Development of Nutritious Rusk by Incorporation of Millets

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ABSTRACT

Millets are highly nutritious, non glutinous and non-acid forming foods. Hence they are soothing and easy to digest. Millets contain about 8 per cent protein and 4 per cent fat. They are rich source of vitamins and minerals. Millets are especially rich in calcium. The dietary carbohydrate content of millets is also relatively high. Antinutritional factors such as phytate and polyphenols are also present in millets but they are mostly confined to the seed coat and the milled millets are generally free from the anti-nutritional factors.

Millets have many nutraceutical properties that are helpful to prevent many health problems such as lowering blood pressure, risk of heart disease, prevention of cancer and cardiovascular diseases, decreasing tumor cases etc. Other health benefits are increasing the time span of gastric emptying, provides roughage to gastro intestine. The objective of this study was to develop a nutritious multi millet rusk. The millets incorporated were kodo(*Paspalumscrobiculatum*), barnyard (*Echinochloaesculenta*)and little millet (*Panicumsumatrense*). Four formulations were used (50:50, 70:30, 100: 100) and rusk made with 100% wheat flour was used as control. The products were analyzed for sensory, nutritional evaluation and keeping quality. Results of the sensory evaluation showed that a combination of whole wheat flour and millet mix at 50:50 as the best treatment through.Assessment of nutrient composition showed that multi grain rusk were low in fat and high in dietary fiber and protein compared to the control rusk. The shelf life of the product was studied by packing in polypropylene foil, polyethylene terephthalate and glass containers. The parameter used for shelf life study included moisture, peroxide value, sensory evaluation and microbial analysis.

Key words: Millets, rusk, fiber, shelf-life study.

Kodo, Barnyard and little millets are highly nutritious. The millet grains are rich in non-starchy polysaccharides and dietary fibre which are beneficial for diabetics as it slowly release glucose to the blood. It contains very healthy polyunsaturated fat. By consuming millets on a regular basis, a diabetic can reduce spikes in blood glucose levels, which otherwise leads to numerous complications. Three main types of millet included in the present study are Kodo, Barnyard and Little millet. Rusk is ideal snack for anyone owing to convenience and compactness .They differ from other bakery products in that it is less sweet and less costly, long storage life and free from microbial spoilage.

Rusk is less costly and has long shelf life. Rusk is enjoyed by many including diabetics during tea time. It is easy to store compared to other snacks. Millets are less popular in our society as people are unaware of the nutritive value of it and due to the lack of knowledge in preparing recipes out of it. Healthy baked foods

are an easy way to reach the consumers and popularise these nutritious grains. Addition of multigrain to bakery products increases the nutritive value of the product and adds variety to our diet.

Overall the global burden of diabetes has increased significantly in recent decades and will continue to soar in the next few decades (Lin *et. al*, 2020). Globally, the number of people with diabetes mellitus has quadrupled in the past three decades, and diabetes mellitus is the ninth major cause of death. About 1 in 11 adults Worldwide now have diabetes mellitus, 90% of whom have type 2 diabetes mellitus (Yan *et al*., 2018).A healthful eating pattern, regular physical activity, and often pharmacotherapy are key components of diabetes management..Dietary treatment is the basis for treatment of diabetes. Nutritional management help in optimizing glycaemiccontrol and reduce risk factors and other complications. (*Vessby et al.*, 2011).

Millets are a group of highly variable small seeded grasses, widely grown around the world for fodder and human food. They are one of the oldest foods known to humans andare rich source of vitamins and minerals. Millets are especially rich in calcium. Millets have many nutraceutical properties that are helpful to prevent many health problems(Kumar*et al,* 2010 and Saritha and Singh, 2016).

Bakery, a crucial segment of food processing industry, is one of the oldest and traditional activities in India. A Rusk is a hard, dry snack or a twice-baked bread.The word `rusk` when used in this specification, includes any cooked product of grainbased dough, whether it has been raised with yeast or not(William, 1976).

According to IIMR (2016), increasing millet consumption through new product development and promotion could be a good strategy for enhancing nutritional and health status of community. Hence developing technology that makes millet based value added products as convenient to make and easy to access at reasonable prices will find great demand in the market particularly in urban places where there is growing requirement for nutritious foods. Keeping this in view the present study was conducted to develop multi millet rusk by incorporating three different millets.

OBJECTIVES

1. To develop and standardise multi millet rusk by using mix of three different flours viz, kodo, barnyard and little millet in different proportion with wheat flour
2. To evaluate the acceptability of the developed product by sensory evaluation
3. To assess the nutritional composition of the product
4. To ascertain the shelf life of the product

METHODOLOGY

The present study entitled "Development of nutritious rusk by incorporation of millets

" was undertaken to make rusk using multi millets such as kodo, barnyard and little millet and to evaluate their nutritional, organolpetic, and microbiological characteristics and to determine the keeping quality of the developed products. The methods adopted for the study are given under the following headings:

Selection of raw ingredients

The main ingredient in rusk i.e. refined flour was replaced with whole grains such as wheat and millets. Three types of millets selected were;

1, Kodo millet (Paspalumscrobiculatum)
2. Barnyard millet (Echinochloaesculenta)
3. Little millet (Panicumsumatrense)

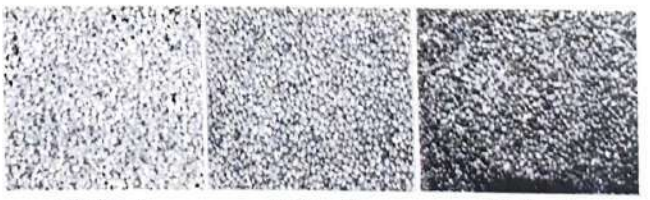


Plate -1 Kodo millet **Plate -2 Barnyard millet** **Plate -3 Little millet**

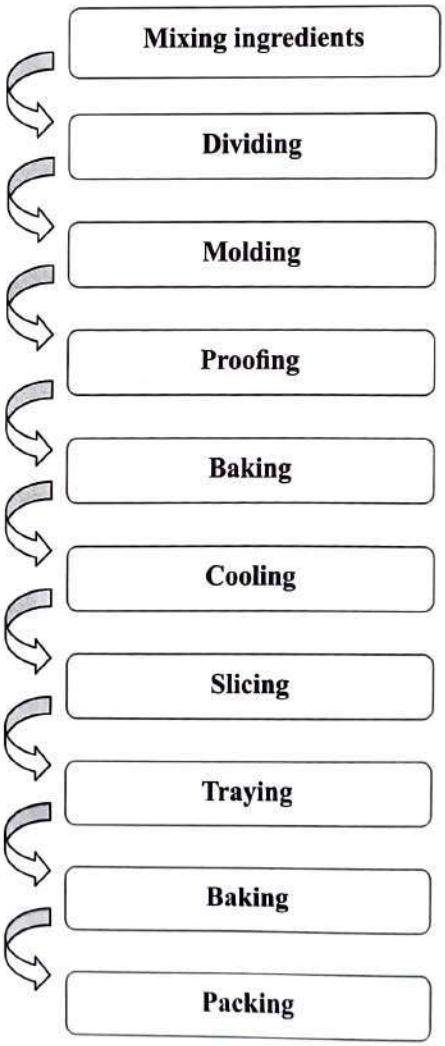
(Paspalumscrobiculatum)(Echinochloaesculenta) (Panicumsumatrense)

Other ingredients used are whole wheat flour, oil, yeast, salt, water. All the ingredients were collected from online shopping and local market.

Method followed for preparation of rusk

Rusks were prepared using method as described by Yaseen (2000), with some modifications. Usually,rusk is prepared frommaida with added yeast, shortenings, water, sugar and salt. In the present study standardized recipe was altered by adding whole wheat flour and different types of millets such as kodo millet, barnyard millet, and little milletin the proportions given belowin the title formulation of the recipe

Flow diagram for steps involved in preparation of rusk



Formulation of recipe

To formulate the recipe wheat flour and mix of three milletswere taken in different proportions such as:

1. 100: 0
2. 50:50
3. 30:70
4. 0:100

Preparation of Rusk

Ingredients	Amount (g)
Flour	72
Sugar	8
Fat	20
Yeast	a pinch
Salt	a pinch

Procedure

Rusk is a yeast leavened crisp product, which has been baked twice. Yeast and water were mixed in a bowl and kept it for 30 min then sugar was added for activation of yeast. Flour and other ingredients except fat were added to the yeast water solution. Adequate amount of water is added until the dough has reached its required consistency. Fat was added in last. Mixing was carried out for 10-12 min and proofing for 45 minutes is done where the dough is allowed to rest and rise a final time before baking and then baking. Baking was done at 200 degree C for 15 minutes and the loaf was left to cool overnight. The next day, the loaf was sliced and then baked a second time at 160 degree C for 20 minutes and finally the prepared rusks were left for cooling and then packed in polyethylene packs and stored at room temperature for further evaluation.

Sensory evaluation

Sensory evaluation of rusk was carried out using a nine (9) point Hedonic scale with a range of 1 indicating an extremely disliked and 9 indicating an extremely liked sample.

The samples were evaluated for its sensory attributessuch as odor, flavor, texture, appearance and overall acceptabilityby the panel consisted of 10 subjects. The sample with highest mean score for different characteristics was chosen as the most preferred one.Rusk prepared with 100% wheat was taken as the control.

Computation of nutritive values

Nutritive values of each ingredient used for the preparation of rusk were calculated using the food composition tables(IFCT,2017). The nutritive value of the major ingredients like kodo, barnyard, and little millet were calculated using the food composition table by Indian institute of millet research (IIMR, 2016).

Shelf life study

The selected rusks were stored in polypropylene foil, glass jars and plastic container (polyethylene terephthalate) and kept at an ambient room temperature for30 days. The stored rusks were then analysed for chemical parameters such as moisture content and peroxide value, microbiological analysis for the presence of yeast and mould and organoleptic evaluation for appearance, taste, texture, flavor, odour and overall acceptability. The shelf life study was done for a period of 30 days.

Packages used for the storage of rusk

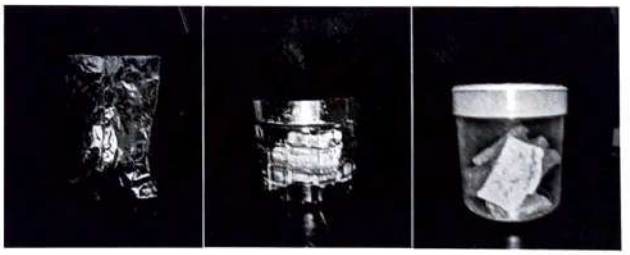


Plate -4 Polypropylene foil | **Plate -5 Glass jars** | **Plate -6 Polyethylene terephthalate container**

Data tabulation and interpretation

All the data were collected regarding the development of multi millet rusk such as physical characteristics, sensory qualities,nutritional composition were tabulated and interpreted using percentage analysis

FINDINGS AND DISCUSSION

Preparation of rusk

The rusk was prepared by the method described by Yaseen (2000). All the ingredients were

collected from the local markets. Four formulations were prepared including the control. The different formulations are given in the table given below:

Table- 1 Different formulations used for the preparation of rusk

Sl.no	Treatment	Wheat flour:Millet mix proportion	Whole wheat flour (g)	Kodo (g)	Barnyard (g)	Little millet (g)
1	Control (T^0)	100: 0	300	-	-	-
2	Recipe 1 (T^1)	50:50	150	50	50	50
3	Recipe2 (T^2)	30:70	90	70	70	70
4	Recipe 3 (T^3)	0:100	-	100	100	100



Plate -7 control (T^0) (100:0)

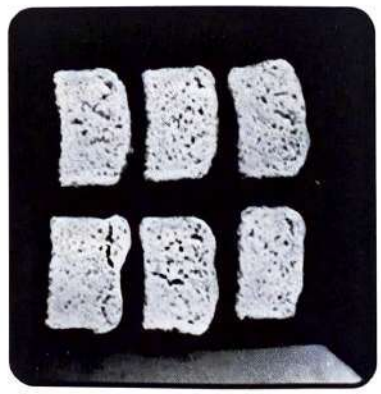


Plate-8 recipe (T^1) (50:50)

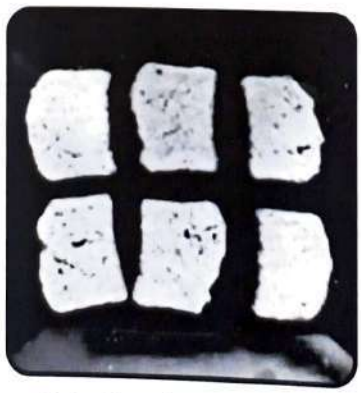


Plate -9 recipe (T^2) (30:70)



Plate -10 recipe (T^3) (0:100)

Sensory evaluation

The multi millet rusk standardizedin the present study was assessedorganolepticallyby a panel of 10 judges using a score card on a 9 pointhedonic scale and compared with control rusksT° (rusk made with 100% wheat flour).

Table- 2 Mean organoleptic scores of prepared rusks

SI.NO	PARAMETERS	CONTROL(T°) W: M (100:0)	(T^1) W: M (50:50)	(T^2) W: M (30:70)	(T^3) W: M (0:100)
1	Appearance	9	9	8.6	6.5
2	Taste	9	7.7	6	7
3	Odor	8	8.5	8	6
4	Flavor	8	7.4	7	6.5
5	Texture	9	8.2	6	5.3
6	Overall acceptability	9	8.5	7	6.4
7	Mean value	8.6	8.2	7.1	6.2
8	Percentage	95.5	91	7 8.8	68.8

W (Whole wheat Flour) : M (Millet Mix)

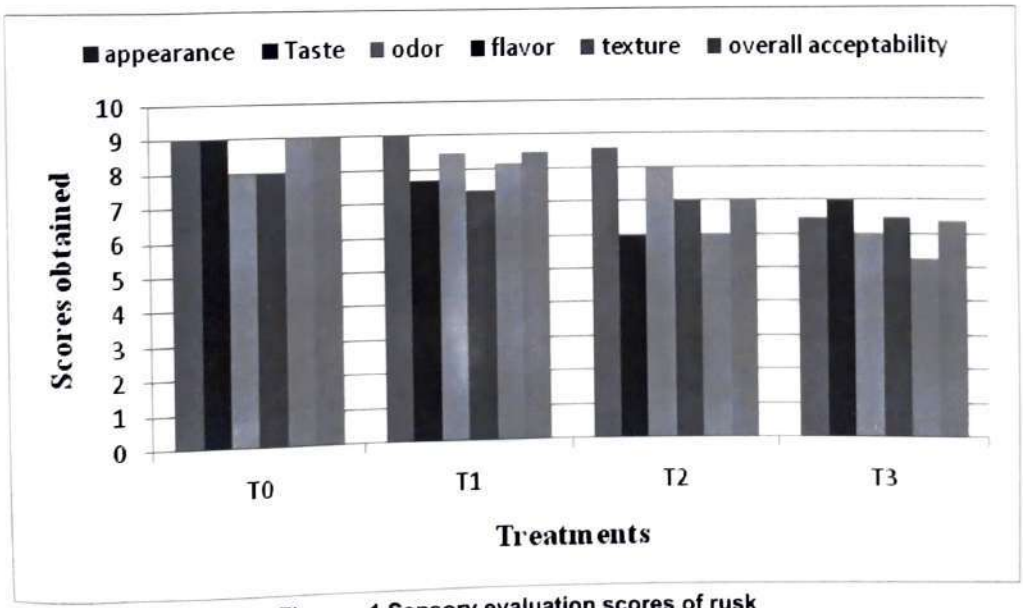


Figure - 1 Sensory evaluation scores of rusk

It was found that rusk with 50% wheat and 50% millet flour (kodo, barnyard, little) was highly accepted as the best by the panel members. Based on the maximum scores obtained for overall acceptability, rusk with 50% wheat flour and 50% millet flour (kodo, barnyard, little) is selected for detailed study. The selected recipe was further studied for nutrient composition and keeping quality

Nutritive value

Based on the results of the sensory evaluation rusk sampleT^1(W:M 50:50) was selected as the best one.Nutritive values of each ingredient used for the preparation of rusk were calculated using the food composition tables (IFCT, 2017and IIMR, 2016) from which nutritive value per 100g was obtained.

Table -3 Nutrient composition of the Rusk T^1(W:M 50:50)per 100g

Ingredients	Amount (g)	Nutrient content						
		CHO(g)	Energy(Kcal)	Protein (g)	Fat (g)	Fibre (g)	Iron (mg)	Calcium (mg)
Kodo millet	12	7.9	39.72	1.07	0.168	1.08	0.28	1.83
Barnyard millet	12	7.8	36.84	1.26	0.26	1.2	0.6	2.4
Little millet	12	7.8	41.52	1.07	0.30	0.9	0.15	1.92
Wheat flour	36	23.1	115.41	3.81	0.55	3.96	1.48	11.14
Ghee	20	-	180	-	20	-	-	-
Sugar	8	8	32	-	-	-	-	-
Total	**100**	**54.6**	**445.49**	**7.21**	**21.27**	**7.14**	**2.51**	**17.29**

From the above table, it is clear that the rusk of 100 grams provides 445.49 Kilo calories of energy, 7.21 grams of protein, 54.6 grams of carbohydrate, 21.27grams of fat, 7.14 grams of fibre, 17.29 mg calcium, and 2.51 mg iron. Thus, the rusk provides sufficient dietary fibre and protein needed for the diabetic patient.

Shelf life study

Based on the results of the sensory evaluation rusk sampleT^1(W:M 50:50) was selected and shelf life study was conducted. The selected rusks were stored in polypropylene foil, glass jars and plastic container (polyethylene terephthalate) and kept at an ambient room temperature for 30 days. These stored rusks were then analysed for chemical parameters such as moisture content and peroxide value, microbiological analysis for yeast and mould and organoleptic evaluation.

Table- 4 Moisture content and peroxide value of the stored Rusk T¹ (50:50)

Duration	Types of packaging	Moisture content (%)	Peroxide value
0 days	Polypropylene foil	5	0
	Polyethylene terephthalate	5	0
	Glass jars	5	0
7 days	Polypropylene foil	5	0
	Polyethylene terephthalate	6.2	0
	Glass jars	5.5	0
15 days	Polypropylene foil	5.1	0
	Polyethylene terephthalate	6.4	0
	Glass jars	5.6	0
30 days	Polypropylene foil	5.1	0
	Polyethylene terephthalate	6.5	0
	Glass jars	5.6	0

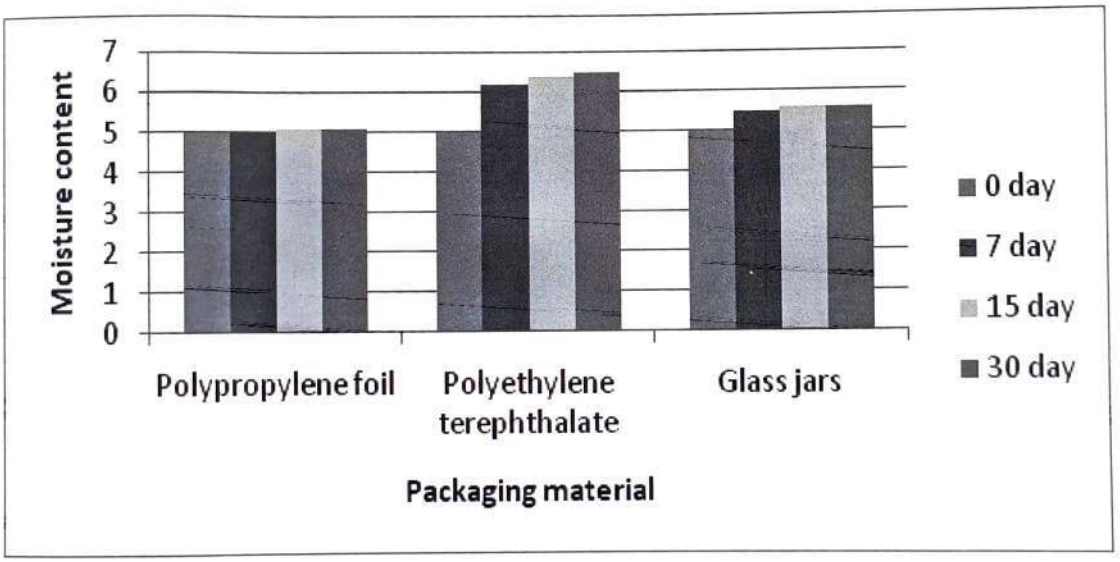


Figure -3 Moisture content of stored rusk

Moisture content in the rusk stored in polyethylene terephthalate was increased from 5% to 6.5% after 30 days of storage. Whereas, the moisture content of the rusks stored in glass jar were increased to 5.6%.Storage in polypropylene foil was found to be the best, as it had only 5.1% moisture after 30 days storage time. As per BIS specification (IS 8555-2013), the estimated value for moisture content of rusk is up to10 percent. Moisture content of the samples were found to be within the permitted limit.

The peroxide value of the stored rusk in different packaging material was found to be zero which means that the product has not undergone any oxidation within the 30 days of storage.

Sensory evaluation of the rusk after storage

Sensory evaluation of the rusk plays an important

role in the acceptability and shelf stability of products. The sensory evaluation of the rusk stored in different packages were periodically evaluated with respect to the sensory parameters using a score card on 9 point Hedonic scale by a selected panel of judges.

Table -5 Sensory evaluation scores of the stored ruskT¹ (50:50)

Duration	Types of packaging material	Sensory parameters							
		Appearance	Taste	Texture	Flavor	Odor	Overall acceptability	Mean score	Percentage
0 days	Polypropylene foil	9	7.7	8.5	7.4	8.2	8.5	8.2	91
	Polyethylene terephthalate	9	7.7	8.5	7.4	8.2	8.5	8.2	91
	Glass jars	9	7.7	8.5	7.4	8.2	8.5	8.2	91
7 day	Polypropylene foil	9	7.7	8.5	7.4	8.2	8.5	8.2	91
	Polyethylene terephthalate	9	7	8	7	8	8	7.8	86.6
	Glass jars	9	7.2	7.8	7	8	8	7.8	86.6
15 days	Polypropylene foil	9	7	7	7	8	8	7.6	84.4
	Polyethylene terephthalate	9	7	7	7	7	8	7.5	83.3
	Glass jars	8	7	7.5	7	7	8	7.4	82.2
30 days	Polypropylene foil	9	7	7	7	7	8	7.5	83.3
	Polyethylene terephthalate	8	7	7	6	7	8	7.1	78.8
	Glass jars	8	7	7	6	7	8	7.1	78.8

Sensory scores obtained for rusk was found to decrease as the storage period increases. Samples in different packages retained sensory qualities (80% score)after 15 days of storage. After 30 days of storage rusks stored in the sealed polypropylene foil scored above 80%.The other two samples also maintained average score i.e.>75%.

Microbial analysis

In order to ascertain the keeping quality, microbial analysis of the rusk sampleT¹(W:M 50:50) in different packages for the detection of yeast and mould growth was conducted at the end of 30 days.

Table-6 Microbial load of stored multi millet ruskT¹ (50:50)

Storage Duration	Types of packaging	Yeast and mould count (cfu/g)	Permitted level(cfu/gm)
30 days	Polypropylene foil	13	$<1.0\times10^4$
	Polyethylene terephthalate	12	
	Glass jars	13	

From the above table it is clear that the yeast and mould growth in polypropylene foil and glass containers were 13 cfu/g and in poly ethylene terephthalate was found to be 12cfu/g. All the three samples stored in different containers were found to be microbiologically safe after 30 days of storage.

SUMMARY, CONCLUSION AND IMPLICATIONS

From the above study it can be summarised that ready eat to eat snack (rusk)prepared with wheat flour and multi millets namely kodo, barnyard, little millet for diabetic subjects was highly acceptable. Based on the results of the sensory evaluation rusk sampleT¹(W:M 50:50) was further studied and was found to be, nutritious, microbiologically safe and these samples could besafely stored for 30 days. Due to the nutritional benefits along with fiber content multi millets if made available in ready-to-eat form or convenient foods can be consumed as health and nutritional foods. Even though the consumption of millet as direct food is declining in India, preference for processed foods is surprisingly picking up in urban areas.

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