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Development of nutrient rich noodles by supplementation with malted ragi flour

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Abstract: In the present investigation attempts have been made to develop nutrient rich noodles by the addition of optimized proportions of wheat and malted ragi flour with other ingredients. Combinations of wheat and malted ragi flour (90:10, 80:20, 70:30, 60:40 and 50:50) and other ingredients like vegetable oil, corn flour, wheat gluten, GMS and guar gum were optimized by varying proportions to result a better quality noodles. Whereas iodized salt, baking powder and water were kept constant for all formulations. Results revealed that among all the formulations tried, noodle sample prepared from 70:30 flour combination had same sensory score as that of control and higher values of protein, fibre and minerals (i.e. calcium, iron and phosphorous) than the control sample. Thus, this nutrient rich noodle will be a good source of instant food for children, teenagers, sport persons, pregnant and lactating women.

Key words: Noodle, ragi flour, gluten, GMS, oil

Introduction

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) and the addition of alkaline salts can help strengthen the structure and hence improve the firmness of the final product (Hou and Kruk, 1998).

The noodles also can be made from, rice, buckwheat, and starches derived from potato, sweet potato, and pulses. The corn starch may be used as binding agent in the noodle (Yalchin and Basmani, 2008; Tan *et al*., 2009). The addition of GMS in noodles decrease the hardness slightly and the cohesiveness, gumminess, springiness and chewiness to a significant extent (Kaur *et al*., 2005). Instant noodles are dried or precooked noodles fused with oil and often sold with a sachet of flavoring. Dried noodles are usually eaten after being cooked or soaked in boiling water for 3-5 min while precooked noodles can be reheated, or eaten straight from the packet (Fu, 2008).

Ragi (*Eleusine coracana*) is an important food crop of the poor marginal farmers, especially tribal people of the India. It is rich in protein, fibre, minerals viz. iron, calcium, phosphorus, and vitamin content. Traditionally ragi is processed either by malting or fermentation (Rao and Muralikrishna, 2001). Malting of finger millet improves its digestibility, sensory and nutritional quality as well as pronounced effect in the lowering the antinutrients. Malting characteristics of finger millet are superior to other millets and ranks next to barley (Malleshi and Desikachar, 1986; Pawar and Dhanvijay, 2007). There is also overall improvement in the flavour profile of ragi during germination process (Nirmala and Muralikrishna, 2002; Ram *et al*., 1979; Rao and Belavady, 1978). There are various benefits of malting such as vitamin-C is elaborated, phosphorus availability is increased and lysine and tryptophan are synthesized (Dulby and Tsai, 1976).

Ragi is indigenous minor millet used in the preparation of geriatric, infant food and health foods both in natural and malted forms. It is usually used for preparation of flour, pudding, porridge and roti (Chaturvedi and Srivastava, 2008). With the changes in scenario of utilization of processed products and awareness of the consumers about the health benefits, ragi has gained importance because of its functional components, such as slowly digestible starch and resistant starch (Wadikar *et al*., 2007). The malted and fermented ragi flour are extensively used in preparation of weaning food, instant mixes, beverages and pharmaceutical products (Rao and Muralikrishna, 2001). In the present study attempts have been made to investigate the maximum substitution of malted ragi flour to wheat flour to improve the nutritional quality of instant noodles without deteriorating their organoleptic properties

Materials and Methods

Malting of Ragi

The Indaf -15 cultivar was reported to be suitable

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for malting purposes (Nirmala *et al*., 2000). Thus ragi seeds of 'Indaf-15' cultivar were procured from a local farm of Bhudargad Taluka, Kolhapur district of Maharashtra state (India) and were taken for the study. The malting of ragi was carried out with the standard procedure suggested by Desai *et al*., 2010.

Preparation of noodle

Different flour combinations of the wheat flour and malted ragi flour were tried to obtain best acceptable formulation. These flour combinations are given in Table 1. Iodized salt (2%), baking powder (0.5%) and water (100 ml) were added to each of these formulations of noodle preparation. The sensorial quality characteristics like elasticity and texture were improved by addition of corn flour, gluten, GMS and guar gum, whereas vegetable oil was added to improve the glossiness of the noodles. The formulation of these added ingredients is given in Table 2. The ragi supplemented noodle was prepared with slight modification in the method suggested by Fu (2008).

Table 1. Compositions of wheat and malted ragi flour of noodle samples

Sample code	Wheat flour(g)	Malted ragi flour(g)
C (control)	100	-
C_1	90	10
C_2	80	20
C_3	70	30
C_4	60	40
C_5	50	50

Physico-chemical analysis

The wheat flour, unmalted ragi flour, malted ragi flour and ragi supplemented noodles were subjected to proximate analysis such as moisture, protein, fat, crude fiber and ash content. The total carbohydrate was determined by the difference. Also unmalted and malted ragi flour and ragi supplemented noodle were subjected to estimation of iron, calcium and phosphorus content. The standard procedures given by Ranganna (1986) were used for all the above determinations.

Sensory evaluation of cooked noodles

The sensory evaluation was carried out in order to get consumer response for overall acceptability of the malted ragi flour supplemented instant noodle compared to the control noodles. The dried noodles were rehydrated in boiling water for 5 min and were served hot for the sensory evaluation. Products were evaluated by a panel of 10 semi-trained judges for different sensory attributes like appearance, flavour, taste, texture and overall acceptability. A 1 to 5 structured scale was used for this evaluation (Desai *et al*., 2010).

Table 2. Formulation of ragi supplemented noodles for improvement in quality and sensorial characteristics

Sample code	Wheat flour (%)	Malted ragi flour (%)	Vegetable oil (%)	Wheat gluten (%)	Guar gum (%)	GMS (%)	Corn flour (%)	Baking powder
C_6	70	30	5	-	0.5	1	10	0.5
C_7	70	30	5	-	1	1	10	0.5
C_8	70	30	5	5	1	1	-	0.5
C_9	70	30	8	5	1	1	-	0.5
C_{10}	70	30	10	7	1	1	-	0.5
C_{11}	70	30	12	10	1	1	-	0.5
C_{12}	70	30	12	10	2	1	-	0.5
C_{13}	70	30	16	10	2	1	-	0.5

Statistical analysis

The analytical data obtained for ragi supplemented noodles were subjected to analysis of variance (ANOVA) (one way anova) using complete randomized design according to Panse and Sukhatme (1961). The critical difference at $p<0.05$ was estimated and used to find significant difference if any.

Results and Discussion

The proximate composition of wheat flour is given in Table 3. The results obtained for wheat flour are in good agreement with the earlier results reported by (Singh *et al*, 2005; Desai *et al*., 2010). The chemical composition of unmalted and malted ragi flour is depicted in Table 4. It was noticed from the data that the malting process was useful to increase the calcium, phosphorus and vitamin C content of ragi flour. Malting of finger millet improves digestibility and bioavailability of nutrients, improves sensory and nutritional quality (Malleshi and Desikachar, 1986). The significant increase in vitamin C content after malting is attributed to the enzymatic hydrolysis of starch by amylases and diastases, which degrade starch and produce glucose. This increased amount of glucose becomes the precursor of vitamin C (Taur *et al*., 1984). It is reported that during malting process calcium and phosphorus content increases whereas iron content decreases (Sangita and Sarita, 2000).

The noodles prepared with different flour combinations were subjected to sensory analysis and results obtained are given in table 5. The results denote that the sample C_1, C_2 and C_3 had no significant difference when analyzed statistically at 5% level whereas samples C_4 and C_5 were significantly different. Though C_1 (90:10), C_2 (80:20) and C_3(70:30) are having similar scores with respect to overall acceptability but C_3 sample with flour

Table 3. Proximate composition of wheat flour*

Parameter	Amount (%)
Moisture (%)	12.67 ± 0.025
Protein (%)	10.55 ±0.032
Fat (%)	0.94 ± 0.006
Total carbohydrate (%)	74.88 ± 0.508
Crude fibre (%)	0.36 ± 0.010
Calcium(mg/100g)	18 ± 0.506
Iron(mg/100g)	2.1 ±0.032
Phosphorus(mg/100g)	107 ±0.150
Ash (%)	0.94 ± 0.010

*Results are mean ±SD of three determinations

Table 4. Chemical composition of unmalted and malted ragi flour

Parameter	Amount*	
	Unmalted	Malted
Moisture (%)	12.67 ± 0.010	12.67 ± 0.17
Protein (%)	7.52 ± 0.025	7.60 ± 0.05
Fat (%)	1.08 ± 0.015	1.14 ± 0.04
Total carbohydrate (%)	76.51 ± 0.021	76.18 ± 0.02
Crude fibre (%)	3.62 ± 0.067	3.80 ± 0.10
Vit. C (mg/100g)	2.12 ± 0.017	5.89 ± 0.12
Calcium(mg/100g)	359.4 ± 0.306	429.8 ± 0.99
Iron (mg/100g)	13.7 ± 0.100	12.4 ± 0.15
Phosphorus (mg/100g)	284.3 ± 0.351	305.5 ± 1.04
Ash (%)	1.76 ± 0.006	1.93 ± 0.01

*Results are mean ±SD of three determinations

combination of 70:30 was selected for further improvement in sensory properties. The sample C_3 was liked moderately by panelist but appearance and elasticity of this sample was poor. This lower value of appearance score is due to the increase in intensity of brown colour which is contributed from the increased amount of supplemented malted ragi flour. The lower value of texture is due to the decrease in elasticity resulting from the decrease in gluten content.

Table 5. Effect of flour quantities on the sensory attributes of ragi supplemented noodles

Sample Code	Appearance[a]	Flavour[b]	Taste[c]	Texture[d]	Overall acceptability[e]
C	3.0	3.0	3.0	4.0	5.0
C_1	3.0	2.9	3.0	3.7	4.8
C_2	2.9	3.0	3.0	3.3	4.7
C_3	2.8	3.0	2.8	3.0	4.5
C_4	2.5	2.8	2.5	2.5	3.5
C_5	2.0	2.9	2.0	2.5	3.0
SE	0.159	0.033	0.164	0.253	0.329
CD (p=0.05)	0.409	0.082	0.402	0.619	0.807

a: 3-shining, 2 – dull, 1- very much dull
b: 3-prominent spicy flavour, 2 – moderate spicy flavour, 1-mild spicy flavour
c: 3-non sticky, 2- sticky, 1- very much sticky
d: 4-elastic and smooth, 3 – slightly elastic and smooth, 2 – elastic and granular,1- nonelastic and powdery
e: 5-liked very much, 4-liked moderately, 3-liked slightly, 2-acceptable, 1 disliked slightly

These sensory defects were overcome by addition of ingredients like gluten, guar gum and vegetable oil. Nine different combinations of these ingredients were tried to improve the sensory quality and the results of sensory analysis is given in Table 6. It is noticed from the statistical analysis data that except for C_{13} all other samples were significantly different ($p<0.05$.) The sample C_{13} scored maximum scores among all the formulations tried and was almost equal to the control sample. The appearance and texture was improved by the addition of gluten, guar gum and vegetable oil. This sample C_{13} prepared from 70% wheat flour and 30% malted ragi flour with added gluten, guar gum and vegetable oil was liked very much by all panel members. Day *et al*. (2006) has reported that addition of wheat-gluten in noodle improve the visco-elasticity in rehydration. GMS and vegetable oil used in vermicelli making resulted in lower cooking loss, creamy yellow colour, firm and non-sticky mouth feel (Prabhasankar *et al*., 2007). The water binding capacity of the noodle during rehydration was increased by addition of guar gum (Sánchez *et al*., 1995).

Table 6. Effect of addition of different ingredients on the sensory evaluation of malted ragi noodles

Sample Code	Appearance	Flavour	Taste	Texture	Overall acceptability
C	3.0	3.0	3.0	4.0	5.0
C_6	1.8	2.9	2.8	1.9	2.2
C_7	2.0	2.9	2.8	2.0	3.0
C_8	2.0	2.9	2.6	2.2	3.2
C_9	2.1	2.8	2.7	2.4	3.6
C_{10}	2.4	2.7	2.8	2.4	3.9
C_{11}	2.6	2.8	2.8	3.0	4.0
C_{12}	2.6	2.9	3.0	3.3	4.2
C_{13}	3.0	3.0	3.0	3.5	4.8
SE	0.148	0.032	0.047	0.245	0.294
CD (p =0.05)	0.341	0.073	0.107	0.554	0.665

a: 3-shining, 2 – dull, 1- very much dull
b: 3-prominent spicy flavour, 2 – moderate spicy flavour, 1-mild spicy flavour
c: 3-non sticky, 2- sticky, 1- very much sticky
d: 4-elastic and smooth, 3 – slightly elastic and smooth, 2 – elastic and granular,1- nonelastic and powdery
e: 5-liked very much, 4-liked moderately, 3-liked slightly, 2-acceptable, 1 disliked slightly

The analysis of nutritional constituents of the ragi supplemented noodle optimized sample (C13) is given in Table 7. The results show that the noodle supplemented with malted ragi flour was rich in protein, crude fibers and minerals especially calcium, iron and phosphorus as compared to the control sample. This increase in protein content was due to the addition of gluten during manufacturing of noodle. Whereas increase in crude fiber and minerals was due to addition of malted ragi flour.

Table 7. Nutritional constituents of noodle supplemented with malted ragi flour

Sample code	Moisture (%)	Protein (%)	Fat (%)	Crude fibre (%)	Calcium (mg/100g)	Phosphorus (mg/100g)	Iron (mg/100g)
C	7.12	9.93	15.8	0.3	21	112	2.2
C_{13}	6.86	15.66	15.6	1.35	160	186	5.61
SE	0.13	2.87	0.10	0.52	69.5	37.00	1.71
CD (p=0.05)	1.56	12.32	0.43	2.26	298.85	159.10	4.04

Conclusion

Among all the formulations tried, noodle sample prepared from 70 % wheat flour and 30% malted ragi flour combination with optimized added ingredients (give exact details) had same sensory score as that of control. It had higher values of protein, fiber and minerals (calcium, iron and phosphorus) than the control sample. Thus, this nutrient rich noodle will be a good source of RTE food for children, teenagers, sport persons, pregnant and lactating women.

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