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QUALITY EVALUATION OF SORGHUM- BASED COMPLEMENTARY FOOD MIXES

Vandana Sati[1] and Dr. Vishakha Singh[2]
[1]Ph.D. Scholar, [2]Assisstant Professor
Department of Food and Nutrition, College of Home Science,
MPUAT, Udaipur, Rajasthan-313001, India
E-mail: bandana.sati@gmail.com (**Corresponding Author*)

Abstract: Complementary feeding becomes a necessity for the optimum development of an infant after completion of six months of age. Sorghum is rich in mineral but considerable amounts of anti-nutrients are present making their elimination necessary to improve the nutritional quality and effectively utilize its full potential as human food. Its use for infant foods needs to be popularized by using simple household technologies and improving its nutritive value and thus formulating a home-based complementary food mix. The present study was aimed to formulate and evaluate complementary food mixes based on sorghum in combination with legumes and other ingredients to obtain optimum nutrition and organoleptic attributes. Formulated mixes were standardized and subjected to organoleptic evaluation. Mean scores of overall acceptability of the formulated mixes ranged from 8.23±0.04 to 8.71±0.05 which revealed that they were **'liked very much'** by panel members. Nutrients of the formulated mixes ranged from 2.21-3.16g moisture; 11.95-14.0g protein; 2.34-3.74 g fat; 2.26-3.25g total ash; 0.35-0.47g crude fibre; 77.99-78.49g carbohydrate and 385.98-401.03kCal energy per 100g. Hence it may be concluded that malted sorghum based complementary food mixes have desirable sensory properties as well as nutritional quality and hence can be recommended for children of 6-24 months age.
Keywords: Complementary food mixes, Sorghum, Malting, Organoleptic evaluation.

Introduction

Protein-energy malnutrition is essentially a syndrome that occurs during the crucial transitional phase of child's life from breast milk to other types of foods. During this period, children need nutritionally balanced, calorie-dense complementary foods in addition to mother's milk because of the increasing nutritional demands of the growing body (Sajilata *et al*., 2002). Breast feeding is the best choice for feeding the infant, but it meets nutritional requirements of growing infant only up to six months. Thereafter, complementary feeding becomes a necessity for the optimum development of an infant. This can be achieved through legume supplementation of cereal-based complementary foods.

Most of the requirement of complementary foods is being met through commercial complementary foods. These are excellent and meet the maximum requirements of the infant.

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However, these marketed products are too expensive for the target groups who need such a product in developing countries. Therefore, it is need of the society to develop ways and means of developing economic but nutritionally excellent products within the reach of wider population.

In the recent years, there has been an increasing recognition of the importance of millets as the substitution for major cereals with respect to protein, energy, vitamins and minerals. In addition, these are rich source of dietary fibre, phytochemicals and micronutrients and hence, rightly termed as "*nutri-cereals*".

Sorghum (*Sorghum bicolor, L. Moench*) is one of the most important crops in the world and is one of the four major food grains of our country after wheat, rice and maize. It is a staple food for millions of poor rural people in Asian and African countries. Sorghum is rich in mineral content but its nutritional quality is dictated mainly by its chemical composition; presence of considerable amounts of anti-nutritional factors such as tannin, phytic acid, polyphenol and trypsin inhibitors that are undesirable. Hence, elimination or inactivation of such anti-nutritional compounds is absolutely necessary to improve the nutritional quality of sorghum, and effectively utilize its full potential as human food, by using simple household technologies like fermentation or germination (Gilani *et al*. 2005).

Till now sorghum has been used in the food preparations for the adults, animal fodder, alcoholic beverages, industrial applications, etc. There is a need to popularize its use for infant foods by applying several processing techniques and improving its nutritive value and thus formulating a home-based complementary food mix.

So with this view the present study entitled as "**Designing of complementary food mixes based on Sorghum (*Sorghum bicolor, L. Moench*)**" was planned with the objective to formulate and evaluate complementary food mixes based on sorghum in combination with legumes and other ingredients to obtain optimum nutritional and organoleptic attributes.

Methodology

The present study was conducted in the Department of Foods and Nutrition, College of Home Science, MPUAT, Udaipur. Sorghum variety CSV-23 was procured and malted (figure 1). Four complementary food mixes were prepared by mixing malted sorghum flour with other ingredients including malted whole green gram flour, malted chick pea (desi) flour**,** roasted rice flakes flour, roasted barnyard millet flour, pumpkin flour, whole milk powder and powdered sugar in different proportions given in Table 1.

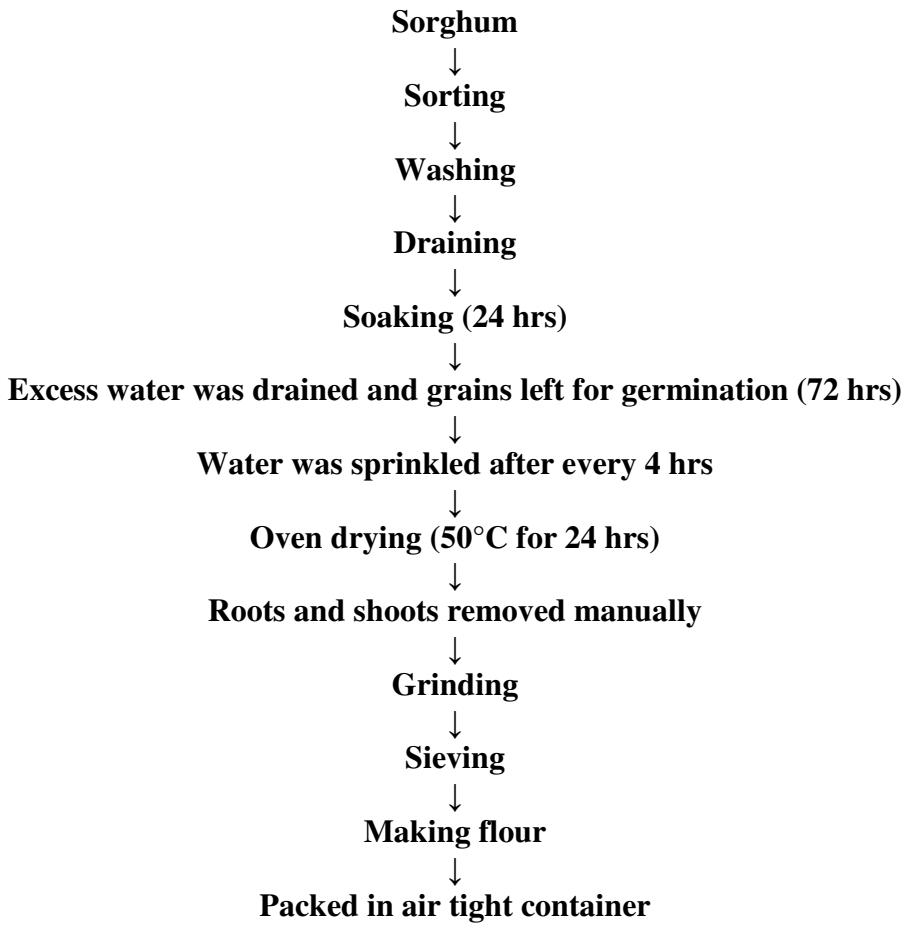

Figure1. Flow chart of the Preparation of Malted and Dried Sorghum flour

The formulated complementary food mixes were subjected to sensory evaluation by a semi-trained panel of ten judges using 9-point hedonic rating scale. Nutritional evaluation of the formulated mixes was done for their proximate composition using standard methods.

Results & Discussion

The amount per serving of the formulated complementary food mixes (Table 1) was calculated such that each gram of the mix provides one kcal as per the guidelines provided by Government of India regarding complementary feeding (Guidelines For Enhancing Optimal Infant And Young Child Feeding Practices, Govt. of India, 2013).

Table 1: Standard Recipe of Complementary food mix for one serving (35g)

Ingredients	**R1**	**R2**	**R3**	**R4**
Water (ml)	30	50	50	50
Malted Sorghum flour (g)	10.5	8.75	8.75	8.75
Malted green gram flour (g)	-	3.5	3.5	-
Malted Chickpea flour (g)	7	-	-	3.5
Roasted rice flakes flour (g)	3.5	1.75	-	-

Roasted Barnyard Millet flour (g)	-	-	1.75	1.75
Pumpkin flour (g)	-	7	7	7
Sugar (g)	3.5	3.5	3.5	3.5
Whole Milk powder (g)	10.5	10.5	10.5	10.5

Sensory evaluation- Formulated complementary food mixes were subjected to sensory evaluation on 9- point hedonic rating scale by panel of ten adult members. (Table 2)

Regarding color, highest score was obtained by complementary food mix *R1* i.e. 8.83±0.12 followed by *R4* (8.57±0.06), *R2* (8.50±0.01) and *R3* (8.47±0.06). The formulated mixes scored in the range of 8.03±0.05 to 8.83±0.11 in terms of taste attribute. The texture of formulated mixes *R1* (8.60±0.01), *R2* (8.63±0.05) and *R3* (8.53±0.11) were "liked very much" and formulated mix *R4* was "liked moderately" (7.96±0.15) by the panel members. Flavor of formulated mixes was "liked very much" and the scores ranged between 8.37±0.06 to 8.73±0.12. The appearance of the formulated complementary food mixes was "liked very much" by the panel members and were acceptable with overall acceptability scores of 8.71±0.05 (*R1*) followed by 8.54±0.03 (*R2*), 8.46±0.08 (*R3*) and 8.23±0.04 (*R4*). The scores revealed that the formulated complementary food mixes were "liked very much" by the judges. Sangwan and Dahiya (2013) reported that biscuit prepared from composite flour in different ratios were in the category of "liked moderately" on the basis of organoleptic evaluation. Varsha (2003) reported moderate acceptability of chapatti prepared by using wheat- sorghum-soya blend each in 70:15:15 ratio.

Table 2: Mean ± SD scores of sensory evaluation of formulated complementary food mixes

Complementary Food Mixes	Sensory attributes					
	Color	**Taste**	**Texture**	**Flavor**	**Appearance**	**Overall acceptability**
R1	8.73±0.05	8.83±0.12	8.60±0.12	8.73±0.12	8.67±0.06	8.71±0.05
R2	8.50±0.01	8.63±0.06	8.63±0.06	8.57±0.06	8.40±0.01	8.54±0.03
R3	8.47±0.06	8.40±0.17	8.53±0.12	8.53±0.06	8.37±0.12	8.46±0.08
R4	8.57±0.06	7.97±0.15	7.96±0.15	8.37±0.06	8.10±0.01	8.23±0.04

All the values are (Mean ±SD) of three observations

Proximate composition of formulated complementary food mixes

Table 3 represents the results of proximate composition of the formulated complementary food mixes. The moisture content of the formulated complementary food mixes ranged from 2.21±0.55g (*R1*) to 3.16±0.23g (*R4*) per 100 g. Crude protein content was highest in *R1*, i.e. 14.0± 0.01g followed by *R2* (13.12±1.75g), *R4* (12.83± 0.50g) and *R3* (11.95± 1.82) per 100

g on dry weight basis, respectively. Highest crude fat content was found in formulated mix *R1* (3.74± 0.15g) and minimum in *R4* (2.34± 0.25g) per 100g, on dry weight basis. Regarding the total ash content of the formulated complementary food mixes, it was found that *R3* had the highest value, i.e. 3.25± 0.11g per 100g, on dry weight basis.

Table 3:- Proximate composition of formulated complementary food mixes (mean ±SD) per 100g on dry weight basis

Nutrients (per 100 g)	Complementary Food mixes			
	R1	R2	R3	R4
Moisture (g)	2.21±0.55	2.32±0.52	2.98±0.61	3.16±0.23
Crude protein (g)	14.0± 0.01	13.12±1.75	11.95± 1.82	12.83± 0.50
Crude Fat (g)	3.74± 0.15	2.82± 0.41	2.85± 0.33	2.34± 0.25
Total Ash (g)	2.26± 0.08	3.18± 0.04	3.25± 0.11	2.90± 0.12
Crude fibre (g)	0.35 ± 0.03	0.39± 0.01	0.45± 0.03	0.47± 0.01
Carbohydrates (g)	77.99±1.64	78.15±1.81	78.49±1.64	78.29±0.66
Energy(kcal)	401.03±0.06	389.94±0.06	387.99±0.04	385.98±0.02

All the values are (Mean ±SD) of three observations

The results show that the crude fibre content of the mixes ranged from 0.35 ± 0.03g to 0.47± 0.01g per 100g. Carbohydrate content of the formulated mixes was calculated by difference method. The values were 77.99±1.64g (*R1*), 78.15±1.81g (*R2*), 78.49±1.64g (*R3*) and 78.29±0.66g (*R4*). High energy value was found in the mix *R1*, i.e. 401.03±0.06 kcal, followed by *R2* (389.94±0.06 kcal), *R3* (387.99±0.04 kcal) and *R4* (385.99±0.02g kcal), per 100g on dry weight basis.

The results of the present study were comparable to the study by Parvin *et al.* (2014) on cereal based supplementary food for young children which had low ash contents (1.88g/100g), 0.58% crude fiber, 11.91 g/100g protein, 8.61g/100g fat, 74.39g/100g carbohydrates and provided 433.9 kcal of energy per 100g on dry weight basis. Weaning blends prepared by Asma *et al.* (2006) (42% sorghum, 20% legumes, 10% oil seeds, and 28% additives-sugar, oil, skim milk powder, and vanillin) were found to contain 16.6% to 19.3% protein, 68.7% to 72.7% carbohydrate, 0.9% to 1.3% fiber, and 405.8 to 413.2 kcal of energy per 100 g. In a study by Satter *et al.* (2013), developed instant weaning food contained the major nutrients like moisture, ash, fat, protein, fiber, carbohydrate and energy 2.43%, 2.26%, 11.32%, 15.98%, 1.06%, 75.35% and 456.6 kcal/ 100 g, respectively.

Conclusion

Thus, on the basis of above results, it can be concluded that the complementary food mixes formulated in the present study, using malted sorghum flour were nutritionally sound for

consumption by infant of weaning age to fulfill his/her nutritional requirements. All the four formulated complementary food mixes have superior nutritional values and were well accepted organoleptically. All the four complementary food mixes are recommended as complementary food for weaning children from 6-24 months age, increasing the frequency of feed depending on the age.

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