

Utilization of Malted Sorghum Flour in Formulation of Sorghum Malt based Dairy Foods

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ABSTRACT: A study was carried out to formulate the sorghum malt based dairy food. The formulations were prepared by replacing various levels (0, 25, 50, 75 and 100) of malted wheat flour with malted sorghum flours. The optimized formulation was further added with Skim Milk Powder (SMP) replacing green gram at 0, 25, 50, 75 and 100 per cent. The best formulation with green gram and /or SMP was added with Whey Protein Hydrolysate (WPH) at various levels (50, 75 and 100 per cent levels). The prepared formulations were made into porridge and served to a team of semi trained panel of judges to adjudge the best combination. From among the various malted sorghum flour blends, the blend with 50:50 was adjudged as best. The addition of SMP (100 per cent) enhanced the over all acceptability of product to a significant level (7.97) compared to product with green gram flour (7.13). The product with WPH was comparable to the SMP added formulation when WPH level was up to 50 percent. The formulated product can be conveniently stored for 3 months. From the study, it was concluded that malted sorghum could be a promising ingredient in malt based dairy foods.

Key words: Malted foods, Malting, Skim milk powder, Sorghum

INTRODUCTION

Millets are the sixth most important cereal grains in the world, sustaining more than one-third of the world's population. Annually, India produces 42.04 million tonnes of coarse cereals of which sorghum accounts for nearly 63 per cent of production with a production of 11.85 million tones [5]. Millets are high in nutritional value as majority of millet grains contain higher protein, fibre, calcium and minerals than wheat and rice. Therefore, these are now also being called the "Nutri-cereals" [5]. In addition to the nutritional value, millets also provide many health benefits [7]. The nutritional value of grains and seeds could be improved greatly by germination [6]. Fermentation of the composite flour resulted in an improvement in the protein content [15]. Proper utilization of small millets which are hitherto neglected is being promoted as nutri-cereals. By proper processing many kinds of food products can be made. Milled millets can be further processed into flakes, quick food

cereals, ready to eat snacks, supplementary foods, extrusion cooking, malt based products, weaning foods and more importantly health foods. Earlier researchers worked on standardization of hydrothermal treatments for processing small millets [25, 12], study of nutritional qualities of different ragi and other small millets and development of ragi based weaning food [2, 22, 10], studies on the processing and nutritional aspects of little millet, foxtail millet and proso millet and development of value-added nutri-rich products including ready-to-eat and ready-to-cook extruded products, ready to eat bakery products, nutri-mixes and Hurihittu in UAS, Bangalore and UAS, Dharwad [2, 3, 17, 4]. NDRI, Karnal has standardized the formulations of pearl millet whey based complementary foods, extruded foods, probiotic foods and pearl millet based composite fermented dairy foods like yoghurt and lassi [20, 21]. Keeping the above facts in mind, the study was undertaken to develop sorghum malt based dairy food formulations for the children of the

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age group of 2-5years and the process of manufacturing them.

MATERIALS AND METHODS

The ingredients used in the investigation namely foxtail millet, little millet, sorghum, white ragi, wheat, green gram, sugar, multi-vitamins; sugar and Dabur honey were procured from the local market. Commercially available "NANDINI" brand of skim milk powder manufactured by Mother Dairy, Yelahanka of Karnataka Milk Federation (KMF), Bangalore, Karnataka was used for formulations of millet based complementary health foods. Whey Protein Hydrolysate (WPH) was procured from Sri Durga Sales corporation, Bangalore, India was used for formulations of millet based complementary health foods with WPH. Poly Ethylene Terephthalate (PET) and Metallized Polyester (MPE) were procured from Local market. The millet grains were de-husked using the de-husking machine of AVM industries, Salem, Tamil Nadu installed at the Centre of Excellence for Small Millets, AICRP on PHT, UAS, GKVK, Bengaluru. The sprouted millets were roasted /kilned using the roaster installed at the Centre of Excellence for Small Millets, AICRP on PHT, UAS, GKVK, Bengaluru. A domestic Grain Pulverizer (make: Anand Associates, Shimoga) was used to mill different millet rice grains into suitable flours. The malted flours were sieved using 70 μ sieve to get uniform flour and stored in air tight containers at room temperature.

Initial Processing of the Ingredients

The ingredients used in the formulation of sorghum malt based dairy food were pre-processed by following standard protocol before used in the formulation.

Preparation of Malted Flour

Sorghum malt flour was prepared as per the procedure described by [22] with slight modification. The whole malted wheat flour was prepared as per the procedure of [23]. The green gram and other grain malt were prepared as per the procedure outlined by [13] with slight modifications.

Preparation of Malted Sorghum Flour

The parameters were optimized for the preparation of sprouted sorghum flour from sorghum. The grains were soaked for 24 hrs with a grain to water ratio of 1:3. The soaked grains were spread on a muslin cloth at a temperature of 37°C. The optimum time for

germination of sorghum was observed to be 18-24 hrs. The sprouted grains were dried at 50°C for 24hours in a tray dryer. The dried grains were subjected to kilning in the machine to get uniform kilned grains. Milling of the malted grains was done in a domestic flour mill to get the millet flour. The resultant flour was sieved using 70 μ sieve to get uniform quality sprouted millet flour for further formulation studies. The flour was then stored in an air tight container until the formulation studies initiated to develop millet based complementary dairy food.

Formulation of Sorghum Malt based Food

The sorghum malt based food was formulated by using malted sorghum flour, malted wheat flour, malted green gram flour, SMP, WPH, sugar, multivitamins and minerals. Various blends of Sorghum malt based foods were prepared by replacing various levels of sprouted wheat flour with sprouted sorghum flours.

A - Malted wheat flour (100%)

B - Malted wheat flour (75%) + Malted sorghum flour (25%)

C - Malted wheat flour (50%) + Malted sorghum flour (50%)

D - Malted wheat flour (25%) + Malted sorghum flour (75%)

E - Malted sorghum flour (100%)

The final formulations for preparation of sorghum based malted dairy food was prepared with 70% of the above blends + 11.5% malted green gram flour + 18.5% sugar.

The blends were added with the fixed level of malted green gram flour and sugar as mentioned above to prepare the final formulation of the malted food. The flours blended with sprouted wheat flour for preparation of malted dairy food was used as a control. The prepared formulation was made into porridge by adding the required quantity of water. The porridge samples were subjected to sensory evaluation studies to adjudge the best combination of the blend using 9 point hedonic scale by a team of semi trained panel of judges.

Optimization of sorghum malt in sorghum malt based food

To prepare sorghum malt based foods, the portion of malted wheat was replaced with sorghum malt at 0, 25, 50, 75 and 100 per cent levels. The blends were subjected to sensory evaluation studies after cooking to make into porridge in order to select the right levels

of millet malt that could be incorporated in the sorghum malt based food.

Optimization of Level of Replacement of Malted Pulses with SMP

The optimized sorghum malt based food with respect to malted sorghum was further added with SMP replacing green gram. The pulses used in the study were replaced with 0, 25, 50, 75 and 100 per cent levels. The blends were reconstituted and cooked and made into porridge. The resultant gruels were subjected to sensory evaluation attribute studies in order to select the right level of replacement of malted green gram with SMP.

Optimization of Level of Replacement of Malted Pulses/SMP with WPH

The best adjudged formulation with green gram and / or SMP was added with Whey Protein Hydrolysate (WPH) at various levels (50, 75 and 100 per cent levels) to increase the protein content of the sorghum malt based food. The blends were reconstituted and cooked and made into porridge. The resultant gruels were subjected to sensory evaluation attribute studies in order to select the right level of replacement of malted cereal with whey proteins.

Chemical Composition of the Optimized Formulations

The blends were also subjected to their Chemical parameters such as moisture, protein, fat, crude fibre, energy and total ash content were determined using [1] method, Carbohydrate content was expressed as per cent and calculated by differential method as per [1]. Gross energy was estimated as per [1] method. Microbiological analysis with respect to total bacterial count was done as per IS: 1165-1975, coliforms was done as per IS: 5401:1969 and yeast and moulds was done as per IS: 5403-1969.

RESULTS AND DISCUSSION

The sorghum malt based food was formulated by using malted sorghum flour, malted wheat flour, malted green gram flour, sugar, multivitamins and minerals.

Formulations of sorghum malt based foods were prepared by replacing sprouted wheat flour with sprouted sorghum flours at different levels. The blends were reconstituted and cooked and made into porridge. The resultant gruels were subjected to sensory evaluation studies in order to select the best formulation. The results of the study are depicted in the Table 1.

Table 1
Effect of replacement of malted wheat flour with malted sorghum flour on the sensory attributes sorghum based malted food

Malted Wheat flour : Malted Sorghum Millet flour Ratio	Sensory scores on 9 point Hedonic Scale			
	Colour and Appearance	Flavour	Body and Texture	Overall Acceptability
100:0	7.32	7.13	7.27	7.4
75:25	7.71	7.26	7.57	7.3
50:50	7.81	7.3	7.65	7.36
25:75	7.73	7.15	7.45	7.21
0:100	7.58	7.05	7.5	7.23
CD	0.538	0.673	0.646	0.734

* All values are average of three trials

The sensory scores of the formulated sorghum malt based food revealed that the sorghum flour can be replaced only up to 50 per cent wheat flour to get the product comparable to the control. The sample adjudged best was with the sensory score of 7.81, 7.30, 7.65 and 7.36 for Colour and appearance, flavour, Body and texture and overall acceptability, respectively, without affecting the acceptability of product with that of control. Lysine, a limiting amino acid in cereals is present in appreciable amount in green gram (5.51-7.65g/100g protein). Even though it contain higher amount of lysine than that recommended in FAO reference protein, its chemical score is poor (33.2) due to low content of methionine and threonine. Many attempts have been made earlier to formulate malted weaning foods by using ragi and green gram [14, 22].

The best formulation from the sorghum malted food with green gram was considered for further studies to incorporate SMP at the level of at various levels 0%, 25%, 50%, 75% and 100% in place of green gram into the blend. The results are depicted in Table 2.

Table 2
Effect of level of replacement of malted green gram flour with SMP on the sensory attributes of the sorghum based malted food with added SMP

Malted Green gram flour : SMP Ratio	Sensory scores on 9 point Hedonic Scale			
	Colour and Appearance	Flavour	Body and Texture	Overall Acceptability
100:0	7.71	7.06	7.24	7.13
75:25	7.32	7.19	7.21	7.20
50:50	7.54	7.39	7.54	7.36
25:75	7.73	7.4	7.57	7.61
0:100	8.07	7.89	7.96	7.97
CD	0.636	0.64	0.737	0.756

* All values are average of three trials

The sensory scores awarded for the formulated sorghum based malted food with SMP revealed that 100 per cent replacement of green gram flour with SMP was adjudged best compared to the other blends with the sensory score of 7.97. The best adjudged sample was awarded the respective sensory scores of 8.07, 7.89, 7.96 and 7.97 for colour and appearance, flavour, body and texture and overall acceptability. Dairy powders are extremely useful products and as this realization grows, so does the demand for a high quality product [19]. SMP is a highly nutritious, versatile, and multi-functional food ingredient finds its application in bakery, confectionery, dairy, sports and nutrition products, infant formulas, and other consumer products. The foaming and whipping properties of SMP allows this product to work well in ice creams, cakes, dry mixes, mousses, and aerated confections such as malted milk and nougat centered candy [24]. The better sensory scores are because of addition of SMP which enhanced the acceptability of product to a significant level with that of sorghum malted food with green gram flour.

Table 3
Sensory attributes of the sorghum based malted food formulation changing with the level of replacement of SMP with WPH

SMP: WPH Ratio	Sensory scores on 9 point Hedonic Scale			
	Colour and Appearance	Flavour	Body and Texture	Overall Acceptability
100:0	8.03	8.11	7.98	8.06
50:50	8.10	7.75	7.74	7.99
25:75	7.78	7.79	7.83	7.75
0:100	7.51	6.95	6.85	7.1
CD	0.566	0.763	0.934	0.753

* All values are average of three trials

The sensory evaluation of the formulated Sorghum based malted food with WPH was conducted on 9 hedonic scales by a team of semi trained panel of judges to know best combination of the blend. The results of the study are shown in Table 4. The results of the study on incorporation of whey protein in to the sorghum based malted food revealed that whey protein could be successfully incorporated up to the level of 50% by replacing the SMP as a protein source without affecting the sensory quality of the product. Sensory scores of 8.10, 7.75, 7.74 and 7.99 were awarded for Colour and appearance, Flavour, Body and texture and Overall acceptability, respectively for the sample adjudged best. Whey solids could be effectively used and should be exploited in novel food formulations to overcome the nutritional deficiencies in grains and legumes.

Because of their high quality proteins, particularly the sulphur containing amino acids milk proteins acts as a balancing ingredient in weaning food formulation [11]. Hydrolyzed whey proteins exhibit improved functional properties such as increased solubility and significant changes in foaming, gelling and emulsifying properties [8]. Whey protein hydrolysates have also been used as the major proteins in formulas for infant's allergic diseases to reduce antigen reactions [11]. These hydrolysed products also possess higher digestibility and better functionality [16]. Whey protein hydrolysate exhibited increased water absorption capacity depending on duration of hydrolysis [18]. This increased water absorption capacity which in turn affecting the viscosity and gelling characteristics may be the reason behind decrease in the sensory scores when WPH was incorporated beyond 50 per cent replacing SMP.

Table 4
Chemical composition of optimized formulations of sorghum malt based dairy foods

Parameter	Sorghum malt based dairy food with green gram	Sorghum malt based dairy food with SMP	Sorghum malt based dairy food with WPH
Moisture (%)	5.70	4.34	3.95
Fat (%)	2.82	2.37	2.55
Protein (%)	11.26	12.16	14.41
Carbohydrates (%)	75.92	77.33	75.52
Ash (%)	2.10	1.85	1.70
Crude fibre (%)	2.2	1.95	1.87
Energy (K.cal/100g)	374.1	379.29	382.67

All values are average of three trials

The chemical composition of sorghum based malt based food as affected by the replacement of green gram, SMP and WPH are presented in Table 4. The composition of green gram added sorghum malt based food with respect to Moisture, Fat, Protein, Carbohydrates, Ash and Crude fibre were observed to be 5.70, 2.82, 11.26, 75.92, 2.10, and 2.2 respectively. As denoted in the table, the replacement of green gram with SMP has resulted in slight decrease in the moisture content (4.34) of the malted food, increased protein content (12.16) in comparison with that of the green gram containing malted food. Upon addition of WPH the protein content was further increased to 14.41 per cent. This is due to the increased protein content in the SMP (34%) and WPH (80%). The decreased the moisture, carbohydrate and crude fibre content were observed in the sorghum malted food with WPH. The results obtained are in accordance

with the observations made by the researchers [22, 9, 10] for the weaning foods developed using finger millet.

Storage Stability of the Formulated Sorghum based Complementary Foods

The best adjudged formulation with Green gram, SMP and WPH were packed in metallized polyester and stored at room temperature. The microbial quality assessment revealed that the total count was observed to be 2.62 log cfu/g and the developed product was free of coliforms and yeast and moulds. The results of the storage study revealed that the products were found acceptable up to 3 months.

CONCLUSION

The results of the investigation revealed that in the formulation of sorghum based malted dairy food sorghum flour can be replaced only up to 50 per cent in place of wheat flour to get the product comparable to the control. The results of the sensory acceptability of formulated sorghum based malted dairy food with SMP revealed that upon 100 per cent replacement of green gram flour with SMP the acceptability of the product was best compared to the other formulated blends. The WPH incorporation up to 50 per cent only was possible in the formulation to get the optimum quality product comparable to the control. Further increase in the WPH content reduced the sensory scores. The ready to cook formulations of cereal based, milk protein based and protein rich whey protein blended sorghum based malted dairy foods can be conveniently prepared.

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