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QUALITY ASSESSMENT AND NUTRIENT COMPOSITION OF WEANING FOOD FORMULATED FROM STAPLE FOODS

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ABSTRACT: ***Prevalence of malnutrition in children in India is high due to poor complementary feeding practices. Every third child in India is suffering from malnutrition. An attempt was made to formulate low cost, nutritive complementary food using soya bean, wheat, apple, sweet potato and carrot. The blend prepared was evaluated for their physical and chemical analysis. According to the sensory evaluation data, WF3 was scored higher on average by the panelist in terms of the taste, consistency, color and overall acceptability. Standard methods were used for the chemical analysis, the ash and moisture content of the prepared blend was 6.519g and 0.33%, protein, calcium, carbohydrate, β carotene, iron, fat, fiber and vit C was 10.67g, 6.48mg, 46.25g, 687.06mg, 5.281mg, 2.329g, 3.88mg and 6.48mg respectively which was able to meet the recommended dietary allowances of infants. The blend was found rich in protein, calcium, energy and β carotene. Therefore result suggests that the weaning food is a potential tool for eliminating the protein energy malnutrition among the children which provides sufficient energy with good proteins, calcium and β carotene in adequate levels through a cost effective way than conventional staple cereals flour mixtures.***
Keywords: conventional, hedonic scale, non-significant, complementary food

INTRODUCTION

Malnutrition has become one of the major health problems facing by the developing countries which contributes to infant mortality, poor physical and intellectual development of children which lowers the resistance to diseases. Throughout the developing world, malnutrition affects about 800 million people which approximately accounts for 20 percent of the world population. High price of commercially available weaning foods, vegetables, animal proteins and the non-availability of low priced nutritious foods, combined with bad feeding practices and late introduction of supplementary foods, are mostly responsible for the observed malnourishment among children in Asia.

In developing countries Weaning is the gradual replacement of breast milk by a good mixed diet. Weaning foods are needed to fill the gap between the total nutritional needs of the child and the

amount provided by the breast milk and also bridge the change in milk diet to adult food (WHO, 2000). A variety of complementary foods are commercially available with high nutritive value, which are directly used for instant preparation of gruels. However these products are beyond the economic means of most families. So mothers use traditional gruels – water suspensions of maize or sorghum, as complementary foods for infants. These gruels usually have low energy density and poor protein, vitamin and mineral contents **Njongmeta *et al* (2003)**. Thus, protein-energy malnutrition is a common problem among infant and children in the poor socio-economic groups of developing countries.

Traditional complementary food could be improved by combining locally available food that complement each other in such a way that the new pattern of amino acids created by this combination is similar to that recommended for infants **Mensa-Wilmot *et al* (2001)**.

Soybean is a rich source of protein hence it is beneficial for malnourished children mainly suffering from Protein Energy Malnutrition. Beans have been called the "poor man's meat," as they are cheap and are easily afforded by the poor people. Carrot are mainly rich in vitamins and fibres. Carrots are a good source of potassium, which can help maintaining healthy sodium levels in the body. The main nutritional material in sweet potato's tubers are carbohydrates (starches and simple sugars), protein, fat and fat-soluble vitamins. Moreover, cultivars with a yellow flesh also contain significant amounts of carotenes **Allen *et al* (2012).** Apples are loaded with vitamin C. Almost half of an apple's vitamin C content is just under the skin, so it is beneficial to eat apples with their skins. Apples contain insoluble fiber, which provides bulk in the intestinal tract. **Sharp (2014).** Wheat is of great benefit, it is nutritionally-balanced and helps in removing millions of cases of nutritionally-related deficiency disease. It is a good source of protein, minerals, B-group vitamins and dietary fiber hence all are good for making weaning food.

METHODOLOGY

Raw Material:

Soya bean, carrot, sweet potato, wheat and apple were collected from local market of Allahabad, and then they all were cleaned by removing dirt and damaged parts.

Processing of soya beans, carrot, sweet potato, apple and wheat:

The cereal grains soya beans and wheat were freed from dirt and extraneous materials by manual sorting and washed thoroughly with sterile distilled water. They were then germinated for 24 hours at 13°C to 21°C. soyabean and wheat grains were then dehydrated in dehydrator at 60 to 65°C for 3-4 h, dry milled and sieved to obtain a fine powder. They were packed in clean air tight containers and were stored until further use. Similarly carrots, sweet potato and apples were freed from dirt and were washed properly, they were then cut into slices and were blanched in 2% sal solution further they were dehydrated at 40 to 45°C for 2-3 h, 40 to 45°C for 2-3 h and

40 to 45°C for 3-4 h respectively and was grinded into a fine powder, the powder obtained was then packed in a clean air tight container.

Formulation of weaning food:

Three composite weaning foods (WF1, WF2, WF3, WF4, WF5 and WF6) were formulated using varying amounts of raw materials (Table 1) by considering nutrient and caloric values of each ingredient in order to meet the nutrient requirement of toddlers according to the recommendations given by the World Health Organization in which 100 g portion of each weaning food enables to provide ⅓ of the daily energy and carbohydrate requirement, ⅔ of the daily protein requirement and ¼ of the daily fat requirement of a growing toddler.

Table-1 Composition of different composite weaning foods

Treatments	Soyabean flour (g)	Carrot flour (g)	Sweet potato flour (g)	Apple flour (g)	Wheat flour (g)
WF1	20	20	25	15	20
WF2	20	15	25	20	20
WF3	20	20	15	25	20
WF4	20	15	20	25	20
WF5	20	25	20	15	20
WF6	20	10	25	25	20

WF1=weaning food 1, WF2= weaning food 2, WF3= weaning food 3, WF4= weaning food 4, WF5= weaning food 5, WF6= weaning food 6

Sensory Evaluation: Each treatment mix was blended with the corresponding amounts of milk and the sensory evaluation of milk-based weaning foods in gruel form was conducted by 6 panelists of Ethelind College of Home Science, SHUATS in Allahabad. The penalists where in good health and are familiar with the taste, flavour and other attributes of weaning food. The prepared weaning food was served in sensory evaluation cups. The samples were assessed for colour, taste, flavour, aroma, texture and over all acceptability. The judges were instructed to sip water before and after assessing each product. The samples were assessed using a 9 point hedonic scale ranging between 7 (like extremely) to 1 (dislike extremely), like extremely =9, like very much = 8, like moderately=7, like slightly =6, neither like nor dislike = 5, dislike slightly = 4, dislike moderately= 3, dislike very much = 2, and dislike extremely = 1

Statistical Analysis:
Sensory data were analysed by Complete Randomized Design (CRD) and one-way ANOVA (Analysis of variance) and means were separated by Least Significant Difference (LSD) procedure.

Proximate Analysis: Moisture was determined by drying a representive 5 g weaning powder in an oven at 100 to 105 until constant weight. Ash content was determined by dry ashing in Muffle furnace at 525 °C for 3-5 hours. The crude protein was estimated by the Lawry method. Crude fat was quantified by the method describe by AOAC method, Ref. 920.39 using the Soxhlet apparatus and n-hexane as a solvent. Crude fibre was estimated by acid-base digestion with 1.25 % H_2SO_4 (w/v) and 1.25% NaOH (w/v) solution **AOAC (2007)**. Available carbohydrate (excluding fibre) was calculated by difference method, whereas metabolizable energy was calculated using energy conversion factors.

Mineral Analysis: 5 g of sample was ashed and extracted with dilute HCl. Suitable aliquots were used for the estimation of iron and calcium. Iron was estimated by the colorimetric method, **AOAC (2007)** which is based on ferric iron giving a blood red colour with potassium thiocynate. The red colour was measured within 20 minute at 560 nm. Calcium was estimated by titrimetirc method **(AOAC, 2007).** It was precipitated as calcium oxalate and was titrated with standard potassium permanganate to definite pink colour persisting for at least 1 min.

Vitamin Estimation: Ascorbic acid was estimated using the 2, 6-dichlorophenol indo-phenol, which was stoichiometrically reduced, by ascorbic acid into a colourless compound. The titration was conducted in the presence of metaphosphoric acid. β-carotene content of the sample was estimated using the method prescribed in the handbook of analysis **AOAC (2007).**

Determination of cost factor:

The cost factor of the prepared food products was determined by calculating per 100 g on the basis of raw materials.

RESULTS

Sensory Evaluation

The results of evaluation of the sensory characteristics are shown on Table 2. Sample WF3 was rated highest in terms of colour, taste and over all acceptability and the least colour and consistency preference was WF4 .and the least taste and overall acceptability preference was in WF1. However overall acceptability of colour shows that sample WF3 was preferred while there was both significant and non-significant difference in the preference for colours, consistency, taste and overall acceptability among the blends.

Table-2 Average sensory score for prepared weaning food with milk

Treatments	Overall acceptability	Colour and appearance	Consistency	Taste and flavor
WF_1	5.91	8.83	5.76	6.16
WF_2	7.19	7.33	7.10	7.16
WF_3	8.13	8.50	7.56	8.33
WF_4	6.02	6.26	5.00	6.83
WF_5	6.94	6.83	6.50	7.50
WF_6	6.27	6.33	6.33	6.50
Result	S	S	S	S
S. Ed. (±)	0.082	0.139	0.163	0.200
C.D. at 5%	0.17	0.29	0.34	0.42

S.Ed.= sum of mean difference

C.D.= critical difference

NUTRITIONAL COMPOSITION OF THE WEANING FOOD

Table-3 The average nutritional composition of the best treatment samples of '*weaning food*' per 100 g.

Nutrients	Moisture (%)	Ash (g)	Protein (g)	Fat (g)	Iron (mg)	Calcium (mg)	Fibre (mg)	Carb (g)	Energy (Kcal)	VitC (mg)	βcarotene (µg)
WF_3	**0.33**	**6.519**	**10.67**	**2.329**	**5.281**	**46.25**	**3.88**	**42.61**	**581**	**6.48**	**687.06**

$WF_{3=}$ weaning food 3

Table-3 shows the nutritional composition of the prepared weaning food (Per 100g).

Moisture

Weaning food had the moisture content of 0.33 percent . The high level of moisture in the sample investigated that the weaning food would stay stored for long without spoilage, since a low water activity could not enhance microbial action bringing about food spoilage. Indeed, the low

moisture content may not induce a greater activity of water soluble enzymes and coenzymes. The study done by **Parvin *et al.*, (2014)** on formulation of weaning food using cereals found that the Moisture content in the weaning food was 1.78%, which was acceptable.

Ash

The ash content resulted from the proximate analysis reflects the mineral content of the weaning food. The formulated Weaning food had the ash content of 6.519g/100g. The study done by **Parvin *et al.*, (2014)** on formulation of weaning food using cereals found that the Ash, content of 1.88%.

Fat

Fat content for the weaning food was 2.329g/00g it was found that the fat content was not much high and hence it is good to be consumed. According to **Abdulaziz *et al.*, (1997)** the fat content in the commercial baby food consumed in Saudi Arabia was 2.0 to 4.8g.

Protein

Protein content of the prepared weaning food analysed was 10.67/100g. Protein content of the sample was found high in the weaning food due to higher content of soya bean and wheat flour. According to **Modu *et al.*, (2013)** the protein content of the weaning blend (12.68±0.45) was not able to meet the recommended Dietary Allowance of infants of weaning age. Similar study was done by **Fatima (1992)** and found that addition of 25% chick pea or pigeon pea increased the protein content of the weaning foods to 16.7% and 14.4%, respectively, while Cerelac and Riri gave protein content of 15.3% and 7.3%, respectively.

Crude fibre

Crude fibre content varied from 0.68g to 9.70 g/100g being highest in Hazardana *(Spinchacia oleracea*) leaves i.e.9.70g /100g. According to **Pillai *et al.*, (2013)** the

Basella rubra showed the highest crude fibre value (8.61g/100g) and lowest was found to be in *Moringa oleifrea* (2.04g/100g) and *Amaranthus virdis* (0.25g /100g).

Carbohydrate

Total carbohydrate content analysed in the weaning food was 42.61/100g. It had the high carbohydrate content. **Kavitha(2014)** studied that the Extruded weaning food was prepared from flour blends made with wheat flour, maize flour, green gram flour and groundnut flour. Material balance method was used in obtaining the proportions of flour that contained above 55% carbohydrate. **Udensi et. al.,(2013)** reported carbohydrate content (49.26 - 55.25%) in weaning food prepared from roasted millet and *Mucuna cochinchinesis.*

Energy

Energy content of the sample was 581Kcal /100g.The energy content was high due to incorporation of sweet potato and wheat mainly as they are rich in carbohydrates.. **Gordon and Kessel, (2002); Yisa *et al*., (2010)** reported that the high carbohydrate content in food means high energy content, which helps in digestion and assimilation of other foods. They are also responsible for carrying out daily activities in day to day life**.**

Mineral and Vitamin Content

Calcium –Weaning food was found to have high calcium content i.e. 46.25mg /100g Similar values of Calcium content of the weaning food blend (50.08±0.09) were reported by the **Modu *et al.*, (2013)**

Iron - The iron content of the formulated mixture was 5.281 mg /100g .The highest iron content was found in soyabean and wheat i.e 10.4mg/100gm and 4.9mg/100gm respectively**. Anigo *et al.*,(2010)** observed that the iron content was between 177.10 and 476.64 ppm. in food gruels formulated from malted cereals, soybeans and groundnut for use in North-western Nigeria.

β-carotene -The β-carotene was found high in the prepared weaning food i.e.687.06µg / 100g. Due to the incorporation of sweet potato and carrot in the weaning food the β-carotene content is very high as they are rich in β-carotene. The similar study was also done by **Elemo et. al., (2011)** he found that the Vitamin A i.e. beta-carotene was (267.0 IU/100 g).

COST OF THE PRODUCTS BASED ON RAW MATERIALS

The cost was calculated on the basis of raw ingredients used. From the table 4.5 it is evident that the cost of prepared weaning food was lowest in WF5(42/100g), WF1(42.25/100g), WF2(45.25/100g), WF3(47.75/100g), WF4(48/100g) and WF6(48.25/100g). The results, indicated that weaning foods developed from locally available less inexpensive foods may be used as good supplements for infants.

Adeniyi (2012) did a similar study, a cost minimization linear programming model was used to select some locally available feeding stuff as substitute for the conventional infant foods. The use of 58% white maize; 41% groundnuts and 1% Soyabean meals was optimum in formulating a good substitute for the conventional infant food based on the data available in Nigeria. At an estimated cost of ₦399.25 per pack of 450 gram weight, the formulation was more than four times cheaper than the least priced commonly marketed tinned baby foods on- shelf in Nigeria.

CONCLUSION

On the basis of the above findings it is concluded that the weaning food can be prepared by using different flours. Sensory score of reconstituted weaning food with milk scored highest T_3 (soyabean flour 20g ,carrot flour 20g , sweet potato flour 15g , apple flour 25g and wheat flour 20g) in relation to colour, flavor, consistency and over all acceptability. The prepared weaning

food is rich in Energy, Protein Carbohydrate and Calcium and fulfill the requirements given by recommended dietary allowances. In prepared weaning food the cost of WF_5 treatment was 42Rs/100g and was found cheaper than other treatments and the cost of WF_3 treatment was 47.75Rs/100g. The prepared weaning food is thus recommended for infants suffering from malnutrition in order to improve their nutritional status particularly of energy, carbohydrate, calcium, protein, carotene etc. so that malnutrition in early infancy can be prevented.

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