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Extraction of protein from de-oiled ground nut cake for the preparation of edible film for food packing

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Abstract
Groundnut is a rich source of protein with biological value and highly desirable both in raw and roasted form. Peanuts after oil extraction gives a lot of meal called as deoiled peanut cake which contains 50-55% of high-quality protein. The extraction of protein powder from de oiled peanut flour is necessary to provide the food industries with new high protein food ingredient for various food product formulations. The protein from the de-oiled peanut oil cake was extracted by alkaline extraction at room temperature by using pH from 4 to 9.5. The amount of protein obtained from 150 µm and 250 µm sized de-oiled flour were 58% and 85%. Protein film solution at different concentrations of 0.5 g CMC and 1.5 g CMC was prepared and edible films for food packing were prepared.

Keywords: Peanuts, deoiled peanut cake, protein powder, Extraction

Introduction
The botanical name of groundnut is *Arachis hypogea* Linn., is derived from two Greek words, *Arachis* meaning a legume and *hypogae* meaning below ground. Peanut oil-cake is an alternative source of protein that can be used for human consumption or animal nutrition. Peanuts are characterized by high oil and protein content and by low percentage of carbohydrates and ash. Peanut seed contains approximately 47-52% oil and 25-30% protein.
An edible film is defined as a thin layer of edible material applied on a food as a protein or placed on or between food components. Its function is to offer a selective barrier to retard migration of moisture, retard gas (O_2, CO_2), retard oil and fat migration, improve mechanical handling properties of foods. Edible films can be formed as food coatings and free-standing films and have the potential to be used with food as gas aroma barrier. The main advantage of edible films over traditional synthetics is that they can be consumed with the packaged products. There is no package to dispose even if the films are not consumed they could still contribute to the reduction of environmental pollution. Edible films can be produced from the materials with the film forming ability.

Materials and Methods
De-oiled peanut cake of good quality was purchased from local oil mill at Madakasira.

Preparation of de oiled flour
De-oiled peanut cake was dried at 50 °C for 24 hours in hot air oven to remove the surface moisture. Dried cake was grounded to powder by using mixer grinder. Powder was divided into different fractions based on particle size by using gyratory sieve shaker. Powder obtained from underflow of 150 µm and 250 µm size sieves was collected and used for further analysis.

Extraction of protein concentrate from de-oiled peanut flour
The protein from the de-oiled peanut oil cake obtained by alkaline extraction at room temperature by using different pH from 4 to 10. 4 samples of each 10 grams mixed with distilled water @ 1:20 W/V and adjusted pH (9 to 10) with 1 N NaOH. The mixture was stirred at 1200 rpm for 1 h at 30°C and subsequently centrifuged at 3000 rpm for 20 min to remove the insoluble residues. The supernatant was collected, the pH was adjusted to 4.5 with 1N HCl to precipitate the proteins.

The precipitate was creamy white in colour. Further, it was centrifuged at 5000 rpm for 15 min to recover the proteins and repeated washings (2 to 3 times) repeatedly with distilled water to free it from acid tinge. Finally, the proteins were air dried at 40 ºC for overnight in hot air oven (Ankit *et al.*, 2015 and Shafiquer *et al.*, 2018) [2, 7].

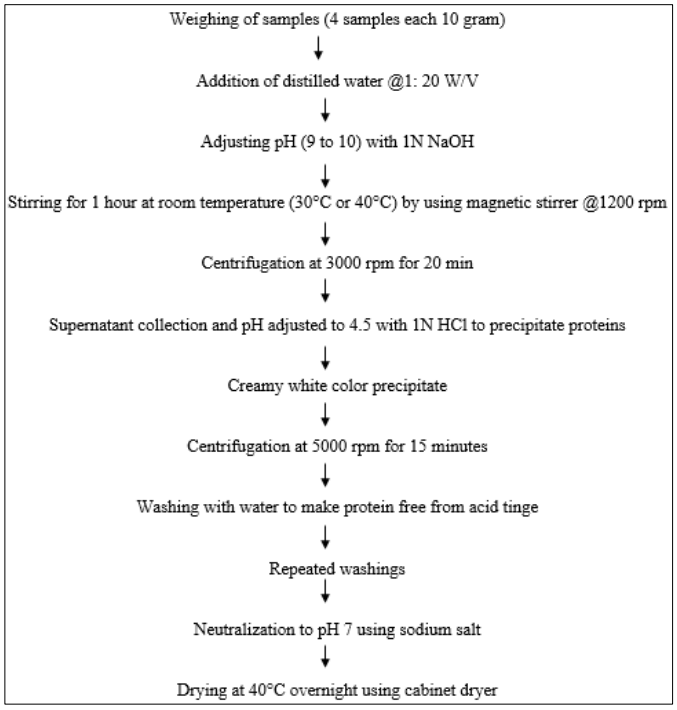

Fig 1: Process flowchart of Protein extraction

Preparation of film solution

Peanut protein concentrate was dissolved in distilled water, then glycerol as a plasticizer was added at concentration of 30% w/w of PPC quantity. The obtained solutions were homogenized at 3000 rpm for 5 minutes using an homogenizer and filtered through cheese cloth to insoluble matters. The pH value of the prepared solution was adjusted to 8-10 with 1 N NaOH before heating to 80-85°C in 20 minutes on hot plate with stirring. After filtration through stainless steel screen to remove any small lumps, the solutions were poured onto 20×20 cm^2 glass plates resting on levelled granite surface, then left for 20 hours at ambient temperature for drying as shown in Fig. 2. (Alabi and Falade *et al.*, 2017; Emad Soliman *et al.* 2007 and Chang and Michael 2013) [1, 6, 5].

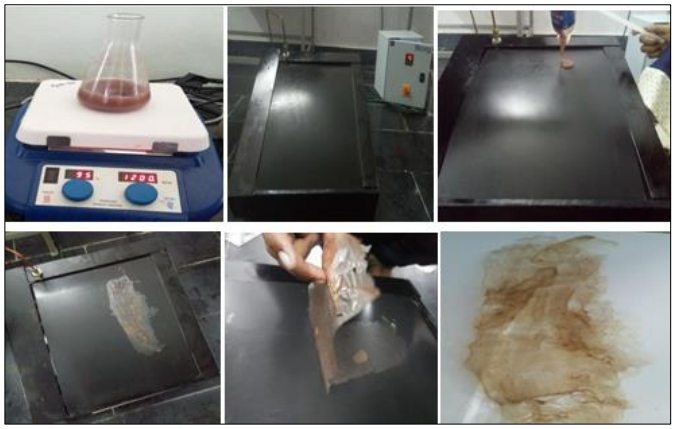

Plate 1: Preparation of edible film on electrical operated machine

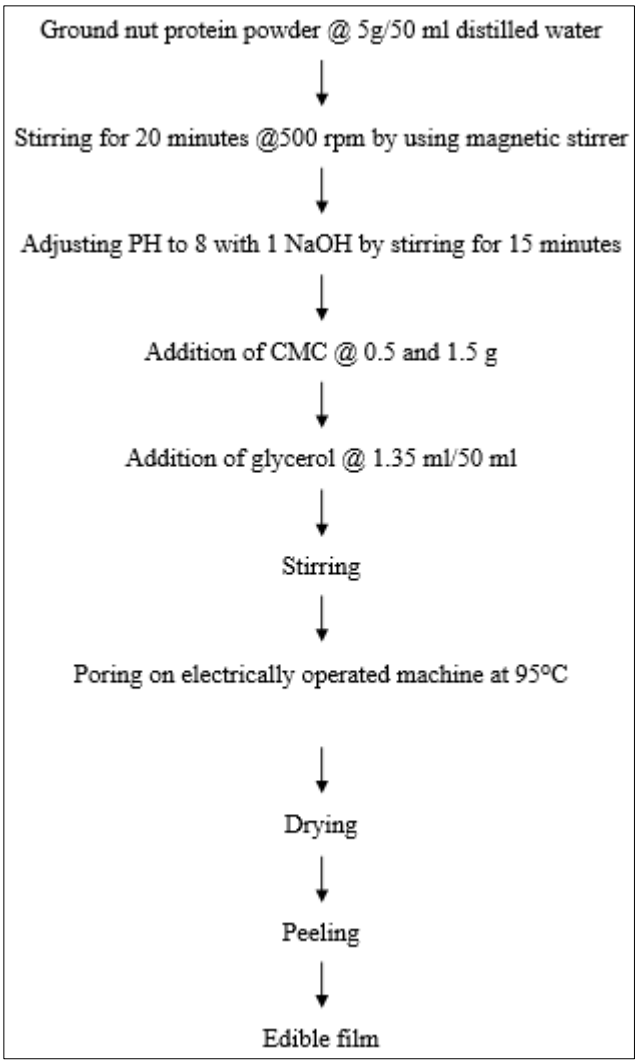

Fig 2: Flow chart for preparation of Edible Film

Results and Discussion

Extraction of peanut protein concentrate

Peanut protein concentrate was extracted from the peanut de-oiled flour of size 150 µm and 250 µm of four samples each. The extracted peanut protein concentrate is presented in Fig. 3 and 4.

Peanut protein concentrate was extracted from the de-oiled flour of size 150 µm four samples are 5.845 g, 5.850 g, 5.834 g, 5.823 g is presented in Fig.3. Peanut protein concentrate was extracted from the peanut de-oiled flour of size 250 µm four samples are 8.596g, 8.610g, 8.542 g, 8.578 g is shown in Fig. 4. These results are on par with Chakraborty, (1986) [4].

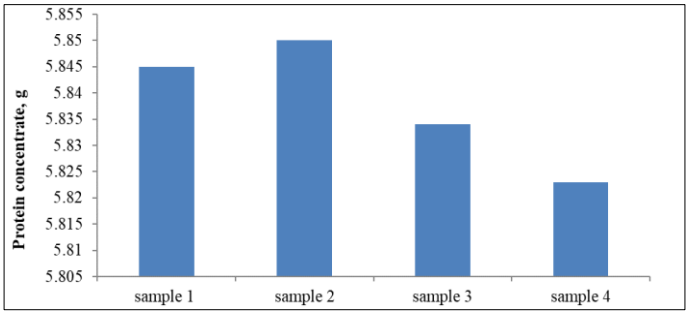

Fig 3: Comparison of protein concentrate weights of different samples of 150 µm flour

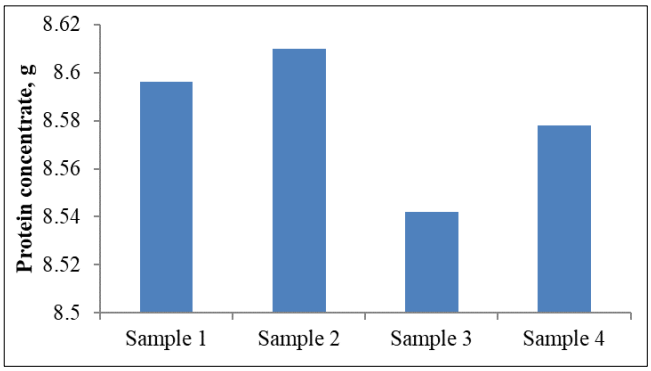

Fig 4: Comparison of protein concentrate weights of different samples of 250 µm flour

Preparation of edible film

The edible film is prepared on the electrical operated machine, the drying time and peeling time of the film at 100 °C, 95 °C and 85 °C is shown in the Table 1. At temperature 100 °C the drying time and peeling time took less time whereas it took maximum time at 85 °C. These results are on par with Bourtoom, (2008) [3].

Table 1: Drying and peeling times of film on hot plate at different temperatures

Temperature (°C)	Drying time(min)	Peeling time(min)
100	1.5	0.8
95	2	1
85	2.3	1.25

Thickness of Edible Film

The thickness of the edible film varies from 0.5 CMC to 1.5 CMC. Thickness of 1.5 CMC film found maximum i.e., 0.078 whereas it was less in the 0.5 CMC film.

Conclusion

The protein from the de-oiled peanut oil cake was obtained by alkaline extraction at room temperature by using pH in the range of 4.5 to 9. The amount of protein obtained from 150 µm and 250 µm sized de-oiled flour were 58% and 85%.

Two protein film solutions were prepared by using glycerol, distilled water and different composition of CMC (0.5g, 1.5g). Edible film was prepared by using hot plate at different temperatures 1000C, 950C and 850C. The drying time is 90s, 120s and 138s respectively. The peeling time is 48s, 60s and 75s respectively. It can be used for packing food products.

Acknowledgments

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