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Influence of spray drying technology on the proximate composition of peanut (*Arachis hypogaea* L.) milk powder

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Abstract
The process for the production of peanut milk powder was developed from peanut as availability of local market. For the preparation of peanut milk powder from peanuts, it was subjected to four different methods such as normal soaking, soaking in 1% $NaHCO_3$, roasting and pressure blanching (at 121°C, 15 psi for, 3 mins). The milk powder obtained from these different methods were analysed for proximate composition. The proximate composition of the pressure blanched peanut milk powder was found to be moisture content (4.30 %), proteins (29.97%), carbohydrates (18.79%), fat (43.18%), ash (2.45%) and crude fibre (1.31%) respectively. Based on the results it was concluded that the pressure blanched peanut milk powder was found most acceptable method compared to other methods. The pressure blanched milk powder is further suitable for preparation of chocolates and bakery products.

Keywords: Peanut milk powder, pressure blanching, proximate composition, spray drying.

1. Introduction
Peanut (*Arachis hypogaea L.*), a legume and belongs to the pea and bean family. Peanuts originated in South America where the crop existed for thousands of years. Peanuts played an important role in the diet of the Aztecs and other native Indians in South America and Mexico. India is one of the largest producers of oilseeds in the world and occupies an important position in the Indian agricultural economy. It is estimated that nine oilseeds namely groundnut, rapeseed-mustard, soybean, sunflower, safflower, sesame, niger, castor and linseed, accounted for an area of 23.44 million hectares with the production of 25.14 million tons (Madhusudhana, 2013). Peanuts have been used as a major source of edible oil and protein meal and considered highly valuable for human and animal nutrition in developing countries (Fekria *et al*., 2012) [6].

Peanut milk is a non-dairy beverage created using peanuts and water. Recipe variations include salt, sweeteners, and grains. It does not contain any lactose and is therefore suitable for people with lactose intolerance. Similar in production to almond milk, soy milk, and rice milk, the peanuts are typically ground, soaked, sometimes heated, and then filtered through a fine filter: the resulting liquid is considered the "milk" (Nelson *et al.*, 1976, Senayah, 1993) [11, 15].

A composite product made using peanuts as sources of nutrients such as protein, dietary fibre and other vitamins and minerals would be an ideal dairy milk substitute. Vegetable milk made from peanut could be dehydrated to produce an inexpensive dry milk powder. Indeed (Chandrasekhara *et al.*, 1964) [4] reported spray drying of peanut milk combined with other sources of milk, and the powder could be reconstituted in water.

The objective of this study was to develop dehydrated peanut milk powder and find the effect of pressure blanching on proximate composition of the developed peanut milk powder

2. Materials and methods
All the research activities were carried at College of Agricultural Engineering, Bapatla, Guntur, and Post-Harvest Technology Centre, Bapatla, (Andhra Pradesh).

2.1 Preparation of peanut milk
peanut milk was prepared using four different methods such as normal soaking, soaking in 1% $NaHCO_3$, roasting and pressure blanching (at 121°C, 15 psi for, 3 mins).

2.1.1 Normal soaking
Peanut milk was prepared by a method reported by Jain (2013) [8] with minor modifications. The peanuts weighing 100g were soaked in water in a ratio of 1:3 (kernel: water) for 18 hours and they

were subjected for dehusking. The dehusked kernels were washed with running water and ground with hot water in a ratio of 1:6 (kernels to water) in the grinder. The slurry formed was sieved by muslin cloth and peanut milk was produced (Plate.1).

Plate 1: Prepared peanut milk from standard soaking method

2.1.2 Soaking in 1% $NaHCO_3$

This method was according to Saio (1986) [12] with slight modification.100 g of peanuts were soaked for 18 h in 1% $NaHCO_3$ (1:3 ratio kernels to 1% $NaHCO_3$). After sometime, the soaked peanuts were dehusked. The dehusked kernels were washed with water and ground with hot water in a ratio of 1:6 (kernels to water) in the grinder. The slurry formed was sieved by muslin cloth and peanut milk was produced. $NaHCO_3$ was used to the removal of beany flavour in the final product, and to help soften the peanuts.

2.1.3 Roasting

Peanut milk was prepared by a method reported by Salunkhe and Kadam (1989) with slight modifications. The peanut seeds was initially sorted and subjected to roasting at temperature 130°C for 20 min in an oven. The obtained roasted seeds were de-skinned and weighed before being soaked in 1% $NaHCO_3$ for at least 18 h. The de-skinned peanut kernels were washed with clean running water. The de-skinned kernels were mixed with water in a ratio of 1:6 [peanuts (g): water (ml)] and transferred to a blender where they were blended for 5 min. The slurry formed was sieved by muslin cloth and peanut milk was produced.

2.1.4 Pressure blanching

Peanut milk was prepared as reported by Jain (2013) [8]. The blanching of peanuts (100 g) were be done in an autoclave at a temperature of 121°C and 15 psi for 3 minutes. Then, blanched peanuts were soaked in water for 6 h in a ratio of 1:3 (kernels to water). After soaking kernels were dehusked and ground in hot water in a ratio of 1:6 (kernels to water) in the grinder. The slurry formed was sieved by muslin cloth and the peanut milk was prepared.

2.2 Preparation of peanut milk powder using spray dryer:

The spray dryer works on the principle of co-current flow atomization and it consisted of feed pump, atomizer, air heater, air disperser, drying chamber, and systems for exhaust air cleaning and powder recovery. The maximum capacity of the dryer was 1.30 l/h with the nozzle fits to 1 mm size. The peanut milk was fed in to the drying chamber with feed flow rate of 20 ml/min and inlet air temperature was maintained at 130°C temperature. The obtained powder was stored in LDPE covers under ambient conditions. The obtained peanut powder is shown in plate 2.

2.2.1 Powder recovery

Powder recovery is expressed as the weight percentage of the final product compared to the total amount of the materials sprayed (Sansone *et al.,* 2011) [14].

$$\text{Powder recovery (\%)} = \frac{\text{Obtained spray dried powder}}{\text{Peanut milk}} \text{ x } 100$$

Plate 2: Prepared peanut milk powder using spray dryer

2.3 Proximate analysis of milk powder

The standard procedures were adopted for proximate analysis of milk powder samples were analysed.

2.3.1 Moisture Content

Five grams spray dried peanut milk powder was weighed using a sensitive digital balance (AJ- 20E, Essae-TERAOKA, Pvt. Ltd. Bangalore) in a non-corrosive metal dish. The moisture content of sample was determined by hot air oven method at 103 ± 2 °C for 24 hours. The moisture content of the samples on wet basis was calculated using the following equation.

$$\text{Moisture content (\% wet basis)} = \frac{W1 - W2}{W1} X\ 100$$

Where,
W1= Initial weight of the sample, g
W2= Final weight of the sample, g

2.3.2 Protein Content

The protein content was determined from the organic nitrogen content estimated by Micro-Kjeldahl method. An automatic Nitrogen/Protein Estimation System (KEL PLUS KES 12 L, Pelican Equipments, Chennai, India) was used for this purpose. The various nitrogenous compounds were converted into ammonium sulphate by boiling with concentrated sulphuric acid. The ammonium sulphate formed was decomposed with an alkali (NaOH) and the ammonia liberated was absorbed in excess of standard solution of acid and then back titrated with standard alkali. The nitrogen value was multiplied by 6.25 to obtain the protein content. The protein content was calculated as:

$$\text{Nitrogen content (g/kg sample)} = \frac{(ml\ HCl - ml\ blank) \times Normality \times 14.01}{Sample\ Weight\ (g)}$$

$$\text{Protein content (\%)} = 6.25 \times \text{Nitrogen content}$$

2.3.3 Fat Content
Fat was estimated as crude ether extract of the dry material. The dry sample of 5 g was taken in thimble was placed in the Automatic Soxhlet Apparatus (Socsplus SCS 4, Pelican Equipments, Chennai) and extracted with petroleum benzene for about 2 h, and the flask with the residue was dried in an oven at 60-80 °C, cooled in a desiccator and weighed. The fat content was then calculated as:

$$\text{Fat content (\%)} = \frac{\textit{Final weight of beaker along with oil} - \textit{Empty weight of beaker}}{\textit{Weight of sample}} \times 100$$

2.3.4 Ash Content
The total ash content was determined by AOAC (1980) method. In a previously heated and cooled porcelain dish, about 5 g of the samples was weighed. The sample was charred carefully on a heater, and then heated in a muffle furnace maintained at 550 °C for 3 hours. Then the ash content was calculated as:

$$\text{Ash content (\%)} = \frac{\textit{Weight of ash}}{\textit{Weight of sample}} \times 100$$

2.3.5 Crude fiber
The crude fiber content of samples was estimated using the procedure described in AOAC (1960). The crude fiber content was calculated as:

$$\text{Crude fiber (\%)} = \frac{\text{We} - \text{Wa}}{\textit{Weight of sample}} X100$$

Where,
We = Pre-weighed ash, g
Wa = Weight of the dish after ashing, g

3. Results and Discussion
3.1 Effect of normal (standard) soaking method on spray dried peanut milk powder
The moisture content of peanut milk powder prepared by normal soaking method was 4.84% (WB) whereas, the moisture content of milk was 89.20% (WB). The high amount of moisture present in the milk was evaporated during the spray drying process and resulted in low moisture powder. The nutritive value of peanut milk powder prepared from this method was analyzed and the values were depicted in Fig 1. The values of proteins, carbohydrates, fat, ash and crude fiber in peanut milk powder were 27.05%, 18.22%, 45.89%, 2.86% and 1.11% respectively. It was observed that all the quality parameters namely proteins, carbohydrates, fat and ash increased when the milk was converted into powder by spray drying.

3.2 Effect of Soaking in Sodium Bicarbonate method on spray dried peanut milk powder
The moisture content of peanut milk powder prepared by soaking in sodium bicarbonate method was 5.65% (WB) whereas, the moisture content of milk was 89.06% (WB). The high amount of moisture present in the milk was evaporated during the spray drying process and resulted in low moisture powder. The nutritive value of peanut milk powder prepared from this method was analyzed and the values were depicted in Fig 2. The values of proteins, carbohydrates, fat, ash and crude fiber in peanut milk powder were 28.25%, 18.87%, 44.03%, 1.86% and 1.34% respectively. It was observed that all the quality parameters namely proteins, carbohydrates, fat and ash increased when the milk was converted into powder by spray drying.

3.3 Effect of roasting method on spray dried peanut milk powder
The moisture content of peanut milk powder prepared by roasting method was 5.43% (WB) whereas, the moisture content of milk was 89.26% (WB). The high amount of moisture present in the milk was evaporated during the spray drying process and resulted in low moisture powder. The nutritive value of peanut milk powder prepared from this method was analyzed and the values were depicted in Fig 3. The values of proteins, carbohydrates, fat, ash and crude fiber in peanut milk powder were 27.44%, 15.25%, 48.35%, 2.12% and 1.26% respectively. It was observed that all the quality parameters namely proteins, carbohydrates, fat and ash increased when the milk was converted into powder by spray drying.

3.4 Effect of pressure blanching method on spray dried peanut milk powder
The moisture content of peanut milk powder prepared by pressure blanching for 3 minutes was 4.30% (WB) whereas, the moisture content of milk was 90.28% (WB). The high amount of moisture present in the milk was evaporated during the spray drying process and resulted in low moisture powder. The nutritive value of peanut milk powder prepared from this method was analyzed and the values were depicted in Fig 4. The values of proteins, carbohydrates, fat, ash and crude fiber in peanut milk powder were 29.97%, 18.79%, 43.18%, 2.45% and 1.31% respectively. It was observed that all the quality parameters namely proteins, carbohydrates, fat and ash increased when the milk was converted into powder by spray drying.

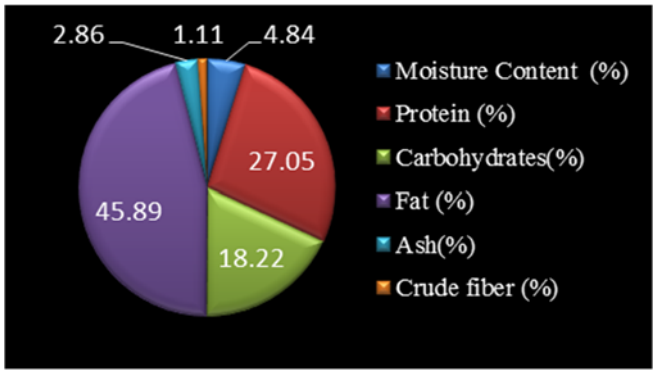

Fig 1: Effect of proximate composition of peanut milk powder in normal soaking method

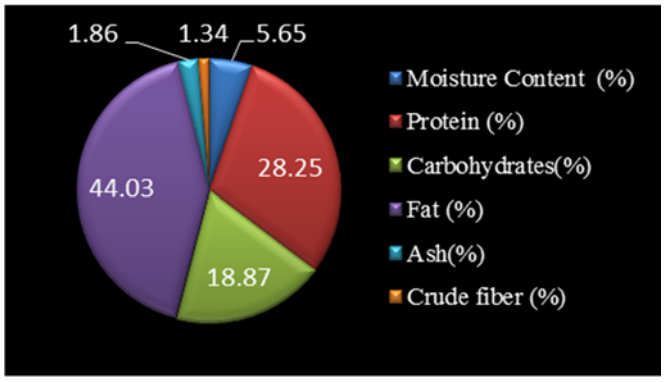

Fig 2: Effect of proximate composition of peanut milk powder soaking in 1% $NaHCO_3$ method

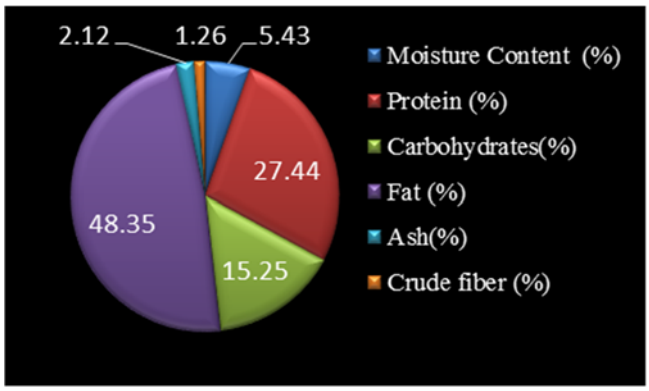

Fig 3: Effect of proximate composition of peanut milk powder in roasting method

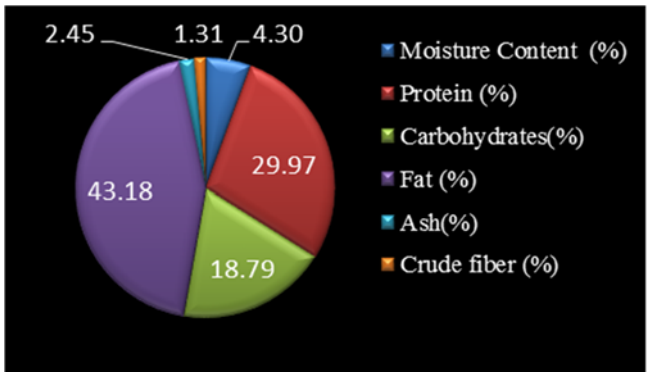

Fig 4: Effect of proximate composition of peanut milk powder in pressure blanching for 3 minutes method

4. Conclusions

Based on the observations from different methods, it was concluded that the pressure blanching of peanut had a significant effect in improving the acceptability of the peanut milk powder on the basis of proximate analysis. Among four methods of peanut milk powder preparation i.e. normal soaking, soaking in 1% sodium bicarbonate, roasting and pressure blanching (121 °C,15 psi for 3 min), the pressure blanching was found most suitable. It also reduces the time of soaking i.e. 6 h as compared to 18 h in other methods.

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