

# Sensory and Nutritional Evaluation of Value Added Products using Peanut Flour for Nutritional and Health Benefits

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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 rating scale and nutritional composition by using standard methods. The acceptable percentage of peanut flour was 10% for *vada*, 15% for *halwa*, *dhokla*, 20% for *idli*, and 50% for *panjeeri* and overall acceptability score was 8 for *vada*, 8.3 for *halwa*, 8.04 for *dhokla*, 8.13 for *idli* and 8.04 for *panjeeri*. The developed products were found to be highly nutritious as *vada* gives 424.58 Kcal of energy, 25.34% protein, 140.85 mg calcium and 3.42mg of iron. *Halwa* gives 630.78 Kcal, 15.49% of protein, 49.00mg of calcium and 4.34mg of iron. *Dhokla* gives 408.85 Kcal of energy, 28.90% of protein, calcium 187.50 mg and iron 3.86mg per100g. *Idli* provides 393.95 Kcal of energy, 19.50 % of protein, 137.08 mg of calcium and 1.50 mg/100g. *Panjeeri* provides 482.50 Kcal of energy, 31.00 g of protein, 57.62 mg of calcium and 3.70 mg of iron. The products were popularized among self help groups by giving lectures and 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.

**Keywords** – Partially Defatted, Organoleptic Evaluation, Nutritional Composition, Microbial Estimation.

## I. INTRODUCTION

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 [1]. 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 [2]. Global progress on stunting has been extremely slow. The proportion of children who

are stunted decreased from 40% in 1990 to 27% in 2010 – an average of just 0.6 percentage points per year [3]. 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 [4]. Nutrition of infants and young children is critical for their survival, cognitive development and growth not only during childhood but 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 crucial for their healthy growth and development [5]. 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. These can be easily prepared at home and stored in the air tight containers for at least a month [6]. These mixes can be reconstituted with boiled water, milk, dal or unsiced gravy and fed to the child whenever required. Increasing work participation of women both in urban and rural areas has made it necessary that the instant foods are available at home for feeding infants and young children.

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 [7, 8]. Also the peanut cake or meal was used as nutritional source for the manufacture of bakery products like cookies [9], breads

[10] 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 [11], 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 [12], generally contains 47-55% high quality protein with high essential amino acid content [13] 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. Regular peanut consumption has been associated with a reduced risk in developing Type II diabetes [14], cardiovascular disease, colon, prostate and breast cancer [15]. It also seems to reduce osteoporosis and deficiencies in protein intake [16]. 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 [17].

Peanuts are often a major ingredient in mixed nuts because of their inexpensiveness compared to cashews and walnuts. Peanut has been a tradition on trips and are liked because of its high protein content and the fact that it resists spoiling for long periods of time. Peanuts have a desirable fatty acid profile and are rich in vitamins, minerals and bioactive materials. They contain several known heart healthy nutrients including monounsaturated and polyunsaturated fatty acids, potassium, magnesium, copper niacin, arginine, fiber,  $\alpha$ -tocopherol, folates, phytosterols, and flavonoids [18].

A high-protein peanut press cake, which is normally used for animal feed, is a byproduct derived from the oil extraction process. Peanut press cake, however, can be used for human food if it is processed from food-grade peanuts under hygienic environments [19]. Peanut flour has a relatively high protein content, bland flavor, and light tan color which allow it to be incorporated into a wide range of foods.

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 [20]. 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.

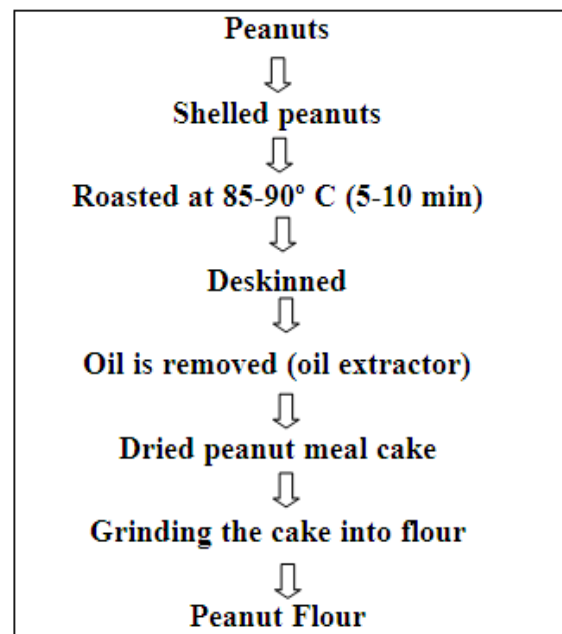
Peanut flour blends well with cereal flour to yield products with excellent flavor texture and color.

Food processing has become important to prevent its post processing loses 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.

## II. MATERIALS AND METHODS

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 Vadas, Halwa, Dhokla, Idli and Panjeeri were prepared. These were prepared using standardized recipe with supplementation of partially defatted peanut flour at different levels.

Recipes of Value-Added Products

### Vadas

Soak the black gram dal (90g) overnight, drain the water. Grind and add salt (2.5g), green chillies (2). Beat the mixture smoothly till fluffy. Give the shape of tikki, make a hole in the centre and deep fry till golden brown. Serve hot.

### Halwa

Take kadahi and heat ghee (100g) in it. Put wheat flour (85g) in it and roast it. When wheat flour is half done add peanut flour (15g) and roast along it. On the other side boil water (200ml) with sugar (80g). When both get roasted slow down the flame and add sugar syrup water. Mix it well and fastly till it binds well. Serve it hot.

### Dhokla

Mix Bengal gram flour (60g), suji (25g), peanut flour(15g), curd(100g) and water (if needed). Make a smooth batter. The batter should be of thick consistency. Add salt and set aside for few minutes. Keep the steamer or cooker ready on gas. Grease a baking dish (it should fit in the steamer or cooker). Take ½ tsp. of eno and add this to the batter and mix well. Pour the batter into the greased pan and steam for 10-12 minutes or till done. Cool for sometime and cut into big cubes. Heat little oil in a small pan and add mustard seeds (2g) and curry leaves allow to splutter. Remove and pour it over dhoklas. Garnish the dhokla with coriander and slited green chilies. Serve with pudina chutney.

### Idli

Mix suji (80g), peanut flour(20g), curd(100g) and water (if needed). Make a smooth batter of thick consistency. Add salt and set aside for few minutes. Keep the steamer or cooker ready on gas. Grease a baking dish (it should fit in the steamer or cooker). Take a ½ tsp. of eno and add this to the batter and mix well. Pour the batter into the greased pan and steam for 10-12 minutes or till done. Heat little oil in a small pan and add mustard seeds (2g) and curry leaves (a few) allow to splutter. Remove and pour it over Idli.

### Panjeeri

Take kadahi and heat ghee (50g) in it. Put wheat flour (50g) in it and roast it. When wheat flour is half done add peanut flour (50g) and roast along it. When both get roasted remove it from flame and add desi sugar (35g). Mix it well 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 prepared 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 [21].

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 was done after drying, sample of peanut flour was packed in double layered polyethylene bags, sealed and stored in air tight containers 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

## III. RESULTS AND DISCUSSION

The present study was based on the development of value added cereal pulse based products namely vada, halwa, dhokla, Idli and panjeeri 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 10-50% levels. The developed products were organoleptically evaluated by a panel of judges.

Vada with 10% of peanut flour revealed the highest scores with an overall acceptability score of 8.0 and was liked very much followed by control with overall acceptability 7.96 which was liked moderately. The highest scores for halwa with 15% of partially defatted peanut flour supplementation was liked very much with overall acceptability of 8.3. These scores were found to be comparatively higher than control sample i.e. 7.6. The mean scores of acceptability trials of Dhokla at 15% showed that the Mean score for all parameters i.e., 8.04 are found to be higher than the control sample i.e 7.16.

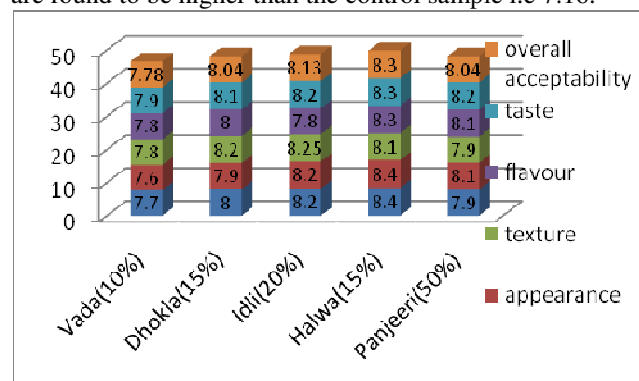


Fig.1. Organoleptic scores for developed products

The mean scores for idli at 20% were slightly higher than the control with overall acceptability 8.13 which was slightly higher as compared to 8.1 respectively of control. The mean scores of acceptability trials of panjeeri at 50% of peanut flour for all parameters were non significantly ( $p \leq 0.05$ ) higher than control with the overall acceptability of 8.04 and 7.62 respectively. Results are shown in Fig 1.

#### 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 (g)	6.5	2.5
Energy (Kcal)	611	396.91
Protein (g)	25.8	52.75
Carbohydrates (g)	16.13	14
Fat (g)	49.24	14.39
Fibre (g)	8.5	11.02
Iron (mg)	4.58	2.6
Calcium (mg)	92	74

#### Vada

The proximate composition of control and test samples of vada presented in Table 2 revealed that the moisture content of vada ranged between 3.75% for control to 3.63% for acceptable level (10%). The protein content was found to be 22.30% in control and 25.34% in acceptable level. Vada with 10% peanut flour showed small increase in fat content from 11.40% in control to 11.62% in test sample. The crude fiber content was 0.75% for control and 1.75% for acceptable level.

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

Treatment	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
<i>Vada</i>					
Control	3.75±0.06	22.30±0.02	11.40±0.02	0.75±0.03	2.86±0.01
Accepted	3.63±0.10	25.34±0.3	11.62±0.35	1.75±0.1	3.00±0.05
<i>Halwa</i>					
Control	7.60±0.02	11.54±0.12	65.00±0.25	1.79±0.32	2.50±0.02
Accepted	8.29±0.13	15.49±0.20	57.10±0.27	3.26±0.03	2.13±0.25
<i>Dhokla</i>					
Control	3.60±0.12	25.20±0.14	8.70±0.03	0.95±0.2	3.25±0.06
Accepted	3.80±0.14	28.90±0.07	9.45±0.66	2.35±0.1	3.45±0.07
<i>Idli</i>					
Control	4.10±0.37	12.10±0.03	3.00±0.07	0.10±0.07	0.75±0.05
Accepted	3.70±0.07	19.50±0.2	5.15±0.33	2.25±0.07	1.50±0.12
<i>Panjeeri</i>					
Control	0.37±0.009	9.27±0.23	37.45±0.02	1.50±0.1	2.50±0.04
Accepted	1.45±0.003	31±0.17	25.50±0.91	6.00±0.32	3.80±0.05

#### Halwa

The proximate composition of control and test samples of halwa is given in Table 2. It was observed that the moisture content of halwa was 8.29 for test sample with supplementation of 15% of peanut flour and 7.60% for control. The protein content was observed to increase from 11.54% for control to 15.49% for test sample. The fat content of control halwa was found to be 65.00%, while that of halwa with 15% peanut flour was found to be 57.10. Acceptable level was found to have the crude fiber content as 3.26% which was significantly ( $p \leq 0.05$ ) higher than 1.79% of control. The total ash content of C and acceptable level were observed to be 2.5% and 2.13% respectively.

#### Dhokla

The moisture content of dhokla ranged between 3.60% for control and 3.80% for acceptable level (15%). The protein content of test sample was found significantly higher i.e. 28.90% than control dhokla with 25.20% of protein. Dhokla with 15% supplementation of peanut flour had slightly higher fat content i.e. 9.45% whereas 8.70% for control. The acceptable level had a fiber content of 2.35% while control having 0.95% of fibre. The total ash content of the samples ranged from 3.25 for control to 3.45 for acceptable level.

#### Idli

It was observed that idli having 20% partially defatted peanut flour had moisture content of 3.70% while the control sample had 4.10% of moisture. Due to the supplementation of partially defatted peanut flour the crude protein content of test Idli increased significantly ( $P < 0.05$ ) to 19.50% whereas 12.10% of crude protein was observed in the control. The fat content of the test Idli was 5.15% while 3.00% was observed in the control sample. The crude fibre content of Idli sample supplemented with 20% of peanut flour was 2.25% and was higher than the control having 0.10% of crude fibre. This could be due to higher crude fibre value of peanut flour. The ash content for test Idli was 1.50% which was higher than 0.75% of ash in the control.

### Panjeeri

The proximate composition of test and control samples is given in Table 2. It was observed that the moisture content of the test panjeeri supplemented with 50% of peanut flour to be 1.45% while 0.37% of moisture content was observed in the control sample. The crude protein content of test panjeeri has been greatly increased from 9.27% for control to 31.00% for test sample. Fat content in test panjeeri has been decreased slightly from 37.45 for control to 25.50% for test sample. The crude fibre content of the test panjeeri was 6.00% whereas for control it is 1.50%. The value of ash in the test panjeeri was observed 3.80% and 2.50 for control.

### Minerals

#### Iron

The iron content of the developed products has been presented in the Table 3. The iron content of salty snacks like vada at 10% level was found to be 3.42 mg/100g. The iron content of peanut flour supplemented halwa was found to be 4.34mg/100g. With addition of partially defatted peanut flour in dhokla at 15% level iron content has slightly increased to 3.86 mg and for Idli at 20% to 1.5mg. The reason may be attributed to the less iron content in peanut flour. Panjeeri is acceptable at highest level of supplementation i.e. at 50% having iron 3.70 mg.

#### Calcium

The results of the calcium content of the developed products as shown in Table 3. The calcium content of vada at 10% level of supplementation shows calcium to become 140.85 mg. Supplementation of partially defatted peanut flour at 15% in halwa, is 49.00 mg/100g. The calcium content of control sample of dhokla was 185.00 mg/100g which increased significantly ( $p \leq 0.05$ ) to 187.50mg/100g on supplementation. The calcium content in Idli and panjeeri had increased to 137.08 and 57.62 mg/100g. The calcium content of all the developed products increased significantly on addition of partially defatted peanut flour.

Table 3: Mineral content of different value added products

Treatment	Iron(mg)	Calcium (mg)
Vada		
Control	3.50±0.7	150.50±0.12
Acceptable	3.42±0.5	140.85±0.34
Halwa		
Control	4.20±0.5	45.00±0.84
Acceptable	4.34±0.31	49.00±0.72
Dhokla		
Control	4.00±0.15	185.00±0.07
Acceptable	3.86±0.2	187.50±0.45
Idli		
Control	1.30±1.4	155.35±1.53
Acceptable	1.50±1.2	137.08±1.6
Panjeeri		
Control	4.50±1.4	43.86±0.5
Acceptable	3.70±1.3	57.62±0.4

### Microbial Testing of Peanut Flour and Acceptable Nutritious 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.

Developed highly acceptable fifteen products like vada, dhokla, Idli, halwa and panjeeri were popularized among the self help groups at two villages by giving them lectures, demonstrations and booklets on peanut based recipes for 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.

Incorporation of the peanut flour in traditional recipes at a level of 10-50% 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

## IV. CONCLUSION

These recipes are highly nutritious and thus can be the part of regular diets of people. They are often cost effective and thus can be easily afforded by the poor section of the society as well. Also, being easy to prepare and less time consuming, they can be prepared at home.

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*Note:* No color figures are required.

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