International Journal of Medical Sciences
Volume 6 | Issue 2 | October, 2013 | 59-64

RESEARCH PAPER

Development of Peanut Flour Based Value Added Products for Malnourished Children

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ABSTRACT : Protein energy malnutrition is the major concern of nutrition. Malnutrition is an underlying cause of death of 2.6 million children each year – one-third of the global total of children's deaths. Partially defatted peanut flour, is a protein-rich, inexpensive and underutilized product that offers the same health and dietary benefits of peanut with less fat and can be utilized for making value added products to eradicate malnutrition among children. It was prepared by crushing roasted peanuts to extract oil and then grinding the left over meal into flour. Partially defatted peanut flour was blended with cereals and pulses for making five value added products and were evaluated for sensory quality by using nine point hedonic scale and nutritional composition by using standard methods. The acceptable percentage of peanut flour was 5% for soup, 10% for pancake, kheer and 30% for *vadiya and papad*. Overall acceptability score was 7.2, 8.14, 8.51, 8.12 and 8.4. The developed products were found to be highly nutritious as soup gives 336.39 Kcal of energy, 14.53% protein, 692.73 mg calcium and 9.15 mg of iron. Pancake gives 458.53 Kcal of energy, 22.75% of protein, calcium 56.00 mg and iron 4.84 mg per100g. *Kheer* provides 390.64 Kcal of energy, 18.10 % of protein, 910.40 mg of calcium and iron 3.24mg/100g. *Vadiya* gives 385.48 Kcal, 31.00% of protein, 73 mg of calcium and 3.50 mg of iron. *Papad* provides 415.61 Kcal of energy, 20.58g of protein, 27.50mg of calcium and 2.89mg of iron. The products were popularized among self help groups by giving demonstrations of most acceptable products for their nutritional and health benefits. Microbial estimation of partially defatted peanut flour showed that peanut flour stored in polythene bags is safe after 3 months storage.

Key Words :
Peanut flour, Organoleptic evaluation, Proximate composition, Microbial estimation

How to cite this paper : Bansal, Payal and Kochhar, Anita (2013). Development of Peanut Flour Based Value Added Products for Malnourished Children. *Internat. J. Med. Sci.*, **6**(2) : 59-64.

Most of the developing countries are facing a problem of various forms of protein energy malnutrition. Protein Energy Malnutrition is the primary concern of nutrition particularly among children, expectant and nursing mothers. Malnutrition in young children is attributed to various factors including female illiteracy, ignorance about nutritional needs of infants and young children and poor access to health care. It is third most common disease of childhood in tropical and subtropical regions of world (Akuyam, 2007). Fifty percent of children under five are underweight and stunted. Malnutrition is an underlying cause of death of 2.6 million children each year – one-third of the global total of children's deaths (UN, 2011). Forty three percent of India's children below the age of three years are malnourished. Approximately 40% of Indian children are underweight, 44.9% of Indian children are stunted and 22.9% of Indian children are wasted. In Punjab 25% of children under age of five years are underweight (NFHS 2006). Nutrition of infants and young children is critical for their survival, cognitive development and growth not only during the childhood but for their whole life span. Adequate and regular complimentary feeding of infants with home based foods from the age of six months, while continuing breast feeding is

Paper History :
Received : 03.09.2013;
Revised : 17.09.2013;
Accepted : 23.09.2013

crucial for their healthy growth and development (UNICEF 2009). Popularization of low cost nutritious food particularly for vulnerable groups like infants, young children, pregnant and lactating women is the main concern. Instant food mixes are important as the child needs to be fed 5-6 times a day.

In recent years much research has been devoted to the utilization of oilseed proteins as an edible source of protein for human as well as animal consumption. Peanuts (*Arachis hypogaea* L.) are among the major oilseeds in the world. Peanuts are often a major ingredient in mixed nuts because of their inexpensiveness compared to cashews and walnuts.

India is one of the major contributors of peanuts produce to the world as India is the world's second largest producer after China. India accounts for nearly 30% of total world peanut production and China accounting for 38% of world production. In India 80% of total peanut production is used for oil extraction and 20% for snacks. Peanuts have aroused great interest as a source of low-cost protein to supplement human diets. In addition to the traditional food uses, peanut butter and roasted peanuts, have also been successfully utilized in supplemented foods such as bakery products, extenders in meat product formulations, in soups and desserts (Ismail *et al.,* 1991; Wu *et al.,* 2007). Also the peanut cake or meal was used as nutritional source for the manufacture of bakery products like cookies (Tate *et al.,* 1990), breads (Jan *et al.,* 2003) and chapattis, breakfast cereals. And recent studies have also demonstrated that oil extraction produces a protein-rich co-product which may be used for human consumption, if processed from edible-grade peanut seed by commercially accepted food processed (Cherry, 1990), generally, this material is available as flakes or grits and may be further processed to partially defatted peanut flour (DPF). DPF, as a protein-rich, inexpensive and underutilized product that offers the same health and dietary benefits of peanut with less fat (Liu *et al.,* 1996), generally contains 47-55% high quality protein with high essential amino acid content (Basha and Pancholy, 1982) which lends itself being used in many food applications. In most of the countries it has been seen that peanuts are usually processed for oil and the residual meal is used either as animal feed or as fertilizers. Although the meal obtained after oil extraction also possess a rich amount of protein which could be utilized for value addition of various food products. In contrast to soybean meal, peanut meal is low in lysine but is an excellent source of arginine.

Regular peanut consumption has been associated with a reduced risk in developing Type II diabetes (Jiang *et al.,* 2002), cardiovascular disease, colon, prostate and breast cancer (Awad *et al.,* 2000). It also seems to reduce osteoporosis and deficiencies in protein intake (Messina, 1999). Recently, it has been associated with metabolic benefits in the context of counteracting metabolic dysfunction associated with the increasing prevalence of obesity and metabolic syndrome (Coates and Howe, 2007).

Peanut flour is made from crushed, partly defatted peanuts and is very low in saturated fat and cholesterol. It is also a good source of dietary fiber, thiamin, folate, potassium and zinc, and a very good source of protein, niacin, magnesium, phosphorus, copper and manganese (Fekria *et al.,* 2012). Peanut flour is lower in fat than peanut butter, and is popular with chefs because its high protein content makes it suitable as a flavor enhancer. Peanut flour is used as a gluten-free solution. Peanuts themselves contain about 25% protein; peanut flour has about 50%. Because the process of mechanically removing fatty oil from roasted peanuts enriches the levels of the remaining peanut components. The resulting flour is naturally low in fat, high in protein and relatively low in carbohydrates. Peanut flour which is most commonly used for fortification contains protein ranging in between 47% - 55% *i.e*. a good amount of protein. Peanut flour has been used to replace animal proteins in a variety of products. Peanut flour blends well with cereal flour to yield products with excellent flavor texture and color.

Food processing has become important to prevent its post harvest and storage losses and provide better shelf life and nutrient quality. Processing also helps to preserve peanut even for the off season consumption. Several value added products have been developed from different combinations of peanut flour with other cereal, pulses, and green leafy vegetable. With increased interest in health foods, consumers now believe in health benefits as being desirable food qualities.

RESEARCH METHODOLOGY

The present investigation was carried out on development and nutritional evaluation of value added cereal pulse based products using partially defatted peanut flour.

Preparation of peanut flour:

Various products namely soup, pancake, *kheer, vadiya* and *papad* were prepared. These were prepared using standardized recipe with supplementation of partially defatted peanut flour at different levels.

Recipes of value-added products:

Soup:

Wash tomatoes (95g) and cut them into cubes. Put tomatoes, ginger (5g), onion (25g), salt (3g) and water (500 ml) in a pressure cooker. Cook till softens, then blend it and sieve. Put them into a pan and cook till it reduces to required consistency. Dissolve peanut flour (5g) in the water and add to the soup and cook till it becomes thick as desired. Serve the soup in a soup bowl and garnish it with coriander leaves.

Pancake :

Chop onion (50g), ginger (1/2 tsp), green chillies (3-

4) and coriander leaves finely. Mix gram flour (besan) (90g), peanut flour (10g), green chilies, ginger, coriander powder (1/4 tsp), onion and salt (to taste). Add water in order to make a smooth batter. Heat a pan, put some oil (10g) on it. Pour a 1 tbsp of batter on pan and spread it with ladle. Cook both sides. And serve it with tomato sauce.

Kheer:

Soak rice (80g) in water for 5 minutes. Put milk in a pan, bring to boil. Put the soaked rice in milk (500ml) and bring to boil then simmer gently until the rice is soft and the grains are starting to break up. Add peanut flour (20g) and simmer for 3-4 minutes. Add the sugar (90g) and stir until completely dissolved. Remove the rice *kheer* from heat and serve either warm or chilled.

Vadiya:

Soak moong dal (70g) in water for 6- 7 hrs. Then grind it and add hing (a pinch) and red chilli(1/5 tsp) powder in it. Keep it overnight. In morning add peanut flour (30g) into it and make it into round shape on a cloth. Keep it in the sun for drying.

Papad:

Mix rice flour (70g), peanut flour (30g), jeera (a pinch), ajwain (a pinch), salt (2 pinch) and sodium bicarbonate (a pinch) together. Put them all in boiling water (200ml). Cook it till it binds together and starts leaving the vessel. Take it out and knead it properly. Now roll it in the shape of *papad* and keep it in the sun for drying. Then fry and serve.

Organoleptic evaluation:

Sensory characteristics of developed products were evaluated for different sensory attributes by a group of panelists. Sensory attributes like colour, appearance, texture, flavor, taste and overall acceptability for all samples were assessed using nine point hedonic scales. The judges were served each preparation with one control and three test samples. Control sample was perepared from ingredients used in the normal and usual recipes and test samples were prepared by supplementing partially defatted peanut flour at different levels for different recipes. The samples were coded to avoid any bias judgement.

Proximate composition:

The peanut flour and their value added products were analyzed for moisture, protein, fat, fiber and total ash contents employing standard methods of AOAC. A factor of 6.25 was used to convert nitrogen into crude protein.

Mineral content:

Calcium content of the peanut flour and their products was determined by the titrimetric method of AOAC and the iron content was estimated by using the AOAC method.

Popularization of developed products using partially defatted peanut flour among self help groups:

The developed mixture and value added products were popularized among the self help group in two villages namely Lohara and Ayali, Ludhiana for the nutritional and health benefits of vulnerable group. Charts describing preparation of partially defatted peanut flour and its nutrient composition with comparison to raw peanuts were prepared. Demonstrations, lectures and booklet on value added products were given in each village.

Storage of partially defatted peanut flour:

After drying, sample of peanut flour was packed in polyethylene bags, sealed and stored at ambient temperature (25- 35° C) for three months. Peanut flour used for making value added products was tested for microbial growth. Food samples were analyzed for the presence of pathogens using the media glucose yeast agar.

Statistical analysis:

The data on all the parameters *viz.*, food and nutrient intake, anthropometric measurements and blood parameters of the subjects were analyzed statistically. The mean, standard error, percentages, paired t-test and their statistical significance was ascertained using a computer programme package.

RESULTS AND DISCUSSION

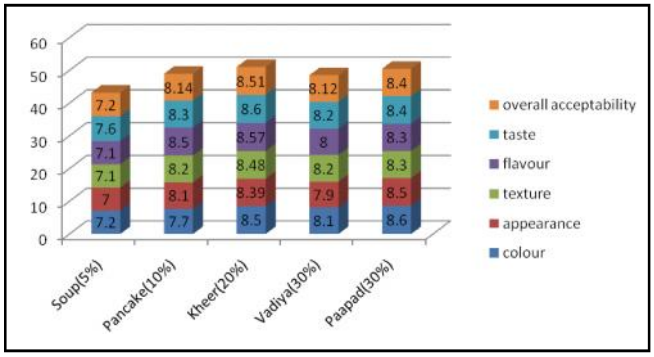
The present study was based on the development of value added cereal pulse based products namely soup, pancake, *kheer, vadiya* and *papad* using partially defatted peanut flour. The developed products were tested for their organoleptic scores and the most acceptable level out of the two was analyzed for their nutritional composition.

Organoleptic evaluation of the developed products:

Four samples of all the products were prepared using ingredients like cereals, pulses, green leafy vegetables for control and for test samples the control was supplemented with partially defatted peanut flour, at 5-30% levels. The developed products were organoleptically evaluated by a panel of judges.

The mean scores of acceptability trials of soup by expert panel of judges using nine-point Hedonic Rating scale are presented. The results revealed that the highest scores for soup at 5% of peanut flour has overall accepatability is 7.2 liked moderately than that of control 8.26. The data revealed that the scores for pancake at 10% level of peanut flour were highest with overall acceptability 8.14 and control with overall acceptability 7.5 which was liked moderately.

The results revealed that the highest scores for overall acceptability were obtained by *kheer* at 10% supplementation than the control 8.51 than 8.5, respectively. The highest scores for all the attributes were obtained by *vadiya* with 30% of partially defatted peanut flour supplementation with scores of overall acceptability as 8.12 which was liked very much than that of control *i.e.* 7.16. These scores were found to be comparatively higher than control. The results revealed that the highest scores for overall acceptability of *papad* at 30% of peanut flour were 8.4 which means liked very much than control which was liked moderately with overall acceptability score 7.7.



Proximate composition :

Addition of partially defatted peanut flour showed significant increase in protein and fibre and decrease in fat. The proximate composition of Peanut flour in comparison to raw peanuts is given in Table 1.

Table 1 : Nutritive composition of peanuts and partially defatted peanut flour (per 100g)

Nutrients	Raw peanuts	Partially defatted peanut flour
Moisture	6.5 g	2.5 g
Energy	611 Kcal	396.91 Kcal
Protein	25.8 g	52.75g
Carbohydrates	16.13 g	14g
Fat	49.24 g	14.39g
Fibre	8.5 g	11.02 g
Iron	4.58 mg	2.6 mg
Calcium	92 mg	74mg

It was observed that the moisture content of Soup prepared from 5% partially defatted peanut flour was 2.10% as compared to 2.32 percent of control, with significant difference. A significantly higher protein content was observed in soup with 5% partially defatted peanut flour as compared to control as 14.53 and 13.00 percent respectively. The fat content was found to be in the range of 2.89% for control to 3.35% for acceptable level and the difference was found to be statistically significant ($p>0.05$).

Pancake:

The proximate composition of control and test samples of pancake presented in Table 2 revealed that the moisture content of pancake ranged between 4.50% for control to 4.27% for acceptable level (10%). The protein content was found to be 19.42% in control and 22.75% in acceptable level. Pancake with 10% peanut flour showed decrease in fat content from 20.50% in control to 19.57% in test sample. The crude fiber content was 1.17% for control and 2.15% for acceptable level.

Kheer:

The moisture content of *kheer* ranged from 4.45 for control to 3.89 for test sample, the most acceptable level *i.e.* 10% of partially defatted peanut flour with significant difference. The protein content of the accepted level was found to be higher than control *i.e.* 18.10% and 15.78%, respectively. The fat content has been increased in case of acceptable level as compared to control *i.e.* 4.56 and 3.3, respectively. Supplementation of peanut flour showed increase in fiber from 0.47 for control to 1.58 for acceptable level. The ash content of *kheer* ranged from 2.08% for control to 2.57% for acceptable level, while the difference was significant.

Vadiya:

The moisture content of *vadiya* was found to be ranging from 2.50-3.50 for control and acceptable level, respectively, while the difference was statistically significant. The protein content ranged from 22.00% for control to 31.00% for acceptable level with significant difference. The increase in the protein content was observed due to the 30% addition of partially defatted peanut flour. The fat content of all the treatments of *seviyan* was found to be 1.10% for control and 5.08% for acceptable level. The crude fiber content in control sample of *seviyan* was 0.78% and it significantly ($p=0.05$) increased to 3.58 percent respectively on supplementation with 30% of partially defatted peanut four. Ash content was observed to decrease in test sample as compared to control *i.e.* 2.90 and 3.20%, respectively.

Papad:

It was observed that the moisture content of *papad* prepared by supplementing 30% partially defatted peanut flour was 0.86% as compared to 0.15% of control respectively, with significant difference. The protein content in *papad* with 30% partially defatted peanut flour and control was observed to be 20.58 and 6.80 percent respectively. The increase is significant. The fat content was found to be in the range of 5.50% for control to 8.16% for acceptable level and the difference was found to be statistically significant. The fiber content was observed to be 3.50% for acceptable level and 0.52% for control, respectively.

Table 2 : Proximate composition of developed products (on dry matter basis)

Treatments	Moisture (%)	Protein (%)	Fat (%)	Fiber (%)	Ash (%)
Peanut flour	2.55±0.015	52.75±0.25	14.39±.60	11.02±0.3	5.2±0.08
Soup					
Control	2.32±0.05	13±0.15	2.89±0.13	11.59±0.21	6.85±0.15
Acceptable	2.10±0.02	14.53±0.2	3.35±0.17	11.34±0.03	6.65±0.15
Pancake					
Control	4.5±0.03	19.42±0.13	20.50±0.1	1.17±0.05	3.2±0.15
Accepted	4.27±0.08	22.75±0.2	19.57±1.24	2.15±0.1	3.4±0.23
Kheer					
Control	4.45±0.03	15.78±0.1	3.3±0.12	0.47±0.2	2.08±0.18
Acceptable	3.89±.08	18.10±.1	4.56±0.48	1.58±0.05	2.57±0.2
Vadiya					
Control	2.50±0.06	22.00±0.1	1.10±0.2	0.78±0.21	3.20±0.12
Accepted level	3.50±0.06	31.00±0.2	5.08±0.5	3.58±0.03	2.90±0.01
Papad					
Control	0.15±0.02	6.80±0.3	5.50±0.2	0.52±0.01	0.65±0.21
Accepted	0.86±0.001	20.58± 0.1	8.16±1.15	3.50±0.07	2.00±0.23

Mineral content:

Iron content:

The iron content of control soup was found to be 9.51 mg/100g which decreased to 9.15 mg/100g on supplementation with 5% partially defatted peanut flour. The total iron content in the control sample is 5.00 mg which is decreased to 4.84mg/100g in pancake. The iron content in *kheer* at 10% level was found to be 3.24mg/100g. The iron content of peanut flour supplemented *vadiya* at the 30% level had an iron content of 3.5 mg/100g while *papad* at same level was found to be 2.89 mg/100g, respectively. Data is presented in Table 3.

Calcium content:

The calcium content in soup was 692.73 with 5% supplementation of peanut flour and in pancake at 10% peanut flour incorporation calcium content had increased to 56.00 mg/100g. *Kheer* supplemented with 10% peanut flour have shown the decrease in calcium content from 950.00 to 910.40 mg. Supplementation of *vadiya* with 30% partially defatted peanut flour increased the calcium content to 73.00/ 100g. Supplementation of peanut flour at 30% in *papad* had increased the calcium content to 27.50 mg/100g. The calcium content of all the developed products except in *vadiya* increased significantly on addition of partially defatted peanut flour.

Microbial testing of peanut flour and acceptable mutritious mixtures :

After drying sample of peanut flour and other acceptable developed nutritious mixtures were stored in polythene bags, sealed and stored at ambient temperature (25-35°C) for three months. Microbial testing of peanut flour was done after storing at 1 month interval to test for microbial growth. It was analyzed using media glucose yeast agar. Total colonies formation units peanut flour was under the safe limits.

Popularization of developed products using peanut flour among self help groups:

Highly acceptable fifteen products like soup, pancake, *kheer*, *vadiya* and *papad* were popularized among the self help groups at both villages by giving them lectures, demonstrations and booklets on peanut based recipes for

Table 3 : Iron and calcium content of different value added products

Treatments	Iron(mg)	Calcium (mg)
Soup		
Control	9.51±1.23	725.3±1.35
Acceptable	9.15±1.4	692.73±1.2
Pancake		
Control	5.00±1.05	54.20±0.34
Acceptable	4.84±2.3	56.00±0.5
Kheer		
Control	3.15±0.23	950.00±1.3
Acceptable	3.24±1.23	910.40±2
Vadiya		
Control	3.60±1.23	72.40±0.23
Acceptable	3.50±1.5	73.00±0.02
Papad		
Control	3.00±0.35	8.40±0.35
Acceptable	2.89±0.4	27.50±0.42

nutritional and health benefits for children. Charts describing the preparation of partially defatted peanut flour and its nutrient composition with comparison to raw peanuts were prepared. Lectures on the nutritional benefits of peanut flour for children were delivered.

Conclusion:

Incorporation of the peanut flour in traditional recipes at a level of 5-50% is highly acceptable and is recommended to improve the nutritional value of the diets in terms of energy, protein, fiber, potassium and niacin. Value added products using peanut flour can be supplemented to children to eradicate malnutrition. These products may also be a part of the supplementary feeding programmes. Keeping in view the availability, economic benefits of peanuts and post processing losses, educate self help groups from different villages regarding preparation of peanut flour and importance of value added products using partially defatted peanut flour to popularize peanut products among the community. Keeping in view the nutritional value of peanut flour, it can be recommended to food industries to incorporate peanut flour in their products to improve the nutritive value. However, further research is required to study the shelf life of developed mixtures and their products by using different packaging material.

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