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DEVELOPMENT OF A NUTRITIOUS INFANT FOOD PREMIX USING HOUSEHOLD FOOD PROCESSING TECHNIQUES

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ABSTRACT

This study has been carried out to develop a low cost nutritious infant food premix from indigenous food products using household food processing techniques and conduct a comparative nutrient analysis of the developed product with the recommended dietary intake for Indians (6-12 month), fortified complementary foods as well as commercial indian food premixes available in India. On the basis of a satisfactory NDpCal percent, four variations of infant food was developed using different proportions of sweet potato flour (SPF), germinated pearl millet flour (GPMF), germinated green gram flour (GGGF) and sesame seed flour (SSF). Variation having 10g SPF, 5g GPMF, and 10g GGGF; 2g SSF and 5g jaggery was organoleptically most preferred. One serving portion (32 g) of this product was found to provide 131.5 kcal, 4.6 g protein, 1.2 g fat, 1.61 mg iron, 33.54 mg calcium, 59.19 mg phosphorus, 256 µg beta-carotene and 0.90 mg zinc. Compared to RDA of a child 6-12 months, the standardized infant food provided 19.6 percent energy, about 30 percent protein and 10 percent fat. These percentages were 32.2, 6.7, 7.9 and 9.1 for iron, calcium, phosphorus and beta-carotene respectively. Comparative nutritive analysis with a fortified complementary food revealed that the product had comparable amount of energy and protein whereas iron, calcium, phosphorus, beta-carotene and zinc content were lower. However, comparison with basic variant of a commercial infant food indicated that the premix had comparable amount of energy, protein, iron and zinc whereas only calcium and beta-carotene content were lower.

Key words: Infant food premix, sweet potato, pearl millet, green gram, sesame seeds, sensory evaluation, house hold processing techniques(germination, sun drying), India

INTRODUCTION

Malnourished children are often victim of various infections and nutrient deficiencies. One of the ways to ensure prevention of malnutrition can be providing nutrient dense complementary foods to the children. Even after 67 years of independence and reforms, malnutrition continues to remain a chronic public health problem in India. It is estimated that one in every three malnourished child in the world lives in India (UNICEF, 2008). With respect to children under 5 years of age in India, NFHS-3(2005-6) data indicate that 48 per cent are stunted, 20 per cent are wasted and 43 per cent are underweight. These figures are 45 per cent, 23 per cent and 40 per cent respectively for children under 3 years of age**.** The critical period when a child is most likely to develop malnutrition coincides with the age of introduction of complementary foods, which are most often nutritionally inadequate. There is a need to feed the child with complementary foods which are energy-dense, nutritionally balanced, and easily digestible.

To provide nutritionally adequate and balanced complementary foods, it is important to have food mixtures or variety of foods that fulfill macro and micro nutrient needs of the infant. The young infant has a small stomach and can only consume small amounts of food at a time. Thus, it is important to feed the child with energy and nutrient dense meals (Burgess and Glasauer, 2004). Complementary foods are traditionally started with cereals which provide some energy, minerals and vitamins. However, cereals have phytates which inhibit the absorption of iron. They also contain minimal amount of vitamin A and vitamin C and are not protein dense (Abbaspour N, Hurrell R and Kelishadi R, 2014) Therefore, cereals need to be given with added pulses or animal foods product such as milk, meat and egg etc. Nuts and oil seed help to increase the energy density and further contribute to some of the protective nutrients. Addition of sugar/ jaggery and fat can also increase nutrient density of complementary foods (Seth and Garg, 2011).

In India, complementary foods given to the infant varies from culture to culture. However most commonly, infants are fed with a sweetened rice porridge, wheat porridge, mashed fruits and vegetables. Until the mid-1900s, complementary foods were generally made at home. The industrial revolution saw the beginning of the baby food market which promoted commercial infant foods as a convenience item. Gradually, commercial infant foods became widely available in dry, ready-to-feed forms. The demand from parents for premixed infant foods began to grow in the 1960s and since then, many larger commercial manufacturers have introduced infant foods in the market. As parents became more aware of the importance of proper and balanced nutrition for babies, they get influenced by advertisements and there dependency and trust on commercial infant foods increased. Additionally, changed lifestyles and a rise in the number of working mothers also pushed parents to look out for convenient options. Most of the times, the commercial infant food premixes are highly priced and within the reach of only affluent population (Gupta and Sabharwal, 2003). However, infant food premixes which are nutritious and economical can be safely prepared at home from indigenous food items using local resources. Considering this the present study has been undertaken to develop a nutritious infant food premix comprising of grains, legumes, vitamin A rich vegetable and nuts/oilseeds which are locally available and can be processed using traditional household food processing techniques. Therefore, an attempt has been made in this study to prepare an infant food premix using sweet potato, pearl millet, green gram and sesame seeds.

Sweet potato roots are an excellent ingredient for weaning foods. According to Gopalan, Ramasastari and Balasubramanian (2007), sweet potato provides higher energy as compared to other root vegetables (sweet potato -120 kcal, potato -79 kcal, and yam-111 kcal). The starch in sweet potato is easily digestible and therefore a useful ingredient in the preparation of infant food (Amagloh *et al.*, 2013). Further, it is the only starchy staple with a significant amount of beta-carotene. Most cereals, with the exception of some varieties of yellow maize, have negligible amount of beta-carotene. The beta-carotene content of the sweet potato depends on its flesh color, highest levels found in deep orange-fleshed varieties (Hagenimana *et al.*, 1999a). In addition, a sweet potato based infant food would not require the use of external sweeteners which, in part could reduce its production costs when it is used for mass production of infant food premixes (Adenuga, 2010 and Nandutu and Howell, 2009). Sweet potatoes have low phytate content which does not interfere with absorption of vitamins and minerals (Gibson *et al.*, 2010). Pearl millet was selected as it provides high energy, has less starch and is gluten free (Nambiar *et al*, 2011). It is also rich in iron and zinc and contains high amount of antioxidant. Green gram is a very good source of protein (24 g/100g) as well as vitamins and minerals (Gopalan, Ramasastari and Balasubramanian, 2007) This is a very high amount which is comparable with eggs, fish and chicken. The presence of protein facilitates quicker development of muscle and organs in infants. Sesame seeds are an energy dense oil seed (563 kcal/ 100g), high in protein (18.3 mg/ 100 g); calcium (1450 mg/ 100 g); iron (9.3 mg/ 100 g) and zinc (12.2 mg/ 100g). Therefore, developing an infant food with these ingredients could be an avenue for utilization of the comparatively rarely used food products for feeding infants which could help in enhancing the nutritional quality of an infant premix and can be processed using household food processing techniques.

MATERIAL AND METHODS

The raw materials required for the preparation of food are widely available in the retail market and are of low cost. They were procured from local market except for sweet potato, oranged fleshed variety of which was procured from wholesale vegetable market of Delhi during the month of December-January. During processing, sweet potato were washed, cleaned, peeled and cut into slices. The slices were blanched at 90°C for about 4-5 minutes and sun dried using stainless steel trays. The trays were lined with black polyethylene film which acted as the heat absorber and helped in the drying process. The dried pieces were grounded, sieved and packed in an air tight container for further use. Pearl millet and green gram were washed and soaked in tap water for 12 hours at room temperature. The soaked seeds were germinated and sun dried. Green gram was dehulled, roasted, grounded, sieved and then packed in air tight container for further use. Pearl millet was also roasted, grounded, sieved and suitability packed. Sesame seeds were roasted, grounded, sieved and packed.

CHEMICAL ANALYSIS

The flours prepared from sweet potato, germinated pearl millet, germinated green gram and sesame seed were analyzed for moisture using oven dried method as describe by Directorate General for Health Services 2012 (DGHS); ash (Gravimetric method as described by DGHS 2012); protein (Kjeldahl's method , IS:7219); fat (Soxhlet method by DGHS, 2005); iron (by AAS , AOAC chapter- 9 (999-10)); calcium (by AAS , AOAC chapter- 9 ; 999-10); phosphorus (Fiske and Subbarow method); beta carotene (Spectrophotometric method) and zinc (AAS by AOAC chapter- 9; 999-10) in a standardized laboratory.

FORMULATION OF DIFFERENT VARIATION OF INFANT FOOD PREMIX

For the preparation of the infant food premix the four ingredients (SPF, GPMF, GGGF and SSF) were blended in different proportions and reconstituted in measured amount of water. Based on the desired consistency and portion size, 32 grams of infant food premix including 5 g of jaggery reconstituted in 150 mL of water and cooked for 1-2 minutes was standardized. The nutritional consideration for preparing infant food with different proportions the raw ingredients was based on the fact that for adequate growth of the infant, a food should provide a net dietary protein-calorie (NDpCal percent) of at least 8 percent (ICMR, 2010). In view of this, four variations of infant food premix were formulated and coded.

SENSORY EVALUATION

Sensory evaluation of the four variations was done by a panel of judges for appearance, texture, color, taste, and overall acceptability using a five point hedonic scale. All the judges were well conversant with the factors governing the quality of food. The variation which was organoleptically most preferred was used to further determine its nutrient composition and comparative nutrient analysis.

NUTRIENT COMPOSITION AND COMPARATIVE NUTRIENT ANALYSIS

The nutrient content of the best accepted variant as indicated by sensory evaluation was calculated using nutritive value determined during nutritional analysis of the flours in the study. These values were compared to recommended dietary allowances for infants aged 6-12 months (ICMR, 2010); the nutrient composition of fortified complementary foods as given by Lutter and Dewey (2003); and commercial infant food premix available in India. Moreover cost benefit analysis was also done for the standardized infant food premix by comparing it with the different brands of commercial infant foods available in the Indian market.

STATISTICAL ANALYSIS

The data obtained through various tools and techniques were tabulated on the master sheet. Prior to analysis, all the data were screened and errors were corrected. It was then subjected to quantitative and qualitative analysis. The data was statically treated using SPSS software. For determining statistical difference with respect to sensory acceptability of different variations of the product ANOVA was applied and for multiple comparison Tukey HSD test was conducted. The difference was considered to be statistically significant at $P<0.05$.

RESULTS AND DISCUSSION

The infant food premix has been made using sweet potato, pearl millet, green gram and sesame seed which were suitably processed into flours using home processing techniques of germination and sun drying. The processed ingredients (SPF, GPMF, GGGF and SSF) were analyzed for moisture, total ash, protein, fat, iron, calcium, phosphorous, beta- carotene and zinc content using standardized procedures as describe by , DGHS 2005 , DGHS 2012, IS:7219 and AOAC chapter- 9 (999-10) respectively. Taking into consideration the cost constraints the analysis was conducted only once and not in duplicate/triplicate but since the laboratory was using standardized procedures and equipments a fair validity of the data has been ensured. The nutrient content of the processed ingredients are given in Table 1. The same was reported by Nazni and Suresh Kumar (2009).

Table: 1: Data on Nutrient Content of the Processed Ingredient

Parameter	Values per 100 grams of edible portion							
	SPF		GPMF		GGGF		SSF	
	A	B	A	B	A	B	A	B
Moisture (g)	7.89	68.50	8.25	12.40	9.25	9.64	5.30	5.85
Energy (kcal)	384	120	380	361	480	348	537	563
Protein(g)	5.5	1.2	13.9	11.6	29.4	24.5	22.5	18.3
Carbohydrate(g)	88.5	28.2	59.9	67.5	88.3	59.9	7.54	2.5
Fat (g)	0.9	0.3	1.2	5.0	1.1	1.2	46.3	43.3
Iron (mg)	1.21	0.21	8.52	8.00	6.52	3.90	14.10	9.30
Calcium (mg)	58.40	46	84.00	42	118.2	75	387.10	1450
Phosphorous (mg)	219	296	405	405	39	50	557	570
Beta-carotene (µg)	2517	1810	47.06	16.2	15.02	6.12	9.68	7.5
Zinc (mg)	0.51	0.11	5.60	3.10	3.60	3.00	10.60	12.20

A= Values of processed flour
B= Values of raw ingredients as per Nutritive Value of Indian Foods, Indian Council of Medical Research 2007
SPF=Sweet Potato Flour; GPMF= Germinated Pearl Millet Flour; GGGF= Germinated Green Gram Flour; SSF= Sesame Seed Flour

The energy content of sweet potato flour was 384 kcal which is higher than the energy values for the raw sweet potato. Similar increase was reported in protein (5.5g/100g), fat (0.9g/100g), iron (1.21mg/100g), calcium (58.40mg/100g), phosphorus (219mg/100g), beta-carotene (2517µg /100g) and zinc (0.51mg/ 100g) content of the sweet potato flour. The moisture content of germinated pearl millet flour was 8.25g/100g and energy content was 380 kcal. The protein, iron, calcium, beta-carotene and zinc values per 100 g of germinated pearl millet flour were 13.9 g, 8.52 mg, 84 mg, 47.06 µg and 5.60 mg respectively which were higher than the values of the raw ingredient whereas the fat (1.2g/100g) and carbohydrate (59.9mg/100g) content were lower. The nutrient analysis of germinated green gram flour also revealed a higher content of energy (480 kcal/100g), protein (29.4g/100g) and carbohydrate (88.3g/100g) besides an increase in iron (6.52mg/100g), calcium (118.2 mg/100g) and zinc (3.60 mg/ 100g) whereas fat (1.1 g/100g) was marginally lower than the value of raw ingredient. Sesame seed flour had protein (22.5 g/100g), fat (46.3 g/100g), carbohydrate (7.54 g/100g), beta-carotene (9.68 µg/ 100g) and iron (14.1 mg/100g) content higher than the values reported by National Institute of Nutrition, while the energy (537 kcal/100g), calcium (387.1mg/ 100g) and phosphorus (557mg/100g) content was lower.

The standardization of serving procedure for the infant food premix was carried out by reconstituting different proportions of flours in water and cooking over slow flame. As texture and consistency play vital role for the preparation of infant food premix, measured about of flour mixes were added to 150 mL of water and appropriate consistency and quantity of the infant food was determined. Moreover, the quantity should be ¾ to 1 katori per day (1 standard katori is 150 grams). It was observed that 25-30 mg of different proportions of flours reconstituted in 150 mL of water and cooked for 1-2 minutes gave the most suitable consistency and quantity. It was also noticed that the premix on reconstitution gave a bitter after taste possibility due pearl millet and sesame seed which are naturally bitter foods and thus, 5 gram jaggery was added to the premix during the time of reconstitution. Therefore, for further standardization, 32 grams of infant food premix including 5 g of jaggery reconstituted in 150 mL of water and cooked for was considered.

On the basis of NDpCal percentage of at least 8 percent and not exceed 15 percent recommended for infants by ICMR (2010), four variations of the infant food premix was formulated and there nutritive composition was determined using nutritive values of the processed ingredients. The results are given in table 3, which indicate that there was not much difference in the nutrient composition of all the variation except for few nutrients. The protein content increased as the amount of GPMF increased. Similar trends were noticed in iron, phosphorus and zinc content. With respect to beta-carotene, the highest content was present in the variation with 15 g of SPF and this amount decreased as the content of SPF decreased. The fat content of all the variations were similar. As neither of the variations was giving a perfect nutritional advantage over the other, all the four variations were subjected for sensory evaluation for final selection of the product based on the most accepted variation in terms of organoleptical qualities.

The four variations of infant food premix were evaluated organoleptically for color, taste, consistency, flavor, mouth feel, aftertaste and overall acceptability. The maximum score for color was obtained by 'variation 1' (3.3 ± 0.74) whereas with respect to consistency 'variation 2' was liked the most (3.3 ± 0.89). The minimum score for taste, mouth feel and aftertaste was recorded for 'variation 3'. In terms of overall acceptability, maximum score was obtained by 'variation 2' (3.3 ± 0.81) followed by 'variation 1' (3.2 ± 0.49) and minimum score was obtained by 'variation 4' (2.8 ± 0.81). On the basis of this, variation 2which had 10 g SPF, 5 g GPMF, and 10 g GGGF; 2 g SSF and 5 g jaggery was found to be preferred over other variations.

The results of our study indicate that one serving of the prepared infant food premix provided 19.6 percent of RDA for energy per day, about 30 percent of protein and 10 percent of fat(Table 4). With respect to micronutrients, these percentages were 32.2, 6.7, 7.9 and 9.1 for iron, calcium, phosphorus and beta-carotene respectively.

A comparison of prepared infant food premix was also done with the nutrient composition for fortified complementary foods proposed by Pan-American Heath Organization (Lutter and Dewey, 2003).This composition for fortification of complementary foods is also recommended by experts in India. The results as shown in table 5 indicate that the prepared infant food premix when compared with fortified complementary food provided about 75 percent of energy, more than 100 percent of protein and one fourth of fat content. As far as micronutrients are concerned, the infant food premix when reconstituted in water provided about one fourth of iron, calcium, phosphorus and zinc and 16 percent beta carotene.

Comparative analysis of one serving portion of infant food premix with the one serving portion of basic variant of a commercial infant food available in the market revealed that the prepared product was comparable to the commercial infant foods in term of energy, protein, iron and zinc content. Calcium content was low and so was the beta-carotene content in comparison to the commercial infant food (Table 6).

The cost of one serving portion of formulated infant foods premix approximates to Rs. 3.94, whereas that of one serving portion of commercial infant food premix was found to range from Rs. 14.85-19.20 depending on the company and variant.

Table 2: Data on Nutrient Composition of Infant Food Premix with Different Proportions of Various Ingredients

Variations	Energy (kcal)	Protein (g)	Fat (g)	Carbohydrate (g)	Iron (mg)	Calcium (mg	Phosphorus (mg)	Zinc (mg)	Beta-carotene (µg)
Variation 1 (SPF-15g; GGF-10g; SSF- 2g; Jaggery- 5g)	135	4.2	1.2	27.0	1.24	33.24	49.89	0.64	379
Variation 2 (SPF-10g; PMF-5g; GGGF- 10g; SSF-2g; Jaggery- 5g)	131.5	4.6	1.2	25.6	1.61	33.54	59.19	0.90	256
Variation 3 (SPF-7.5g; PMF-7.5g; GGGF- 10g; SSF- 2g; Jaggery-5g)	129	4.8	1.2	24.0	1.79	34.19	63.84	1.03	193

Variation 4 (SPF-5g; GPMF-10g; GGGF- 10g; SSF- 2g; Jaggery-5g)	127.49	5.1	1.2	24.1	1.60	34.84	68.49	1.15	132

SPF=Sweet Potato Flour; GPMF= Germinated Pearl Millet Flour; GGGF= Germinated Green Gram Flour; SSF= Sesame Seed Flour

Table 3: Data on Nutrient Composition of Standardized Infant Food Premix and Contribution to the RDA (6-12 month)

*Taking the requirements of 6-12 month infant as 100%

Nutrients	RDA (6-12 months)	Nutrient Composition of Prepared Infant Food Premix (One serving -32 g)	Percentage contribution of Infant food premix to the RDA*
Energy(kcal)	672	131.5	19.6
Protein(g)	14.9	4.6	30.9
Fat(g)	19	1.2	10.0
Iron(mg)	5	1.61	32.2
Calcium(mg)	500	33.54	6.7
Phosphorus(mg)	750	59.19	7.9
Beta- carotene(µg)	2800	256	9.1
Zinc(mg)	-	0.90	-

Table 4 : Data on Nutrient Composition of Standardized Infant Food Premix and Fortified Complementary Foods

* Taking the nutrient composition of fortified complementary food as 100%

Nutrient	Nutrient composition of prepared infant food premix (32 g)	Nutrient composition of fortified complementary foods (40 g)	Comparison of prepared infant food premix to fortified complementary foods (%)*
Energy(kcal)	131.5	176	74.7
Protein(g)	4.6	3–4.5	153-102
Fat(g)	1.2	4.8	25
Iron(mg)	1.61	6.8	23.7
Calcium(mg)	33.54	100–200	33.5-16.8
Phosphorus(mg)	59.19	75–100	78.9-59.1
Beta- carotene(µg)	256	1600/ 200 IU	16
Zinc(mg)	0.90	4–5	22.5-18

Table 5: Data on Nutrient Composition of Prepared Infant Food Premix and Commercial Infant Food Premix

** Taking the nutrient composition of commercial infant premix as 100%*

Nutrients	Nutrient composition of formulated infant food premix (32 g)	Nutrient composition of Commercial infant food premix (33 g)	Comparison of prepared infant food premix to commercial infant food premix (%)*
Energy(kcal)	131.5	135	97.4
Protein(g)	4.6	4.95	92.9
Fat(g)	1.2	2.97	40.4
Iron(mg)	1.61	1.65	97.5
Calcium(mg)	33.54	138	25.2
Phosphorus(mg)	59.19	145.2	40.7
Beta- carotene(µg)	256	924/ 115.5 IU	27.8
Zinc(mg)	0.90	0.99	90.9

CONCLUSION

It can be concluded that a potential infant food premix of good nutritional quality can be prepared at home using sweet potato, pearl millet, green gram and sesame seeds especially for infants belonging to low socio economic strata. The chemical analysis of sweet potato flour, revealed that the energy content was 384 kcal which is higher than the energy values reported by National Institute of Nutrition (NIN) for sweet potato (Gopalan, Ramasastari and Balasubramanian, 2007). This increase in the energy may be due to the reduction in the moisture content of sweet potato after sun-drying. The results are in conformation with study done by Antarlina (1994), where the energy content of sweet potato flour was found to be 366.89 kcal. Similarly higher content of protein, fat, iron, calcium and zinc was reported for the sweet potato flour in the present study. The beta-carotene content of sweet potato flour was 2517 µg/ 100 g. This value is higher than the values reported by NIN for the yellow variety of raw sweet potato. The beta carotene content of sweet potato depends on the color of the flesh. In India, a study done in West Bengal reported the beta-carotene content of sweet potato varies from 2580 - 4380 µg/100 g depending on the colour of the flesh Mitra (2012). However, in other countries like Africa the beta-carotene content has been reported to be as high as 7820µg/100 ; in Bangladesh the beta-carotene content of sweet potato has been reported to be 2580 to 4380 µg /100g Faber et al. (2002). It is also anticipated that the beta-carotene content of raw sweet potato (oranged fleshed) used for the present study would be greater than the content found in the processed flour as some losses in beta-carotene are expected during blanching and sun-drying. According to Hagenimana et al. (1999a), the usual cooking method reduced carotenoid content (and beta-carotene content) by between 14 and 59 percent after 30 minutes. Van Jaarsveld et al. (2006), reported boiling of a dark orange variety reduces beta-carotene content by between 12 percent (open pot) and 24 percent (closed pot) after 30 minutes, depending on whether same sized pieces or different sized pieces were used. Further, according to Bengtsson et al. (2008), oven-drying slices of sweet potato at 57ºC for 10 hours reduced trans-beta-carotene concentration by 12 percent, whereas solar-drying (at temperatures between 45 and 63ºC for 6 to 10 hours) resulted in 9 percent reduction. Highest losses were observed for open-air sun dried slices (16% for drying temperatures between 30 and 52ºC for 6 to 10 hours).The nutrient analysis of germinated pearl millet flour**,** revealed that the energy content was 380 kcal which is higher than the energy values reported by NIN for raw ingredient. This increase in energy is due to the reduction in the moisture content of the germinated pearl millet flour. Further, higher content of iron and calcium in the pearl millet flour was reported in the present study, which may be attributed to germination as this process has been reported to be associated with increase in concentrations and bioavailability of trace elements and minerals (Adawy EL et al., 2004). Kaushik et al., (2010) found that germination improves calcium, copper, manganese, zinc, riboflavin, niacin and ascorbic acid content. However, in the present study the carbohydrate and fat content was lower in germinated pearl millet flour than of the reported value for pearl millet. The reduction in carbohydrate content can be explained by the finding of Vidal-Valverde et al. (2002) who reported that during germination, carbohydrate is used as source of energy for embryonic growth which results in a decrease of carbohydrate content after germination. In a study by Bau et al. (1997), a decrease in the fat content was reported as fat was used as the major source of carbon for seed growth. Hahm et al., (2008) also suggested that fatty acids are oxidized to carbon dioxide and water to generate energy for germination. The nutrient analysis of germinated green gram flour also revealed higher value for energy and protein besides that of iron, calcium and zinc whereas fat content was marginally lower. However the carbohydrate content washigher than the values reported by NIN (Gopalan, Ramasastari and Balasubramanian, 2007).The nutrient analysis of sesame seed flour revealed that protein, fat, carbohydrate, beta-carotene and iron content were higher than the values reported by NIN while the energy, calcium and phosphorus content was lower. Calcium content could be lower because dehulled variety of sesame seeds was used in the present study and many researchers have reported that calcium content of dehulled sesame seed is lower than the hulled ones.

The standardized infant food premix contributed to recommended dietary allowances for most macro and micronutrients. The energy, protein and iron content of developed infant food premix were comparable to the recommended nutrient content of a fortified commercial food for the respective nutrients. On the other hand, when compared to commercial infant food premix, the prepared infant food premix provided almost equal amount of energy, protein, iron and zinc. However, calcium and beta-carotene content were lower. The prepared infant food premix also has an edge over commercial premixes as the cost is much lower than the later. Further, the nutritive value to standardized infant food can be improved by reconstituting it in milk, vegetable and fruit purees or adding milk powder, fresh mashed fruits and vegetables. The energy density can also be further increased by adding little fat. The low levels of antinutritional factors also make this product superior to other alternatives. It is also expected that minerals from this product will be better assimilated in the body as pearl millet and green gram were germinated before processing them into flours. In the preset study sun drying was used for drying of the raw products which may have led to few nutrient losses. Other methods of drying like over or microwave drying can also be used instead of sun drying which could result in better retention of nutrients if feasible. Moreover, since the product is gluten free it can be used as an alternative infant food for children suffering from gluten intolerance and related diseases. However, this study is just a preliminary effort in the direction of preparation of home based infant foods. A robust study for developing standard operating procedures for product development at household level and feasibility for scaling-up has to be undertaken before advocating use of such products at mass level.

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