

Development & Evaluation of Amylase Rich Malted Mixes (ARMMS) to Improve the Nutritional & Health Status of Pre School Children

Abstract. Two types of Ready to Use Amylase rich malted mixes (Ragi / Wheat in combination with green gram) were formulated and suitable products namely *laddu*, *roti*, *kheer* and *porridge* were prepared. Organoleptic evaluation rated between 4 (good) to 5 (very good) for all the sensory attributes such. Malting decreased grain length, width, kernel weight (0.45 to 19.0g), volume (0.50 –31.2 ml), hardness (1.12 to 5.9 kg/cm²) and reduced the bulk density. Wheat malted mix had significantly higher (P<0.05) fat (2.27 g), carbohydrate (98.0 g) and calorie (396 kcal) content. Significantly higher (P<0.05) calcium (440 mg), thiamine (0.7 mg) and riboflavin (0.9 mg) content was observed in ragi malted mix compared to native and germinated grains. When compared to the native grains and malted mixes germinated green gram had significantly higher protein (33.0 g), fiber (11.5 g), iron (8.0 g) and vitamin C (157.8 mg) content.

Key words: development, evaluation, amylase rich malted mixes

1. Introduction

Flours of germinated cereals which are rich in enzyme amylase constitute amylase rich foods (ARF). Even small quantities of this type of foods liquefy and reduce the bulk of the cereal-based diet. Thus, ARF helps in increasing the energy density of weaning gruels and in reducing its bulk as well. It will also help in enhancing the digestibility. Therefore, a study was conducted to develop ready to use (RTE) Amylase rich malted mixes (ARMMS) using malted wheat / Ragi in combination with green gram and to assess the physico-chemical and organoleptic quality characteristics of the developed malted mixes.

2. Methodology

Raw material required for the study, such as Ragi, Wheat, Green gram, Sugar and Milk powder were procured from local market, Hyderabad. Two types of Ready to use ARMMS (Ragi/Wheat in combination with green gram) were formulated using standard procedure developed by Malleshi and Dasgupta et al (1995) [1]. Suitable products namely *Laddu*, *Roti*, *Kheer* and *Porridge* were prepared with the developed Amylase Rich Malted Mixes.

The formulated ARMM and products were subjected to organoleptic evaluation (Amerine et al. 1965) [2] for colour, flavor, texture, taste, appearance and overall acceptability by 15 selected trained panel members from staff and students of Post Graduate and Research Centre, Rajendranagar.

Raw ingredients i.e. whole ragi, wheat and green gram were subjected to physical parameters using standard procedures (Kumar et.al, 1991) [3] for colour, texture, length, width, kernel weight, kernel volume and hardness in native and malted grains. For the assessment of colour, texture, length and width, an average of 10 whole grains were taken.

Proximate composition (Moisture, Protein, Fat, Fiber and Ash) of whole grains, germinated grains and ARMMS were analyzed. (AOAC, 1990) [4]. Vitamin C was assessed by colorimetric method (Association of vitamin chemist Inc, 1975) [5]. Thiamine was assessed by Modified thiochrome method (AOAC, 1990) [4], Riboflavin was assessed by Florescence technique (AOAC, 1990) [4]. Minerals such as Iron and Calcium were determined by atomic absorption spectrophotometer method (AOAC, 1990) [4]. Amylase activity was estimated by the standard procedure given by Byfield, 1955. Carbohydrate content was calculated by difference and energy values were computed.

3. Results and Discussion

The mean organoleptic scores obtained for the products prepared with Ragi malted mix and Wheat malted mix are given in Table 1 & 2 respectively.

Table – 1 Organoleptic Scores obtained for the products prepared with malted Ragi mix

Products	Sensory attributes*				
	Appearance	Colour	Flavor	Texture	Over all acceptability
Ragi malted mix	4.90±0.42	4.75±0.44	4.90±0.31	4.85±0.37	5.00±0.00
Porridge	4.65 ± 0.48	4.75 ± 0.44	4.70 ± 0.47	4.80 ± 0.41	4.85 ± 0.36
Roti	4.60 ± 0.50	4.70 ± 0.47	4.80 ± 0.41	4.85 ± 0.36	5.00 ± 0.00
Kheer	4.75 ± 0.44	4.65 ± 0.48	4.85 ± 0.36	4.70 ± 0.47	5.00 ± 0.00
Laddu	4.75 ± 0.44	4.80 ± 0.41	4.85 ± 0.36	4.70 ± 0.47	4.79 ± 0.30

*5- very good, 4- good, 3- fair, 2- poor and 1- very poor

Table 2: Mean organoleptic scores obtained for the products prepared with malted Wheat mix

Products	Sensory attributes*				
	Appearance	Colour	Flavor	Texture	Over all acceptability
Wheat malted mix	4.85±0.44	4.90±0.36	4.79±0.48	4.80±0.41	4.95±0.38
Roti	4.75 ± 0.44	4.80 ± 0.41	4.70 ± 0.47	4.65 ± 0.48	4.75 ± 0.44
Kheer	4.80 ± 0.41	4.80 ± 0.41	4.70 ± 0.47	4.85 ± 0.37	4.90 ± 0.31
Laddu	4.65 ± 0.48	4.70 ± 0.47	4.80 ± 0.41	4.85 ± 0.36	4.90 ± 0.31

*5-very good, 4-good, 3-fair, 2-poor and 1-very poor

From the tables 1 & 2, it was observed that the organoleptic scores rated between 4 (good) to 5 (very good) for the products with malted ragi and wheat mixes. Maximum sensory scores were obtained for ragi malted mix (5.0), Ragi roti (5.0) and Ragi kheer (5.0) in the present study. Vaidehi et al (1985) ^[6] reported that the overall acceptability of the biscuits prepared with ragi malted mix and wheat malted mix were good which is comparable with the present study. Whereas, burfi prepared from genotype malted finger millet flour showed that the overall acceptability scores ranged from fair to good. (Sangeeta Kumari et.al, 2000) ^[7]

Native and malted grains (Ragi, Wheat and Green gram) were assessed for the physical parameters. The results are given in Table 3. Malting resulted in decrease of 1000 kernel weight by 0.45 to 19.0 g and the volume by 0.50 to 31.2 ml. A noticeable level of decrease in grain hardness was also observed in all grains after malting because the malts of the grains had shrunken appearance and their hardness was considerably lower (1.1 to 5.9 kg/cm²) than the native grains. Malting helped to reduce the bulk density of the malted mixes. Similar observations in weight, volume and hardness of native and malted grains were reported by Della Valle G *et.al* ^[8], Ibeanu VN, 2010 ^[9], Malleshi, N.G and Desikachar, H.S.R.(1981) ^[10] & Sangita Kumari et. al (2000) ^[7].

Table – 3 Physical parameters of native and malted grains (Ragi, Wheat and Green gram)

Sino.	Parameters	Ragi	Wheat	Green gram
1.	Colour	Cream white	Brown	Green
2	Texture	Hard	Hard	Hard
3	Length (cms)			
	a) Native	0.65	-	0.55
	b) Malted	0.75	-	0.5
4	Width (mm)			
	a) Native	0.35	-	0.45
	b) Malted	0.34	-	0.4
5	1000 – Kernel wt (g)			
	a) Native	52.00	2.87	44.0
	b) Malted	47.90	2.42	25.0
6	1000 – Kernel volume(ml)			
	a) Native	35.50	2.80	64.5
	b) Malted	33.70	2.30	33.3
7	Hardness kg/cm ²			
	a) Native	13.10	1.90	7.6
	b) Malted	7.20	0.80	3.5

Kolusheva T and Marinova A (2007)^[11] conducted a study to determine the optimal conditions for enzymatic hydrolysis of starch through the use of thermally resistant bacteria-amylase, produced from strain of *Bacillus Subtilis* XK-86 in the plant Biovet, Peshtera, Bulgaria. The Study revealed that the optimal concentration was 12 enzyme units per ml suspension, since the use of higher concentration did not lead to an increase in the rate of enzymatic reaction. The study concluded that an alpha amylase gives high reaction rate of hydrolysis and thus high concentration of reducing sugar content (Table 4 in a relatively short period of time (4 hours and 15 minutes).

Table4: Influence of substrate and enzyme concentrations on the level of enzymatic starch hydrolysis (30 min after the beginning of hydrolysis)

Influence of the substrate concentration		Influence of the enzyme concentration	
Concentration of the substrate g.l ⁻¹	% hydrolysis of starch	Enzyme concentration: units per ml suspension	% hydrolysis of starch
100	18.2	6	8.2
150	22.5	8	12.4
200	27.1	10	25.2
250	30.1	12	30.1
300	30.3	14	30.2

Influence of amylase content on the viscous behavior of low hydrated molten starches with various amylase contents (0-70%) were processed on a twin screw extruder equipped with a special slit die rheometer. Relationships between thermo mechanical treatment and starch macromolecular degradation are defined and flow curves are discussed in order to determine the role of moisture content, product temperature, and mechanical energy on melt viscosity. The viscous behavior is described by a power-law expression. Viscosity is more sensitive to moisture content and macromolecular degradation at lower amylose contents. Using multiple regression analysis, expressions for the different starches were proposed to describe the influence on the viscosity of amylopectin, which is the macromolecular component with short chain branching. The main differences observed when decreasing the amylose content were a lower viscosity and less pronounced shear thinning.

The chemical composition of native grains, germinated grains and malted mixes is given in Table-5.

Table – 5 Nutrient composition of native, germinated grains and malted mixes (per 100g)

Parameters	Native flours			Germinated grains			Malted Mixes	
	Ragi	Wheat	Green gram	Ragi	Wheat	Green gram	Ragi malted mix	Wheat malted mix
Moisture (g)	11.9	11.5	9.4	17.0	43.5	90.10*	8.0	7.6
Protein (g)	7.8	12.25	23.75	10.3	14.0	33.0*	15.3	19.0
Fat (g)	1.5	1.2	1.6	1.3	2.0	2.1	1.8	2.27*
Fibre (g)	3.3	2.0	4.0	1.8	10.5	11.5*	2.0	8.0
Ash (g)	2.6	2.4	3.6	2.0	2.0	4.5*	2.9	1.8
Carbohydrates (g) ^b	72.6	71.0	57.0	75.0	82.1	60.8	94.51	98.0*
Energy (k.cal) ^c	336	348	228.0	390.0	403.0	380.0	376	396*
Calcium (mg)	350	30.0	320.0	242.0	54.0	109.0	440*	193.2
Iron (mg)	3.9	3.5	4.0	7.7	5.0	8.0*	4.4	5.9
Vitamin C (mg)	-	-	-	8.7	5.0	157.8*	25	14.1
Thiamine (mg)	0.19	0.17	0.28	-	0.9	0.37	0.7*	0.4
Riboflavin (mg)	0.42	0.45	0.43	-	1.23	0.31	0.9*	0.5
Amylase activity [@]	10.0	6.0	3.0	169*	145	132	117	102

[@] mg maltose released by 1g of malt flour when acted on 1ml of 1% starch at 37°C for 30 min.

*- Significant at 5% level

b- Calculated

c- Computed

It is evident from Table 5 that, wheat malted mix has significantly higher ($p < 0.00$) content of fat (2.27g), carbohydrate (98.0g) and calories (396 k.cal). Whereas, ragi malted mix has significantly higher ($p < 0.05$) content of calcium (440mg), thiamine (0.7mg), riboflavin (0.9mg) and amylase activity (169 mg %) when compared to native and germinated grains. Aisien (1982)^[12] and Glennie (1984)^[13] reported that significant decrease in fiber on malting due to cell wall degradation during sprouting process. The results in the present study can be comparable with the results reported by Malleshi, N.G and Desikachar, H.S.R(1981)^[10]. However, germinated green gram had significantly higher ($p < 0.05$) content of Protein (33.0g), Fibre (11.5g), Iron (8.0g) and Vitamin C (157.8mg). Thus, the incorporation of malted green gram mix and skimmed milk powder to the wheat malted mix and ragi malted mix helped to improve nutritional status of vulnerable segments of population with regard to protein, energy, iron, calcium and 'B' complex vitamins status.

A study was conducted by Ileana V N to assess the energy and nutrient densities and the rate of reduction in viscosity of formulated amylase rich infant complementary blends based on local staples. In the study the amylase rich infant complementary blends based on local staples were prepared/chemically analyzed and combined in different ratios to supply 20g of protein per day. The energy and nutrient densities of the composites were calculated before being used to prepare porridges. Amylase rich flour (ARF) made from germinated sorghum was added to the porridges to produce gruels. The rate of reduction in viscosity of the porridges after the addition of ARF was also calculated. The results indicated that the energy and protein densities of the blends were high and ranged from 0.7 to 0.8kcal and 0.7 to 1.1g/100kcal, respectively. The densities of vitamin A, calcium and iron were low, while those of folate and iodine were high. All the porridges had over 600cP viscosity before the addition of ARF. The viscosities of the porridges were reduced on addition of ARF and the percentage reduction ranged from 1.4% in plantain: cowpea (PCo) blend to 88.6% in maize: cassava: soybean (MaCS) blend. The formulated complementary gruels were energy, protein, folate and iodine dense but low in vitamin A, iron and calcium. The gruels are however, capable of bridging the energy/nutrient gap between breast milk and the introduction of adult family diet if

supplemented with vitamin A, iron and calcium from other rich sources. The results of the present study also coinciding with the results reported in the above study.

In conclusion, with regard to physical parameters of native and malted grains (ragi, wheat & green gram), decrease in grain length, width, kernel weight, volume and hardness of the malted grains was observed. Thus the malted grains help to reduce the bulk density of the malted mixes. ARMMs formulated were found to be nutritionally dense when compared to native and germinated grains. Thus, the incorporation of malted green gram mix and skimmed milk powder to the wheat malted mix and ragi malted mix helped to improve nutritive value of the malted mixes, specially protein, energy, iron, calcium and 'B' complex vitamins.

4. References

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