centrifuge tube. Distilled water was added from a burette to the 5 mL mark and the volume of water noted (v_i). The flour and water were quantitatively transferred into a 50 mL tube, using an additional 10 mL distilled water, and then placed in a heating block at 90°C for 1 hr, with periodic shaking. After cooling, the suspension was transferred to a graduated centrifuge tube and centrifuged at 5000rpm (3015 X g) for 10 min. The supernatant was discarded. The excess water adhering on the sediment was removed using a tissue paper. The volume of the wet sediment was measured as described above (v_f). The weight of the wet sediment was also determined (w_f). The Results were expressed as a ratio of the final volume (v_f) or weight (w_f) to the initial volume (v_i) or weight (w_i) and reported as swelling capacity of flour on volume as well as weight basis.

Solubility (%)

Solubility (%) was found by multiplying the ratio of wet sediment (w_f) to initial weight (w_i) by 100. [11]

Sediment volume: Millet flour (1 g) was mixed with 95 ml of distilled water. The pH of starch slurry was adjusted to pH 7.0 using 5% NaOH/HCl followed by heating in a boiling water bath for 15 min. Distilled water was added to make the total weight to 100 g. The mixture was transferred to a 100 ml graduated cylinder and was sealed. The starch slurry was kept at room temperature for 24 h and volume of sediment consisting of starch granules was measured. [12]

Gel consistency: Flour samples (0.1 g, dry basis) were wetted in a test tube (16×150 mm) with 0.2 ml of 95% ethanol containing 0.025% bromothymol blue and dispersed in 2 ml of 0.2 N KOH. The tubes were heated in a vigorously boiling water bath for 8 min, cooled at room temperature for 5 min followed by cooling in an ice water bath for 20 min and then laid down horizontally for 1 h at room temperature. Longer the gel travel within tube implies the, lower consistency. [13]

Viscosity:

Viscosity of the cooked grains was measured by using line spread test (that measures the consistency of food in terms of their ability to spread on a flat surface) by noting the spread at four sides and taking the average Cooked paste viscosities of flour were tested at 10 per cent and 15 per cent slurry concentration. Concentric circles measuring up to 6 cm were drawn on a sheet and placed under a glass plate. A hollow cylinder (2" diameter) was placed over glass plate at the centre of concentric circles. Separately 10 and 15 per cent slurries were prepared and cooked in boiling water bath for 30 minutes. These cooked hot samples were poured to fill the cylinder individually. The cylinder was carefully lifted and flow of liquid was measured as viscosity. The spread of the slurry was measured at four different direction and average calculated viscosity

Dough quality of millets

Dough and roti preparation

Rotis were prepared from the whole flour of pearl millet as described by. [10] To 50g flour, hot water (about 90°C) was added in small increments, mixed well and kneaded by hand until appropriate consistency was obtained. The volume of water required to achieve the desired dough consistency was noted and calculated as mL required for 100g flour and the final weight of the dough was measured.

Dough handling property:

The Dough handling property was determined by observing the cohesiveness of the dough. After kneading well, the cohesiveness of dough was subjectively evaluated using a score of 1 to 3, where 3 is sticky, 2-slightly sticky and 1 is non sticky, and expressed as Dough Handling property.

Rollability:

For evaluating Rollability, the procedure was followed as described in Subramanian [10]. The dough was prepared as described above using another 50-g sample of flour. The dough was pressed into a small disc by hand and rolled into a round shape to a uniform thickness of 2.5 mm on a smooth laminated board with raised edges, using a wooden rolling pin. Four to five grams dry flour were sprinkled on the surface to prevent the dough from sticking to the board or the pin. The maximum diameter in millimeter, to which the dough could be rolled until it broke was measured, and expressed as rolling quality. The rolled dough was cut into disc of 20 cm diameter and baked on a flat baking pan, at 260-270°C. Baking was considered complete when uniform puffing with intermittent brown spots appeared on the surfaces. The roti was removed from the baking pan. The time taken for baking and the moisture loss in roti during baking were recorded.

Sensory evaluation of rotis

Rotis were evaluated for sensory qualities using a 10 member trained panel. Sensory evaluations of the products were carried out by 30 panelists, selected among the research scholars and post graduate students in the department of Food Science and Nutrition. Two rotis were prepared from each millet and was supplied to each panelist in plates. The samples were coded with an Alphabet letter. 8 test samples were supplied at a time. Testing of the samples was done in separate ventilated cabins, under incandescent lights. The temperature of the Cabins was between 30ºC and 32°C. Panelists were provided with drinking water to rinse their mouth between samples.

A 9 –point hedonic scale was used for sensory evaluation.

The samples were presented in random order and panelists were asked to rate their assessment of Appearance, texture, flavor, odour and overall acceptability on a 9-point hedonic scale (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, 9 = like extremely). A score of 5 or below was considered a limit of acceptability for all sensory attributes tested.

Statistical analysis

Data analysis was done using SPSS software. Mean and standard deviation was calculated for flour and dough quality of millets and sensory evaluation of roti.

Results and Discussion:

Table-1: Flour Quality of Millets

Millets	Bulk density (g/ml)	Swelling capacity		Solubility (%)	Sediment Volume (ml)
		v_f/v_i	w_f/w_i		
Finger	0.67 ± 0.11	3.1 ± 0.12	4.2 ± 0.18	16 ± 0.40	1.35 ± 0.14
Kodo	0.61 ± 0.45	4.2 ± 0.13	6.1 ± 0.24	14 ± 1.02	2.15 ± 0.12
Foxtail	0.71 ± 0.21	5.2 ± 0.04	9.3 ± 0.21	17 ± 0.58	2.23 ± 0.02
Pearl	0.55 ± 0.61	2.4 ± 0.10	3.9 ± 0.36	16.52± 0.67	1.63 ± 0.32
Barnyard	0.50 ± 1.10	2.1 ± 0.63	3.7 ± 0.41	14.23 ± 0.18	2.54 ± 0.47
Little	0.46 ± 0.26	1.6 ± 0.09	2.9 ± 0.12	11.21 ± 0.45	1.57 ± 0.14
Proso	0.62 ± 0.23	2.3 ± 0.06	4.1 ± 0.21	18.23 ± 0.56	1.69 ± 0.51
Sorghum	0.63 ± 0.31	4.7 ± 0.51	6.2 ± 0.43	12.21 ± 0.21	2.98 ± 0.95

Table-1; The bulk density among the eight millets was found highest in Foxtail millet (0.71 ± 0.21) followed by finger millet (0.67 ± 0.11), Sorghum (0.63 ± 0.31), Proso millet (0.62 ± 0.23) andkodo millet (0.61 ± 0.45), whereas least density was observed in little millet (0.46 ± 0.26). The swelling capacity was observed predominantly in Foxtail millet followed by Sorghum and Kodo millet.However, least swelling capacity was observed in little millet. With respect to the solubility Proso millet (18.23 ± 0.56) has highest solubility among the eight millets followed by Foxtail millet (17 ± 0.58), Pearl millet and Finger millet whereas least solubility was observed in little millet (11.21 ± 0.45).

Table-2: Dough Quality of millets

Millets	Water required for making dough (ml/100gm)	Weight of the dough (gms)	Rollability (mm)	Dough handling property score*
Finger Millet	77.12 ± 0.21	207.53± 1.23	12.33± 0.12	3
Kodo Millet	50.5 ± 0.24	145.14± 3.25	10.51± 0.85	2
Foxtail Millet	47.51 ± 0.71	144.41± 2.54	16.11± 0.25	2
Pearl Millet	56.14 ± 0.16	149.17± 4.25	13.66± 0.45	3
Barnyard Millet	45.13 ± 0.19	144.23± 2.45	11.16± 0.21	3
Little Millet	50.36± 0.55	147.54± 1.19	14.50± 0.41	2
Proso Millet	55.89± 0.71	144.94± 1.65	16.12± 0.63	2
Sorghum	60.35± 0.95	160.12± 2.45	8.51± 0.51	3

Table-2: Highest water required to make dough was observed in Finger Millet (77.12 ± 0.21) and weight of dough was (207.53± 1.23) followed by Sorghum (60.35± 0.95) & (160.12± 2.45) Pearl Millet (56.14 ± 0.16) & (149.17± 4.25) and Proso Millet (55.89± 0.71) & (144.94± 1.65) respectively. The Dough handling property of Finger Millet, Pearl Millet, Barnyard Millet and Sorghum was found sticky and remaining millets were fund slightly sticky.

Table-3: Sensory Evaluation of Rotis made from Millets

Millets	Appearance (Mean ± S.D)	Colour (Mean ± S.D)	Flavor (Mean ± S.D)	Texture (Mean ± S.D)	Overall acceptability (Mean ± S.D)
Finger Millet	7 ± 1.00	7 ± 0.23	6 ± 0.21	7 ± 1.64	7 ± 0.58
Kodo Millet	5 ± 1.14	5 ± 1.75	5 ± 0.36	6 ± 0.12	6 ± 1.11
Foxtail Millet	6 ± 0.22	6 ± 1.41	8 ± 1.25	7 ± 0.89	7 ± 0.85
Pearl Millet	5 ± 1.39	5 ± 0.56	6 ± 1.39	6 ± 0.25	6 ± 0.45
Barnyard Millet	6 ± 1.56	5 ± 0.12	6 ± 1.53	6 ± 0.63	6 ± 0.25
Little Millet	7 ± 0.12	8 ± 0.43	7 ± 0.11	7 ± 12	8 ± 0.45
Proso Millet	7 ± 1.69	5 ± 1.93	6 ± 1.23	6 ± 0.56	7 ± 1.25
Sorghum	8 ± 0.89	6 ± 0.23	7 ± 1.75	7 ± 1.15	7 ± 0.815
Control	8 ± 0.56	8 ± 0.93	8 ± 0.79	8 ± 0.45	8 ± 0.63

For organoleptic quality test of the millets roti, the trained panelists (10 Number) were asked to evaluate appearance, colour, flavour, texture and overall acceptability. Roti samples were served to the trained panel members (Table- 3). Among the eight millets roti the Little Millet roti scored highest among all and was at par with control sample. The appearance of Sorghum roti and flavor of foxtail millet roti was found as on par with the control sample. Hence it can be concluded from the sensory evaluation of eight millets roti samples overall acceptability was found in Little Millet roti followed by Sorghum, Proso Millet, Foxtail Millet and Finger Millet respectively.

Table-4: Relationship between Overall acceptability of Rotis from various millets and Dough Properties of millets

Millets	Bulk density (g/ml)	Swelling capacity		Solubility (%)	Sediment Volume (ml)	Water required for making dough (ml/100 gm)	Weight of the dough (gms)	Rollability (cm)
		v_f/v_i	w_f/w_i					
Finger Millet	-0.27	-0.22	-0.34	-0.72	-0.61	-0.54*	-0.32	0.41*
Kodo Millet	0.45	0.41	0.47	-0.23	-0.26	0.35	0.46	-0.34
Foxtail Millet	0.72*	0.79*	0.81*	0.64*	0.75*	-0.68*	0.84*	-0.28*
Pearl Millet	-0.71*	-0.73*	-0.69*	-0.56*	-0.64*	-0.73	-0.71*	0.56*
Barnyard Millet	-0.44	-0.48	-0.54	-0.41	-0.49	0.58	-0.51	-0.49
Little Millet	-0.67	-0.62	-0.66	-0.64	-0.68	-0.71	-0.63	-0.59
Proso Millet	0.28	0.25	0.27	0.29	0.32	0.39	0.23	-0.25
Sorghum	0.55*	0.57*	0.53*	0.51*	0.54*	0.59*	0.60*	-0.57*

*significant at 5% level

The relationship between overall acceptability of Rotis from various millets and Dough Properties of millets (Table-4) indicates that overall acceptability of Rotis prepared from various millets was depends on dough quality. The finger millet roti overall acceptability showed that negative and positive significant relation with water required for making dough and rollability. Further, Foxtail Millet roti overall acceptability represents positive significant relationship with bulk density, swelling capacity, solubility, sedimentation and weight of dough and negative significant with relationship with water required for making dough and rollability. However, with respect to Pearl Millet overall acceptability revealed that negative significant relationship with bulk density, swelling capacity, solubility, sedimentation, water required for making dough and weight of dough and Sorghum roti showed positive significant relationship with bulk density, swelling capacity, solubility, sedimentation, water required for making dough and weight of dough.

Conclusion:

Millets are staple food source that is not only providing major nutrients like protein, carbohydrate, fat etc. but also provide ample of vitamins and minerals. In developing country, occurrence of malnutrition and various health problems like obesity, diabetes, cardiovascular disease, skin problems, cancer, celiac disease etc. are most prominent because of inadequate supply of nutrition. This is mainly due to the underutilized agricultural crops as food and unawareness of people and lack of knowledge to people. Millets are easily available and cheap in cost. This study emphasized on flour and dough quality of millets and their suitability for south Indian roti preparation. Hence, the sensory evaluation of among the eight

millets roti samples overall acceptability was found in Little Millet roti.

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