IJFANS
International Journal of Food And Nutritional Sciences

Volume 7, Issue 1, January 2018, www.ijfans.com e-ISSN: 2320-7876

INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES

IMPACT FACTOR ~ 1.021

Official Journal of IIFANS

IJFANS

International Journal of Food and Nutritional Science

e-ISSN 2320 -7876 www.ijfans.com
Vol. 7, No. 1, January 2018

Research Paper | *Open Access*

NUTRITIONAL COMPOSITIONS OF MILLET-BASED WEANING FOOD SUITABLE FOR INFANTS UNDER THE AGE GROUP OF 6-12 MONTHS

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Received on: 12th November, 2017 Accepted on: 15th December, 2017

Weaning is the process of gradually introducing an infant mammal to what will be its adult diet and withdrawing the supply of its mother's milk. Objective of the study is to find the proximate, mineral, amino acid and anti-nutritional composition of formulated weaning mixes. In this study, four types of weaning food based on barnyard millet flour (21-30%), defatted soy flour (18%), sugar (52.5-58.55) and skim milk powder (49.5-52.5%) was prepared based its standard procedure. The developed complementary mixes were analysed for its proximate, mineral, amino acid and anti-nutrient compositions based on its standard procedure. The results of the study revealed that, mix 1 and mix 4 had lower (1.02 and 1.2) moisture content than mix 2 and mix 3 but which were significantly higher moisture content. Highest protein content was observed in mix 3 (18.90 g/100 g) and mix 4 showed high carbohydrate of 77.25 g/100 g than mix 1 and mix 2 combinations. Highest sodium, potassium, calcium, magnesium and phosphorus was observed in mix 4. Mix 4 showed high manganese content 16.49 mg/100 g, high iron 21.20 mg/100 g, zinc with high level of 6.75 mg/100 g and copper 15.51 mg/100 g. Regarding amino acid compositions, mix 4 (30% Barnyard millet flour, 18% defatted soya flour, 52.5% of sugar and 49.5% of skim milk) showed highest value of isoleucine, leucine, lysine, cystine, methionine, tyrosine, phenylalanine, theonine, valine, histidine, arginine, glutamic acid, serine, proline, glysine and alanine. Conclusion of the study revealed that, nutritionally the formulated samples were better than a commercial complementary food in terms of proximate, minerals and amino acid compositions.

Keywords: Barnyard millet, Soy flour, Amino acid, Anti-nutrients

INTRODUCTION

Nutritional wellbeing is a sustainable force for health and development and maximization of human genetic potential. The nutritional status of a community has therefore been recognized as an important indicator of national development. In other words, malnutrition is an impediment in national development and hence assumes the status of national problem. For solving the problem of deep-rooted food insecurity and malnutrition, dietary quality should be taken into consideration. Diversification of food production must be encouraged both at national and household level in tandem with increasing yields. Growing of traditional food crops suitable for the area is one of the possible potential successful approaches for improving household food security.

The importance of balanced weaning supplements for promoting children growth and wellbeing is well recognized. Growth and development of infants and children towards mature adult stage is the result of number of competing, complementary, and interacting influences. The most important influence is the supply of sufficient nutrients of adequate quantity and quality. The economically affluent and elite generally meet growing infants needs through commercially standardized foods. These foods are excellent

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and meet the nutritional requirements of young children in both developed and developing countries. However, the products are too expensive for the target groups in developing countries.

In India, around 63% of the children under five years of age are malnourished. This accounts for 75 million malnourished children and is one of the worst levels in the world (Rhode, 1994). Nutritionally inferior diets and improper feeding practices are major contributing factors to the development of childhood malnutrition (Huffman and Martin, 1994). Many attempts have been made by government, international organizations and commercial enterprises to manufacture and market a formula that provides a balanced weaning food for the child (WHO, 1998; and SPCFA, 2000). However, these formulae have proved too expensive to be used by those within the range of very poor (Chandrasekhar *et al.*, 1988).

Millets also referred to as coarse cereals are a variety of small edible grasses belonging to the grass family (*Gramineae/Paniceae*). These are distributed in about 10 genera and 20 species in all (Lupien, 1990). Millet is a collective term referring to a number of small seeded annual grasses that are cultivated as grain crops, primarily on marginal lands in dry areas in temperate, subtropical and tropical regions (Baker, 1996). The millets include five genera of the *Panaceae* family (*Panicum, Setaria, Echinochloa, Pennesetum and Eleusine*). The most important cultivated species are: Proso millet (*Panicum miliaceum*), Foxtail millet (*Setaria italica*), Japanese barnyard millet (*Echinochloa frumentacea*), Finger millet (*Eleusine coracana*) and Koda millet (*Paspalum scrobiculatum*).

Low-cost, high protein food supplement development for weaning infants is a constant challenge (Schmidt, 1983). This is particularly important in developing countries where malnutrition problems are still common particularly during weaning. In African countries weaning can be a period of problems and vulnerability to the survival of a child, where traditional foods are characterized by the low nutrient density and high bulk. The baby is either weaned directly onto the family diet early in life or continues to be breast-fed, with sub optimal nutrient intake. In either case, the nutrition of a child suffers and optimum growth cannot be ensured. So, the introduction of traditional semi-solid foods to infants in developing countries is unsatisfactory in timing, and the quality and quantity of the food is insufficient. The effect on children is growth flattering and the result is malnutrition disease later. Moreover, the high prices of proprietary weaning food and of vegetable and animal protein and the non-availability of nutritious foods, combined with faulty feeding practices and late introduction of supplementary food, are all aggravating the disorder.

Protein-energy-malnutrition generally occurs during the crucial transitional phase when children are weaned from liquid to semi-solid foods. During this period, because of their rapid growth, children need nutritionally balanced calorie-dense supplementary foods in addition to the mother milk (Cameroon and Hofvander, 1971; and Berggren, 1982). Severe protein energy malnutrition results in kwashiorkor and marasmus, while inadequate growth or stunting produced as a result of poor supplementation is described as hidden malnutrition. This is because the child may appear healthy while being severely malnourished. The effects of protein-calorie malnutrition on morbidity and mortality among infants in under-privileged socio-economic groups have been well recognized. Impaired physical growth and mental development have been scientifically verified (Davidson and Passmore, 1986).

MATERIALS AND METHODS

Procurement and Preparation of Raw Materials

Barnyard millet was procured from Tamilnadu Agricultural University, Coimbatore. The millets were cleaned properly, dried and stored cleanly for further use. Major ingredients such as defatted soya flour, sugar and skim milk powder were procured from local market.

Processing of Barnyard Millet

The selected barnyard Millet was soaked for 24 hours, steamed for 20 minutes and dried. By using the roller, the millets were polished and its outer layer was removed. The cleaned grains were pulverized using a plate mill to obtain whole flour, which was be further sieved through a 44-mesh sieve (BSS). The obtained flour was stored in an airtight container until further use.

Malting

Defatted Soya flour was steamed for 20 minutes, dried and powdered and packed in air tight container for further use. Sugar and Skim milk powder was purchased from the local market checked for its purity and stored until further use.

Blend Formulations

The blends were prepared or mixed from the individual flour ingredients in the percentages or proportions as shown in

Table 1: Composition of Blends

Mixes	Processed Barnyard Millet Flour	Defatted Soy Flour (20 min Steamed)	Sugar	Skim Milk Powder
Mix 1	21	18	58.5	52.5
Mix 2	24	18	55.5	52.5
Mix 3	27	18	54	51
Mix 4	30	18	52.5	49.5

Table 1. The developed composite mixes nutrient, amino acid, fatty acid, minerals and anti-nutrient properties were analysed using standard procedure.

Proximate Analysis

Proximate Analysis Standard procedures of AOAC were used to determine the moisture content, crude fat, crude protein, ash and the total carbohydrates have been obtained by difference (AOAC, 1990). Energy value was calculated using the Atwater's conversion factors (Spackman *et al.*, 1958; and Harper, 2003).

Minerals Analysis

Minerals such as potassium and sodium content, calcium, magnesium, manganese, iron, zinc and copper were determined by Atomic Absorption Spectrophotometer, Hitachi Model 180-80, and Ion Chromatographic Analyzer ICA model IC 100 (AOAC, 2000).

Amino Acid Composition

The developed samples amino acid was measured on hydrolysates using amino acid analyzer Sykam-S7130 based on high performance liquid chromatography technique.

Anti-Nutritional Parameters

The anti-nutrients such as saponin, tannin, alkaloid, flavonoid, cyanogenic glycoside. Oxalate, phytate, trypsin inhibitor and haemagglutinin were determined by the modified Vanillin assay (Butler *et al.*, 1982).

Statistical Analysis

Data obtained were analysed for its mean ± standard deviation. Duncan multiple range test was used to compare the differences between the means. Significance was accepted at $p \leq 0.05$.

RESULTS AND DISCUSSION

The developed complementary feeding mixes nutritional parameters were discussed with the following headings.

Proximate Analysis of the Developed Complementary Mixes

The proximate analysis of the developed complementary mixes was shown in Table 2.

Table 2 shows result of proximate composition of the developed complementary foods. The moisture (dry basis), carbohydrates, protein, fat and ash g/100g ranged from 1.02-1.2%, 74.56 -77.25 g/100 g, 16.78-18.90 g/100 g, 1.59-2.83 g/100 g and 3.18-3.42 g/100 g respectively. Mix 1 and mix 4 had lower (1.02 and 1.2) moisture content than mix 2 and mix 3 but which were significantly higher moisture content. Moisture content of food is an important index of their susceptibility to microbial spoilage. When the moisture content is on the high side, it encourages the growth of microorganisms. Moisture content would therefore indicate low growth of bacteria and fungi (Temple *et al.*, 1996). This thus predisposes such food to degradation and enhances its perishability.

The recommended protein content (grams of protein per 100 kcal of food) for complementary foods is of 0.7 g/100 kcal, from 5 to 24 months. In most countries, the protein requirements of infants are met when the energy intake is appropriate, except if there is a predominant intake of low-protein foods (WHO/UNICEF, 1998). In this present study, highest protein content was observed in mix 3 (18.90 g/100 g) than mix 1 (18.58 g/100 g) and mix 2 18.11 g/100 g. According to the protein Advisory Group, guidelines for weaning foods should be 20% of proteins, fat levels of up to 10%, moisture content 5% to 10% and total ash content not more than 5% (FAO/WHO/UNICEF/Protein Advisory Group (PAG), 2007). Diets with this high content of protein can be helpful not only for weaning children but also for children already suffering from PEM.

Among the four mixes, mix 4 showed high carbohydrate of 77.25 g/100 g than mix 1 and mix 2 combinations. For infants with an average breast milk intake and who eat at least three meals a day containing

Table 2: Proximate Analysis of the Developed Complementary Mixes

Blends	Moisture (%)	Protein (g/100 g)	Carbohydrates (g/100 g)	Fat (g/100 g)	Ash (g/100 g)
Standard (Commercial Brand)	NA	14±0.14 [a]	68±0.24 [a]	9±0.03 [a]	NA
Mix 1	1.02±0.02[a]	18.58±1.70[a]	74.56±1.24[a]	2.45±0.32	3.39±0.18[a]
Mix 2	1.03±0.01[b]	18.11±1.54[a]	74.61±1.21[a]	2.83±0.34[b]	3.42±0.74[a]
Mix 3	1.03±0.03[b]	18.90±1.23[b]	73.65±1.01[a]	2.20±0.33[a]	3.19±0.85[a]
Mix 4	1.2±0.02[a]	16.78±1.20[a]	77.25±1.34 [b]	1.59±0.21[a]	3.18±0.64[a]

Note: NA - Not available; Values are expressed as the mean of three replicate samples ± SD. Values in a column with different superscripts differ significantly ($p<0.05$).

complementary foods, the recommended energy intake ranges from 0.6 kcal/g at 6-8 months of life to 1 kcal/g at 12-23 months. When breast milk intake is lower or the infants have a growth delay, energy intake should be higher, ranging from 0.8 to 1.2 kcal/g (WHO/UNICEF, 1998).

Fat content of all the formulated mixes, mix 2 (2.83 g/100 g) showed a significant difference between mix 1 and mix 3. Low fat content may be necessary to prolong its shelf life also by avoiding lipids peroxidation. Lipids in complementary foods should provide approximately 30 to 45% of the total energy required (WHO, 2000; and Dewey and Brown, 2002) which is enough to guarantee the adequate intake of essential fatty acids, good energy intake and uptake of fat-soluble vitamins (PAHO/WHO, 2003). Fat in the diet affects the general intake of nutrients and, if excessive, may exacerbate micronutrient malnutrition in vulnerable populations (PAHO/WHO, 2003). Anecdotal evidence suggests that excessive fat intake predisposes to childhood obesity and cardiovascular diseases (Milner and Allison, 1999).

Mineral Compositions of Developed Complementary Mixes

Macro Minerals Present in the Developed Complementary Feeding Mixes

The macro mineral present in the developed complementary feeding mixes was shown in Table 3.

Table 3 revealed highest sodium, potassium, calcium, magnesium and phosphorus was observed in mix 4 with level of 6.52 mg/100 g, 638.12, 312.32, 10.64 and 46.18 mg/100 g respectively.

Micro Minerals Present in the Developed Complementary Feeding Mixes

The micro mineral composition of the dietary samples is shown in Table 4. Mix 4 showed high manganese content 16.49 mg/100 g, high iron 21.20 mg/100 g, zinc with high level of 6.75 mg/100 g and copper 15.51 mg/100 g. To meet the nutritional mineral requirements of infants, a variety of mineral-rich complementary foods should be offered, since the consumption of these foods is relatively small among infants/children aged between 6 and 24 months. From 9 to

Table 3: Macro Mineral Present in the Developed Complementary Feeding Mixes

Blends	Sodium	Potassium	Calcium	Magnesium	Phosphorus
Standard (Commercial Brand)	60±2.17	NA	175±2.34	NA	145±3.47
Mix 1	2.63±0.08[a]	129.71±7.07[a]	99.5±5.70[a]	5.49±0.21[a]	21.73±0.87[a]
Mix 2	3.52±0.25[a]	234.25±21.47[a]	158.4±26.40[a]	6.58±0.40[a]	25.91±0.56[a]
Mix 3	5.27±0.25[a]	481.53±17.39[b]	240.35±38.91[b]	7.49±0.12[c]	31.72±0.87[a]
Mix 4	6.52±0.14[a]	638.12±12.67[a]	312.32±21.50[a]	10.64±0.11	46.18±0.79[a]

Note: NA - Not available; Values are expressed as the mean of three replicate samples ± SD. Values in a column with different superscripts differ significantly ($p<0.05$).

Table 4: Micro Minerals Present in the Developed Complementary Feeding Mixes

Blends	Manganese	Iron	Zinc	Copper
Standard (Commercial Brand)	NA	3.75±0.31	1.25±0.22	NA
Mix 1	10.38±0.29[a]	10.94±0.56[a]	4.60±0.16[a]	10.64±0.33[a]
Mix 2	12.59±0.25[a]	15.83±0.62[a]	5.62±0.18[a]	12.93±0.53[a]
Mix 3	15.61±0.40[a]	17.44±0.18[a]	6.01±0.06[a]	13.97±0.45[b]
Mix 4	16.49±0.26[a]	21.20±1.22[b]	6.75±0.20[a]	15.51±0.24[a]

Note: NA - Not available; Values are expressed as the mean of three replicate samples ± SD. Values in a column with different superscripts differ significantly ($p<0.05$).

11 months of life, the amount of minerals that should be provided by complementary foods is high: 97% for iron, 86% for zinc, 81% for phosphorus, 76% for magnesium, 73% for sodium and 72% for calcium. The recommended iron intake is 4 mg/100 kcal from 6 to 8 months, 2.4 mg/100 kcal from 9 to 11 months and 0.8 mg/100 kcal from 12 to 24 months; all our formulated diets fall within this range. Duncan's test reveals that there was a significant difference between standard and developed complementary mixes.

Amino Acid Analysis of the Complementary Feeding Mixes

The amino acid analysis of formulated food mixes from barnyard millet, defatted soya flour, sugar and skim milk power blends is presented in Table 5. Among the four CCF mixes, mix 4 showed highest value of isoleucine (2.49 mg/100 g), leucine 5.96 mg/100 g, lysine 30.13 mg/100 g, cystine 1.73 mg/100 g, methionine 30.15 mg/100 g, tyrosine 6.51 mg/100 g, phenylalanine 8.15 mg/100 g, theonine 3.15 mg/100 g, valine 6.44 mg/100 g, histidine 4.50 mg/100 g, arginine 5.25 mg/100 g, glutamic acid 13.29 mg/100 g, serine 5.95 mg/100 g, proline 12.20 mg/100 g, glysine 0.96 mg/100 g and alanine 3.29 mg/100 g. Duncan's test reveals that there was a significant difference between standard and developed complementary mixes.

The amino acid profile of the formulated complementary foods showed that glutamic acid was the most abundant. This observation is in close agreement with the report of Olaofe *et al.* (1994), Oshodi *et al.* (1998), Adeyeye (2004) and Ogungbenle (2011). The Total Amino Acids (TAA) of the food samples were far above average and this observation indicates that the complementary food samples are nutritionally rich to meet the essential amino acids demand of the children. In comparison, the total amino acid profiles of FPB and FPAB were higher compared to melon (53.4 g/100 g), pumpkins (38.3 g/100 g) and gourd seed (53.6 g/100 g protein) respectively as reported by Olaofe *et al.* (1994) and compared to soybean (44.4 g/100 g protein) and pigeon peas (45.2 g/100 g protein) as reported by Nwokolo (1987). The Total percentage of Essential Amino Acids (% TEAA) in the food samples was far above average, and this further shows that the formulated food samples were a good source of essential amino acids. The percentage of recommended daily allowance met by essential amino acids of the food samples revealed that the food samples can adequately provide four-fifth of infant and young children daily requirements. The predicted protein efficiency ratios (P-PER) of FPA, FPB and FPAB samples were lower than 2.88 in whole hen's egg (Paul *et al.,* 1976), 2.50 in reference casein (Oyarekua and Eleyinmi, 2004), 4.06 of modified cornogi (Oyarekua and Eleyinmi, 2004); but favourably comparable to 1.21 in cowpea, 1.82 in pigeon pea (Salunkhe and Kadam, 1989), 0.27 in sorghum ogi, and 1.62 in millet ogi (Oyarekua and Eleyinmi, 2004). The Essential Amino Acid Index (EAAI) of the food sample was quite low compared with defatted soy flour (Nielsen, 2002).

Phyto Chemical and Anti-Nutrient Composition of the Developed Complementary Feeding Mixes

Table 6 shows the phytochemical and anti-nutritional composition of barnyard millet, defatted soya flour, sugar and skim milk power combinations of blends. The result showed that oxalate concentration range between 0.03-0.35 mg/100 g for all mixes and the highest oxalate was found in mix 4. Oxalic acid is primarily located in the outer layers of grains (Siener *et al.*, 2006). Based on the reference of Ravindran (1991) and Siener *et al.* (2006) the content of oxalate (from 0.03-0.35 mg/100 g) in barnyard millet grain is low and about 60-91% of the oxalates are present in a

Table 5: Amino Acid Analysis of the Complementary Feeding Mixes

Parameters	Commercial Brand	Mix 1	Mix 2	Mix 3	Mix 4
Isoleucine	NA	0.97±0.20[a]	1.27±0.02[a]	1.91±0.07[a]	2.49±0.25[a]
Leucine	NA	3.95±0.03[a]	4.86±0.01[a]	5.00±0.02[a]	5.96±0.02[a]
Lysine	NA	20.16±0.01[a]	27.05±0.03[a]	29.14±0.02[a]	30.13±0.04[a]
Cystine	NA	0.15±0.00[a]	0.26±0.02[a]	0.87±0.02[a]	1.73±0.03[b]
Methionine	NA	21.37±0.40[a]	25.26±0.02[a]	29.52±0.26[a]	30.15±0.03[ac]
Tyrosine	NA	3.24±0.07[a]	4.71±0.33[ac]	5.53±0.37[a]	6.51±0.35[b]
Phenylalanine	NA	3.69±0.44[ab]	4.85±0.02[a]	7.25±0.05[a]	8.15±0.03[a]
Theonine	NA	0.46±0.06[a]	1.16±0.17[a]	2.35±0.02[a]	3.15±0.04[b]
Valine	NA	2.47±0.06[a]	3.45±0.43[a]	4.38±0.26[a]	6.44±0.72[ac]
Histidine	NA	1.27±0.08[a]	2.62±0.32[a]	3.17±0.02[a]	4.50±0.27[ac]
Arginine	NA	2.35±0.04[a]	2.96±0.02[a]	4.54±0.23[a]	5.25±0.03[a]
Glutamic acid	NA	10.47±0.28[a]	11.33±0.17[a]	12.26±0.03[a]	13.29±0.09[a]
Serine	NA	3.57±0.21[a]	3.67±0.06[a]	4.58±0.23[a]	5.95±0.02[ab]
Proline	NA	9.37±0.05[a]	10.48±0.12[a]	11.10±0.03[a]	12.20±0.15[b]
Glysine	NA	0.06±0.04[a]	0.16±0.03[a]	0.22±0.06[a]	0.96±0.01[a]
Alanine	NA	0.97±0.02[a]	1.33±0.01[a]	2.21±0.07[a]	3.29±0.10[a]

Note: NA - Not Available; Values are expressed as the mean of three replicate samples ± SD. Values in a column with different superscripts differ significantly ($p<0.05$).

Table 6: Phytochemical and Anti-Nutrient Composition of the Developed Complementary Feeding Mixes

Blends	Oxalate Analysis (mg/100 gm)	Tanin Analysis (mg/100 gm)	Phytates Analysis (mg/100 gm)	Saponin (mg/100 gm)	Alkaloid Analysis (mg/100 gm)	Flavonoids Analysis (mg/100 gm)	Cyanogenic Glycoside Analysis (mg/100 gm)	Trypsin Inhibitor Analysis (mg/gm)
Commercial brand	NA	NA	NA	NA	NA	NA	NA	NA
Mix 1	0.03[a]±0.02	4.42±0.37[a]	0.44±0.03[a]	31.08±0.79[a]	81.40±0.23[a]	103.05±1.58[a]	20.05±0.03[a]	0.16±0.01[a]
Mix 2	0.16±0.01[a]	4.95±0.03[a]	0.66±0.03[a]	43.85±1.25[b]	97.78±1.13[a]	123.25±0.01[b]	25.17±0.03[a]	0.91±0.03[b]
Mix 3	0.25±0.02[a]	5.13±0.04[a]	0.73±0.00[ac]	48.42±1.91[a]	107.36±1.73[a]	130.73±0.57[a]	29.45±0.12[a]	1.66±0.19[a]
Mix 4	0.35±0.03[a]	5.59±0.20[b]	0.96±0.02[ab]	50.55±0.02[c]	251.83±1.35[a]	171.17±0.96[a]	35.17±0.03[b]	2.33±0.02[a]

Note: NA - Not Available; Values are expressed as the mean of three replicate samples ± SD. Values in a column with different superscripts differ significantly ($p<0.05$).

soluble form. Soluble oxalate can be leached out during normal cooking but in foods they have probably a major effect on oxalate absorption (Chai and Liebman 2004). Cooking will slightly reduce levels of oxalates, so during the weaning food development the oxalate will be leached completely.

Febles *et al.* (2002) researched in this study that, ninety-one percent of the whole variety of flours presented values between 6 and 10 mg/g of phytic acid, whereas 2-4 mg/g were found in 60·6% of refined flours. Based on this reference, in our study phytate content was ranged from 0.44-0.96 mg/100 g and this indicates lowest levels of phytate present in all the four mixes. During processing of grains such as soaking, sprouting and fermenting all *reduce* phytate levels.

Millets contain phytates, phenols, tannins, trypsin inhibitors and dietary fiber which act as "antinutrients" by chelating minerals. Tannins are naturally occurring polyphenolic compounds linked to reduce protein digestibility by forming complexes with proteins and inhibiting enzymes (Aganga and Mosase, 2001). Though in this study tannin concentration ranged from 4.42-5.59 mg/100 g. Tannins are polyphenolic compounds that are water soluble in nature (Kumar *et al.*, 1979); therefore, reduction in tannin content may be attributed to leaching out of phenols into the medium which can be eliminated with the discarded soaking water.

Saponin, alkaloid, flavonoids, cyanogenic glycoside and trypsin inhibitor showed their concentration ranged from 31.08-50.55 mg/100 g, 81.40-251.83 mg/100 g, 103.05-171.17 mg/100 g, 20.05-35.17 mg/100 g and 0.16-2.33 mg/100 g respectively. Though all these anti-nutritional compounds were one of the phytochemical present in the outer layer of whole gains. Protease inhibitors reduce trypsin activity and to a lesser extent chymotrypsin; therefore, impairing protein digestion by monogastric animals and some young ruminant animals (Friedman *et al.*, 2003). Processing techniques as soaking, cooking, germination and fermentation have been found to reduce significantly the level of phytate and tannin by exogenous and endogenous enzyme formed during processing.

Duncan's test reveals that there was a significant difference between standard and developed complementary mixes. Based on above points it was reported that the four mixes anti-nutrient content was slightly differ from the reference value and all the anti-nutrient compositions were categorised as phytonutrient compounds in barnyard millet. Au and Fields (1981), Yasmine (2002) and Ochanda *et al.* (2010) reported that processing methods improve the nutritional quality of legumes and cereals by causing significant changes in their chemical composition and elimination of anti-nutritional factors.

CONCLUSION

The study investigated the proximate composition, amino acid profile, mineral composition and anti-nutritional quality of four formulated complementary foods from the combinations of barnyard millet, defatted soya flour, sugar and skim milk power. The mix 4 sample was ranked best when compared with other formulated food samples, i.e. mix 1, mix 2 and mix 3. However, the three formulated samples were good sources of high quality protein of almost adequate or more than adequate of essential amino acids and energy values. Nutritionally, the formulated samples were better than a commercial complementary food in terms of proximate, minerals and amino acid compositions. Barnyard millet is an important staple food in parts of eastern and central Africa and India. It is non-acid forming food and easy to digest. It is considered to be one of the least allergic and most digestible grains available and is a warming grain so it helps to heat the body in cold or rainy season. Composite flour technology holds excellent promise for developing countries. Although actual consumer trials have been rare, products made with composite flours have been well accepted in many countries. The products made from composite flours are nutritionally superior to their respective controls and can be successfully used for supplementary feeding programmers. Efforts should be made to educate people about nutritive value and health benefits of millet and its food products. Cereals and millets constitute a major component of diet consumed in developing countries like India. Keeping in view the above facts described that processing of gains through roasting, cooking, fermentation and germination should be done to improve nutritional and sensory properties of weaning mixes.

ACKNOWLEDGMENT

Author is grateful to the Indian Council of Medical Research (ICMR), New Delhi for providing finding assistance to do this research work.

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