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PREPARATION AND QUALITY EVALUATION OF NUTRITIOUS INSTANT BABY FOOD FROM INDIGENOUS SOURCES

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ABSTRACT: The objective of study was to prepare nutritionally balanced baby foods from indigenous food materials utilizing home cooking methods and evaluate the sensory attributes and shelf life at ambient conditions. Four different recipes of baby foods were developed containing 50% cereals, 30% legumes, 10% vegetables and 10% nuts and seeds. Different processing methods cleaning, washing, germination of pulses, peeling, cutting and blanching of vegetables, drying, roasting, grinding and mixing of ingredients were used. Recipe "A" containing rice, mung, potato and poppy seed was organoleptically preferred. No significant change in moisture content, peroxide value and free fatty acid were observed during three months storage in double polyethylene bags at ambient temperature (20-25 ºC).

Key Words: Baby Foods; Nutritionally Balanced; Sensory Attributes; Shelf Life; Cereals; Legumes; Vegetables; Nuts; Seeds; Processing; Pakistan.

INTRODUCTION

Protein-calorie malnutrition is one of the major public health problems among children in developing countries. The weaning period, from 4-6 months until 2 years of age, is a critical period of a baby's life when it is at risk from malnutrition and diseases. Most babies need extra food beside breast milk as they grow fast and breast milk is no longer enough to support their growth (Srivastava, 2002). Moreover, milk is deficient of iron, which must be supplied through fortification. Improper weaning practices mostly lead to malnutrition (Dirrige, 1991). In Pakistan, it is common practice to withhold solid foods from infants until they are in their second year of life. More than 50% of the children receive only milk or other liquids even at the age of one year, while10% still take only liquids at the age of two years (Lubna, 2001). Around 37% children are underweight, 35.5% stunted and 15% are wasted (Khan, 2004). Another problem prevalent during the weaning period is contaminated food, prepared from unsanitary water that is not heated or stored at hygienic conditions. Such foods usually cause diarrhea and infections, which lead adequately to malnutrition and ill-health (Khan, 1996). The introduction of supplementation in terms of weaning foods prepared from easily available and low cost ingredients is of vital importance to meet the requirements of the growing infants. The need to educate families to exploit locally produced foods to produce nutritionally adequate products is stressed (Cameron and Hofvender, 1983). Weaning problems in developing countries could be solved by encouraging breast-feeding and taking proper balanced weaning foods made from recipes based on locally available and cheap staple foods and processed by technology adapted to local conditions. Such a food must not only be nutritious and cheap, but also safe and according to local taste. Fortification of complementary foods for infants in developing countries with calcium, iron and zinc is urgently needed (Gibson et al., 1998). The sorghum based weaning food fortified with iron rich gudeim is a good source of protein and calcium and iron for weaning children. It scored well with the commercial brands of infant instant baby foods (Obeid et al., 2005). Weaning foods may be processed substituting the wheat flour by soy flour up to 10%. No remarkable change in moisture content, peroxide value, free fatty acid and flavour were observed up to 4

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months of storage in ambient conditions (Ahmed et al., 2008). In Pakistan, main reasons behind the poor nutrition of children are poverty, food system deficiencies, food habits, taboos and poor hygiene. Keeping this in view, a study was undertaken to develop balanced nutritious baby foods from local materials, to analyze raw materials and the foods for chemical composition, to evaluate the sensory attributes and the shelf life of weaning foods at ambient conditions.

MATERIALS AND METHODS

The raw materials required for the preparation of baby foods were procured from the local market and processed at Food Quality and Nutrition Program (FQNP) Lab. National Agricultural Research Centre (NARC), Islamabad. During processing, pulses and cereals (except rice) were overnight soaked in water. Vegetables were washed under tap water, peeled, cut, water blanched for 2 to 5 minutes and dried in hot air oven. Pulses, cereals, nuts and seeds were dried in hot air oven and then roasted on medium flame for specific time, i.e., 5 to 8 minutes. Four baby food formulas were prepared from different combinations of cereals (rice, wheat, maize and barley), pulses (mung, peas, lentil and chickpea), vegetables (potato, cabbage, carrots and spinach) and oilseeds (poppy seeds, groundnut, sesame seeds and soybean). Different baby foods were formulated and coded (Table 1).

Serving Process

One-cup (250ml) clean drinking water was taken in a pan and 3 table spoon of the formula was added to water and mixed it well. Then pan was placed on burner and baby food was cooked for 10-15 minutes on medium heat.

Chemical Analysis

The raw materials and the baby foods were analyzed for moisture, ash, crude protein, crude fat, crude fiber, minerals and free fatty acid and peroxide values as described by AOAC (2005). Calories of baby foods were calculated as described by Kirk and Sawyer (1991).

For moisture determination, samples were dried in the oven provided with opening for ventilation and maintained at 130ºC for 60 minutes except vegetables at 105ºC for 16 hours. Ash was determined by igniting samples at high temperature 550°C in muffled furnace so that all carbon compounds (organic) were burnt out as CO_2 and the remaining inorganic part calculated as ash.

Crude fat present in the sample was extracted by suitable solvents (n-hexane). Fat was dissolved in the solvent. After the extraction, solvent was evaporated and fat content was determined. Crude fiber, the insoluble and combustible organic residue which remained after the sample had been treated under prescribed conditions i.e. 1.25% sulphuric acid and sodium hydroxide solution. The digested material was then filtered, washed with hot water and then ignited. Crude fiber content was determined by calculating the loss in weight after ignition.

For crude protein, the samples were digested with H_2SO_4 in the presence of catalyst converting all organic nitrogen into ammonium sulphate, which was then treated with sodium hydroxide and heated to distil ammonium hydroxide into boric acid solution. The ammonium hydroxide was titrated with standard sulphuric acid. The percent nitrogen was converted to per-

Table 1. Formulation of different baby food recipes

Recipe Code	Cereals (50%)	Legumes (30%)	Vegetables (10%)	Nuts and Seeds (10%)
A	Rice	Mung	Potato	Poppy seeds
B	Wheat	Pea	Cabbage	Groundnut
C	Maize	Lentil	Carrot	Sesame seeds
D	Barley	Chickpea	Spinach	Soybean

cent protein by multiplying it with specific nitrogen factor (N x 6.25).

For iron and zinc determination, the organic matrix was destroyed by dry ashing in muffle furnace. Ash was dissolved in dilute acid and analyte was determined by atomic absorption spectrometry.

Peroxide value was determined by shaking the samples with acetic acid-chloroform (3: 2) and subsequently titrating it with 0.1 M sodium thiosulphate in the presence of saturated potassium iodide and few drops of freshly prepared 1 % starch solution as an indicator until the blue colour just disappeared. A blank was also prepared along with the samples. For free fatty acids, neutralized alcohol was added to the samples and titration was carried out with 0.25 M NaOH until permanent faint pink colour appeared and persisted for > 1min.

Sensory Evaluation

Sensory evaluation of different baby foods was done by a panel of judges for colour, taste, flavour, texture and overall acceptability. All the judges were well conversant with the factors governing the quality of the products. Samples were presented to the panelists in generic containers and panelists were asked to rate evaluation variables according to 9-Point Hedonic scale as described by Larmond (1977).

Storage Studies

The samples were stored in the laboratory for 3 months in double polyethylene bags at ambient temperature (20-25 ºC). The stored baby foods were analyzed for moisture, peroxide and fatty acid values and sensory parameters at different storage intervals i.e.0, 30, 60 and 90 days.

Statistical Analysis

The data obtained for each parameter was subjected to statistical analysis according to methods described by Steel et al. (1996) using Statisca software. Complete Randomized Design was used for data analysis and means were compared by Duncan Multiple Range test.

RESULTS AND DISCUSSION

Raw materials as well as baby food recipes were analyzed for proximate composi-

Table 2. Chemical composition of raw materials

Ingredients	Moisture (%)	Ash (%)	Protein (%)	Crude Fat	Crude Fiber	CHO (%)	Iron (mg $100g^{-1}$)	Zinc (mg $100g^{-1}$)
Cereals								
Rice	11.81	0.59	6.61	0.88	0.37	79.74	1.80	1.40
Wheat	12.13	1.57	11.46	2.10	1.84	70.90	3.60	2.50
Maize	13.19	1.24	9.16	3.85	2.18	70.38	2.40	1.60
Barley	12.95	2.23	9.91	2.42	3.45	69.04	5.40	2.10
Legumes								
Mung	9.64	3.45	22.73	1.30	3.62	59.26	6.90	2.10
Peas	12.63	2.50	22.65	1.28	5.24	55.70	4.70	3.00
Lentil	10.51	2.48	21.56	1.16	3.71	60.58	9.10	3.20
Chickpea	10.42	3.01	19.90	4.74	2.95	58.98	3.40	2.80
Vegetables								
Potato	77.78	0.86	1.95	0.15	0.39	18.87	0.80	0.30
Cabbage	92.20	0.64	1.56	0.25	0.85	4.50	0.60	0.40
Carrot	87.70	0.73	0.98	0.24	0.91	9.44	1.40	0.20
Spinach	92.55	1.20	2.14	0.37	0.62	3.12	4.10	0.50
Nuts & Seeds								
Poppy seeds	5.73	3.57	17.15	41.18	2.80	29.57	5.60	6.10
Groundnut	5.30	2.45	24.10	44.52	2.27	21.36	2.40	1.80
Sesame seeds	5.85	3.71	18.10	51.90	4.10	16.34	14.00	7.50
Soybean	9.66	4.87	35.73	17.96	4.25	27.53	8.10	4.30

All values are means of three replications

Table 3. Chemical composition of baby foods

Recipe Code	Moisture (%)	Ash (%)	Crude Protein (%)	Crude Fat (%)	Crude Fiber (%)	CHO (%)	Iron(ppm) (%)	Zinc (ppm)	Calories (kcal 100g^{-1})
A	5.87 c	2.14 c	14.37 d	5.68 c	2.20 c	69.74 a	36.00 c	19.00 bc	388 b
B	5.98 b	2.23 b	17.54 b	7.79 b	3.67 a	62.79 c	37.00 c	24.00 a	391 b
C	6.20 a	2.12 c	14.57 c	8.89 a	2.18 c	66.04 b	52.00 b	15.00 c	402 a
D	5.06 d	2.90 a	21.13 a	5.42 d	2.96 b	62.53 d	62.00 a	22.00 ab	383 c

All values are means of three replications

**Means followed by same letters do not differ significantly (P < 0.05)*

Table 4. Sensory evaluation of different baby foods

Recipe Code	A	B	C	D
Color	7.67 a	6.27 b	6.13 c	4.27 d
Taste	7.93 a	5.00 c	5.73 b	5.33 bc
Flavour	7.33 a	4.47 c	5.27 b	4.20 c
Texture	8.07 a	6.40 b	6.07 b	6.13 b
Overall acceptability	7.87 a	5.53 bc	6.00 b	5.20 c

All values are means of three replications
Means followed by same letters do not differ significantly (P < 0.05)

tion and sensory characteristics.

Chemical Composition of Raw Material

The moisture content of raw materials ranged from 5.30% to 92.55%, protein content 0.98% to 35.73%, fat content 0.15% to 51.90%, fiber content 0.37% to 5.24%, ash 0.59% to 4.87%, carbohydrates 3.12% to 79.74%, iron and zinc ranged from 0.60 to 14mg100g^{-1} and 0.20 to 7.50 mg 100g^{-1}, respectively (Table 2). Raw material composition was in accordance to the Food composition table for Pakistan (Khan et al., 2001).

Chemical Composition of Baby Foods

Chemical composition of different baby foods revealed that recipe"A" had higher carbohydrate content (69.74%), recipe "B " had higher fiber (3.67%) and zinc (24ppm), recipe "C " had higher moisture (6.20%) and fat values (8.89%), recipe "D " had higher ash (2.90%), protein (21.13%) and iron content (62ppm) (Table 3). DMR-test for moisture, protein, fat and carbohydrates show that all baby food recipes were significantly different from each other. DMR-test for ash, fiber, iron and zinc reveals that recipe "A" and "C" were non-significant from each other for ash and fiber, whereas recipe"A" and "B" were non-significant from each other for iron and recipe "A" was significantly different from other baby food recipes for zinc content. In terms of energy values, there was not much difference in different recipes. However, recipe "C" had highest calories (402kcal 100g^{-1}) and recipe "D" had lowest calories (383kcal 100g^{-1}). Results were according to recommended composition for weaning foods as described by Royal Tropical Institute (1987).

Table 5. Effect of storage on moisture, peroxide and free fatty acid values of different baby foods

Recipe code	Moisture (%)				Peroxide value(ml.eq kg^{-1})				Free fatty acid value (mg of KOH kg^{-1} of fat)			
	Storage Intervals (Days)				Storage Intervals (Days)				Storage Intervals (Days)			
	0	30	60	90	0	30	60	90	0	30	60	90
A	5.87	6.05	6.10	6.15	8.83	8.75	8.70	8.62	3.04	3.07	3.11	3.15
	±0.03	±0.08	±0.04	±0.04	±0.06	±0.04	±0.03	±0.05	±0.02	±0.02	±0.01	±0.03
B	5.98	6.13	6.15	6.20	9.10	9.03	8.95	8.83	3.13	3.17	3.20	3.24
	±0.02	±0.05	±0.04	±0.06	±0.06	±0.05	±0.04	±0.08	±0.02	±0.03	±0.03	±0.02
C	6.20	6.41	6.48	6.56	9.13	9.05	8.90	8.70	3.15	3.20	3.23	3.27
	±0.04	±0.08	±0.08	±0.05	±0.08	±0.07	±0.06	±0.08	±0.03	±0.03	±0.02	±0.03
D	5.06	5.31	5.42	5.52	8.92	8.78	8.69	8.55	3.08	3.14	3.17	3.20
	±0.02	±0.07	±0.05	±0.03	±0.05	±0.03	±0.02	±0.02	±0.04	±0.02	±0.03	±0.01

All values are mean of three replications

Sensory Analysis

Different recipes of baby foods were evaluated organoleptically for colour, taste, flavour, texture and overall acceptability (Table 4). The maximum score for colour was obtained by recipe "A" (7.67) followed by recipe "B" (6.27). The minimum score for taste was recorded in recipe "B" (5.00). Recipe"A" was at the top (7.33) in flavour and it was the least in recipe "D" (4.20). Highest mean score for texture was obtained by recipe"A" (8.07) while recipe "C had lowest score (6.07). With respect to overall acceptability of baby foods, maximum score was obtained by recipe "A" (7.87) followed by recipe "C (6.00) and minimum score was obtained by recipe "D" (5.20). Results obtained in the study reveal that baby food recipe "A" was preferred over other recipes.

Storage Studies

The shelf life of baby foods was studied for three months at ambient conditions. No significant change in moisture, peroxide and free fatty acid values were observed (Table 5). Similar findings were reported by Ahmed et al. (2008) while studying the quality of soya based weaning food.

Therefore, baby food recipes are good source of protein and iron for weaning children. The raw materials being easily available and the method of production kept simple makes it economically feasible. It can be prepared just by the addition of water and therefore lowering the risk of contamination. Since baby food recipes are in powdered form, their storage is simple and may be stored for more than three months.

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