ORIGINAL ARTICLE

Nutritional and Functional Characterization of Peanut Okara (Defatted Peanut) Flour Cookies

Trushal Dharsenda¹, Mukesh Dabhi¹, M. Jethva¹ and M. Kapopara²

¹Department of Processing and Food Engineering, College of Agricultural Engineering and Technology, ²Bakery School, Junagadh Agricultural University, Junagadh-362001, Gujarat, India.

Abstract

*Corresponding Author:

Mukesh Dabhi

Email: mndabhi@hau.in

Received: 03/12/2015

Revised: 24/12/2015

Accepted: 29/12/2015

Peanut is the most important oil seed in the world, and rapidly becoming a valuable source of plant protein. The oil can be removed from peanut, the protein could be concentrated from residual cakes and this cake was known as peanut okara. Peanut okara was used for the preparation of nutritional protein rich cookies. In this study the mixing ratios of refined wheat flour and peanut okara flour were 100:00 (Control), 90:10 (Treatment T1), 80:20 (Treatment T2), 70:30 (Treatment T3), 60:40 (Treatment T4), 50:50 (Treatment T5) respectively. The nutritional characteristics in terms of moisture content, protein, total ash, fat content and carbohydrates of cookies were increase with increases peanut okara flour with refined wheat flour. The functional properties i.e. Water Absorption Index and Water Solubility Index of cookies were increase with increases proportion of peanut okara flour. Cookies versatility, long shelf life, availability in numerous shapes and sizes, high digestibility, good nutrition, and relatively low cost are attractive to the consumer.

Keywords: Cookies, Nutritional Characteristics, Functional Characteristics, Peanut Okara, Defatted Peanut.

1. Introduction

Food crops have occupied an important place in human nutrition as they remain the major sources of proteins for a large proportion of the world population, particularly, in the developing countries (Singh and Singh, 1991a). Protein malnutrition is a serious problem in India due to cereal based dietary pattern. Therefore, various preparations based on cereal-pulse combination are of paramount importance to improve the protein quality of Indian diet. Peanut is a species in the legume family Fabaceae, native to South America, Mexico and Central America (Gibbon and Pain, 1985). Groundnuts have been known to man as an important food crop for many centuries. The groundnut is a main crop in Saurastra region in Gujarat. The groundnut (Arachis hypogaea L.) is one of the cheapest sources of protein. Peanut are probably the most important oilbearing seed in the world, and rapidly becoming a valuable source of plant protein. The basic composition of peanut per 100g of nuts is Water 1.55g, Carbohydrates 21.51g, Fiber 8.0g, Lipids (Fats) 49.66 g, Proteins 23.68g, Energy (Total Calories) 244kJ (585 kcal), Vitamines (0.77g) and Minerals (0.018g) (Settaluri et al., 2012). Most of the peanut utilised domestically appear in the retail market places are raw

nuts, salted nuts, roasted nuts etc. Oil extracted from peanut is not only more stable but also contains high oleic/linoleic acid. Nutritionally, high linoleic acid is desirable as it is an essential fatty acid and produces a hypocholesterolemic effects. Generally, the peanut oil contains around 10 percent palmitic acid and a total of around 80 percent of oleic and linoleic acids. These three fatty acids accounts for approximately 90 percent of the total fatty acids content in the peanut oil. Groundnut contains fat and protein which helps to prepare protein rich cookies. Cookies are ideal for nutrient availability, palatability, compactness and convenience. They differ from other bakery products like bread and cakes because of having low moisture content, comparatively free from microbial spoilage and long shelf life of the product.

Previous research has shown that peanut seeds are a potential source of food-grade protein for the fortification of food products. Such protein could be concentrated from residual cakes and flours through industrially applicable techniques (Kim *et al.*, 1992; Quinn and Beuchat, 1975; Rhee *et al.*, 1973; Yadav *et al.*, 2012). The amino acid profile of peanut residual flours showed that it could be an ingredient for protein fortification (Yu and Goktepe, 2007). Peanut protein

concentrates were obtained using raw un-roasted, fermented and unfermented peanut flours (Yu and Goktepe, 2007). These authors obtained peanut protein concentrates with 85% protein versus 50% protein in the defatted peanut flour. Partially defatted peanut flour is an inexpensive and underutilized by-product from the peanut oil industry which is rich in protein and offers the same health and dietary benefits of peanuts but with less fat. The concentration of proteins from this material could increase its value; and it could become a source of new protein with applications in different industries and processes. The basic composition of peanut okara (defatted peanut) flour per 100g is Moisture 7.8g, Carbohydrates 34.70g, Fiber 14-16g, Lipids (Fats) 0.55-5g, Proteins 25-28g and Ash 1.4g (USDA Nutrient Database, Journal of Food Research, 2014). Therefore, the objective of this study was to find out the best recipes for the preparation of protein rich cookies from peanut okara (defatted peanut) flour.

2. Materials and Methods

2.1 Materials

Refined wheat flour (maida), vanaspati ghee, sugar was purchased from the local market, Junagadh, and peanut okara flour was purchased from the Nutrinity Foundation, GIDC, Junagadh.

2.1.1 Preparation of Cookies

Process flow chart of cookies is given below,

Mixing the flour

Place in baking tray (1cm apart)

Baking (temperature is 160°C, time is 15 to 20 min.)

Cooling

Storage in glass jar (At ambient temperature)

2.1.2 Nutritional Properties

The nutritional properties i.e. moisture content (by gravimetric method), protein content (Sadasivam and Manikam, 1992), total ash content (AOAC, 1995), fat content and carbohydrates (Sadasivam and Manikam, 1992) of cookies were determined.

2.2 Methods

Moisture content of cookies product was measured by the hot air oven (Scientronic Instruments, New Delhi) method. The 2gm ground and well mixed sample was kept at 100° C for 24 hour in hot air oven and loss in weight was taken as moisture content of product.

Micro-Kjeldahl method (Sadasivam and Manikam, 1992) was used for protein determination. The percentage of protein and percentage of nitrogen was calculated by the following formula:

Nitrogen
$$g'_{kg} = \frac{[ml \text{ standard - ml blank}] \times \text{Normality} \times 14.01}{\text{Weight of the sample}}$$

% Nitrogen = $\frac{[ml \text{ standard } - ml \text{ blank }] \times \text{Normality } \times 14.01}{\text{Weight of the sample } \times 10}$

% Protein = % N x 6.25

The total ash content measured as, 5g of the ground sample was weighed into a silica dish. The material was kept at 550°C for 4h in a muffle furnace (Meta Instruments, Mumbai). The dish was cooled and weighed (AOAC, 1995). The total ash content was calculated by difference in weights and was expressed as percent.

% Total Ash =
$$\frac{\text{Weight of ash}}{\text{Weight of the sample}} \times 100$$

The fat is extracted by using Soxhlet apparatus (EIE Instruments Pvt. Ltd., Ahmedabad). The fat content of the cookies products was determined as per the method given by (Sadasivam and Manikam, 1992). The fat was calculated by the following formula,

% Fat =
$$\frac{(\text{Weight of flask} + \text{oil}) - (\text{Weight of flask})}{(\text{Weight of the sample})} \times 100$$

The carbohydrates are the major sources of energy and play key role in many biochemical processes including energy generation. The carbohydrates was calculated by the following formula,

Carbohydrate, %
=
$$\frac{\text{Sample reading X Glucose equivalent } \left(\frac{\mu g}{\text{OD}}\right) \text{X Volume made up}}{\text{Weight of pulp } (g) \text{X Aliquot taken (ml)}} \text{X 100}$$

2.2.1 Functional Properties

The functional properties i.e. Water Absorption Index (WAI) and Water Solubility Index (WSI) of

cookies were determined by (Andersonb *et al.*, 1969). 4-5g sample was suspended in 30ml of distilled water in a tarred 60ml centrifuge tube. The slurry was stirred with a glass rod for 1 min at room temperature $(25^{\circ}C)$ and centrifuged (3000rpm, for 10 min) in centrifuge (Electrocraft India Pvt. Ltd., Mumbai). The supernatant was eliminated. Thereafter, WAI was calculated from the weight of the remaining gel and expressed as g gel/g dry flour.

% WAI =
$$\frac{\text{Weight of sediment}}{\text{Weight of dry solid powder}} \times 100$$

The cookies were first milled to a particle size of approximately 180-250µm. A 2.5g sample was dispersed in 25ml of distilled water. A glass rod was used to break up any lumps. After stirring for 30 min, the dispersions were rinsed into tarred centrifuge tubes and made up to 32.5g followed by centrifuged at 3000 rpm for 10 min. The supernatant was decanted for determination of its solids content and the sediment was weighed. WSI was calculated by the equation,

% WSI =
$$\frac{\text{Weight of dissolve solids in supernatan t}}{\text{Weight of dry solid powder}} \times 100$$

2.2.2 Statistical Analysis

Data were analyzed by completely randomise design.

3. Results and Discussion

3.1 Nutritional Properties

From Table 1 it was observed that there was increase in moisture content while increasing peanut okara flour in the treatments T1 to T5 with substitution of peanut okara flour, moisture content in cookies were at par. Water holding capacity was increased significantly with increase in proportion of peanut okara. This may be due to moisture content of peanut okara was less as compared to refined wheat flour. In the experimental cookies the highest moisture content in T5 (1.79%) and lowest in T1 (1.37%) treatment.

The protein content was found in significantly higher than control cookies (Table 1). This may be due to protein solubility was less in peanut okara. The cookies of treatment T5 had the highest protein content of 9.15%. The protein content was observed to increase with progressive increase in proportion of peanut okara flour, similar trend was also found by (Beuchat, 1977) during an experiment of substitution of peanut flour with wheat flour for preparation of cookies. Peanut proteins undergo changes due to heating. Ory *et al.* (1970) summarized the effects of dry roasting of peanut (145°C for 60 min) and found that solubility of proteins was reduced by about 50%. For addition of pulse product (mung bean flour) in refined wheat flour, there was increase in protein in cookies (Pasha *et al.*, 2011) whereas addition of cereal product (maize flour) there was decrease in protein (Mishra *et al.*, 2012). The ash content was observed 0.98 to 0.99% during all the treatment with the increase in proportion of peanut okara flour in the refined wheat flour (Table 1). This indicates that the addition of peanut okara flour has not significant effect on mineral contents of the cookies. Inversely, Mishra *et al.* (2012) reported increase in ash content with increase in maize flour in cookies.

The fat content of cookies in treatment T5 observed significantly highest 37.67%. The fat content was observed increase with the increase in proportion of peanut okara flour with the refined wheat flour (Table 1). Similar results were observed in the study of Pasha et al. (2011) that indicate increase in fat content of cookies after supplementation of mung bean flour, but Mishra et al. (2012) found that the increase in maize flour level in cookies, there was decrease in fat content. Chapplwar et al. (2013) were also found that oat and finger millet flour addition significantly improved the fat content of cookies. Timbadiya (2013) found that the maida did not contain significant amount of fat to contribute desirable fatty acid in the cookies, whereas; peanut butter contained noticeable amount of peanut protein and desirable fatty acid (MUFA + PUFA) even though the result revealed that the total fat content gradually decreased with increase in the proportion of peanut butter in experimental cookies.

The carbohydrates of cookies in treatment T5 had the significantly highest 46.47% and in the treatment T1 lowest carbohydrates 42.33% (p<0.05) observed. The carbohydrate was observed to increase with the increase in proportion of peanut okara flour in the refined wheat flour (Table 1). Mishra et al. (2012) support with the increase in maize flour level in cookies, there was increase in carbohydrate content. The CHO content was higher in peanut okara cookies than control cookies. The carbohydrates of cookies prepared with 10% and 20%, 30% and 40% as well as 40% and 50% substitution of peanut flour were at par. Yadav et al. (2012) reported utilization of de-oiled peanut meal flour in biscuits resulted decrease in carbohydrates level while increase in ash, moisture content, crude fat and protein level.

3.2 Functional Properties

3.2.1 Water Absorption Index (WAI)

Hydration or rehydration is the first and perhaps most critical step in imparting desirable functional properties to proteins in a food system. Interactions of -

Table 1: Proximate composition of nutritional analysis of cookies prepared with different ratio of refined wheat flour and peanut okara flour.

Sample code	MC,% (w.b.)	Protein,%	Ash,%	Fat,%	CHO,%
Control	1.1	8.03	1.00	31.07	31.10
T1	1.37 ^a	8.77	0.98	36.54	42.33 ^a
T2	1.47^{a}	8.82	0.98	36.62	42.93 ^a
T3	1.68 ^b	8.92	0.98	37.28	44.88 ^b
T4	1.73 ^b	9.10	0.99	37.53	45.70 ^{bc}
T5	1.79 ^b	9.15	0.99	37.67	46.47 ^c
S Em±	0.05	0.13	0.01	0.53	0.44
CD at 5%	0.15	NS	NS	NS	1.34
CV%	6.38	3.00	1.27	2.84	1.99

In the treatment ^a, ^{ab}....i.e. same letter shows that treatment was at par, NS- Non significant

water and oil with flours are very important in food systems because of their effects on the flavor and texture of foods. Intrinsic factors affecting water binding properties of food flours with relatively high protein contents include amino acid composition, protein conformation and surface polarity/hydrophobicity (Barbut, 1999). Result shows that the maximum water absorption index was 131.51 %, found in treatment T5, while minimum 130.66% in treatment T1. From the result it was observed that the WAI increases as the percentage of peanut okara flour in refined wheat flour increases, which may be due to the increase in protein content. Similar results were found by Abdel et al. (2011) for Bambara groundnut (Vigna subterranean). This may be due to the higher polar amino acid residues of proteins having an affinity for water molecules (Yusuf et al., 2008). The major chemical compositions that enhance the water absorption capacity of flours are proteins and carbohydrates, since these constituents contain hydrophilic parts, such as polar or charged side chains (Lawal and Adebowale, 2004). Mishra et al. (2012) were found that the Soya bean flour 20% increase in water absorption capacity (WAC), probably due to the higher protein content of Soya bean.

Table 2: Water absorption index of cookies prepared with different ratio of refined wheat flour and peanut okara flour.

Sample code	WAI (%)
Control	145.03
T1	130.66
T2	130.75
Т3	131.00
T4	131.39
T5	131.51
S Em±	0.28
CD at 5%	NS
CV%	0.37

NS- Non significant

3.2.2 Water Solubility Index (WSI)

The water solubility index commonly used to measure the amount of starch (and other soluble components). The results on WSI measurement of cookies is presented in Table 3. The results were similar to those of for WAI. Mixing with more peanut okara flour contain more protein particles than other mixing, whose solubility is good as compared to starch particles present in peanut okara flour. The results reflect that the WSI increases as the percentage of peanut okara flour in refined wheat flour increases, which may be due to increase in protein content in the ratios.

Table 3: Water solubility index of cookies prepared with different ratio of refined wheat flour and peanut okara flour.

Sample code	WSI (%)		
Control	45.03		
OT1	30.66		
OT2	30.75		
OT3	31.00		
OT4	31.39		
OT5	31.51		
S Em±	0.28		
CD at 5%	NS		
CV%	1.55		

NS- Non significant

4. Conclusion

The data obtained in this study showed that the varietals differences of peanut okara have no significant effect on functional properties of cookies. The high protein content of cookies indicated that they could be a valuable protein supplement for cereals based food products. Moreover, high water absorption capacities as desirable characteristics so, their effects on the flavor and texture of foods. The good textured

properties observed in cookies. This kind of protein concentrate could be a potential source of vegetal

proteins with applications in different industries and processes.

References

- AACC (1995). Approved methods of the AACC. American association of cereal chemists. *St. Paul, MN, USA*.
- Abdel RS, Eltayeb M, Ali O, Azza A, Abou-Arab and Ferial M Abu-Salem (2011). Chemical composition and functional properties of flour and protein isolate extracted from Bambara groundnut (*Vigna* subterranean). African Journal of Food Science, 5(2): 82-90.
- Anderson RA, Conway HF, Pfeifer VF and Griffin EL (1969). Gelatinization of corn grits by roll and extrusion cooking. *Cereal Science Today*, 14: 4-6.
- Barbut S (1999). Determining water and fat holding. In G. M. Hall (Ed.), Methods of testing protein functionality, New York: *Blackie Academic and Professional*, 186-225.
- Beuchat LR (1977). Modification of cookie-baking properties of peanut flour by enzymatic and chemical hydrolysis. *Cereal Chemistry*, 54(3): 405-414.
- Chappalwar VM, Dayanand Peter, Bobde H and John Steffi M (2013). Quality characteristics of cookies prepared from oats and finger millet based composite flour. *IRACST-Engineering Science and Technology: An International Journal (ESTIJ), ISSN: 2250-3498*, 3(4): 677-683.
- Gibbon D and Pain A (1985). Crops of the drier region of the tropics. *Longman group Ltd UK*, 146.
- Kim N, Kim YJ and Nam YJ (1992). Characteristics and functional properties of protein isolates from various peanut (*Arachis hypogaea* L.) cultivars. *Journal of Food Science*, 57: 406-410.
- Lawal OS and Adebowale KO (2004). Effect of acetylation and succinylation on solubility profile, water absorption capacity, oil absorption capacity and emulsifying properties of muncuna bean (*Mucuna pruiens*) protein concentrate. *Nahrung/Food*, 48(2): 129-136.
- Mishra V, Puranik V, Akhtar N and Rai GK (2012). Development and compositional analysis of protien rich soya bean-maize flour blended cookies. *Journal of Food Processing and Technology*, 3(9): 182.
- Ory RL, Neurcere NJ, Singh R and St Angelo AJ (1970). Stability of peanut proteins to heat and organic

solvents. Journal of American Peanut Research and Education Associations, 2: 119-128.

- Pasha I, Rashid S, Muhammad A, Sultan MT, Qayyum MN and Saeed F (2011). Quality evaluation of wheat-mung bean flour blends and their utilization in baked products. *Pakistan Journal of Nutrition*, 10(4): 388-392.
- Quinn MR and Beuchat LR (1975). Functional property changes resulting from fungal fermentation of peanut flour. *Journal of Food Science*, 40: 475-479.
- Rhee KC, Cater CM and Mattil KF (1972). Simultaneous recovery of protein and oil from raw peanuts in an aquous system. *Journal of Food Science*, 37: 90-93.
- Rhee KC, Cater CM and Mattil KF (1973). Effects of processing pH on the properties of peanut protein isolates and oil. *Cereal Chemistry*, 50: 395-404.
- Sadasivam S and Manikam A (1992). Biochemical methods of agricultural science. *Wiley Eastern Ltd., New Delhi.*
- Settaluri VS, Kandala CVK, Puppala N and Sundaram J (2012). Peanuts and Their Nutritional Aspects-A Review. Food and Nutrition Sciences, 3: 1644-1650.
- Singh B and Singh U (1991a). Peanut as a source of protein for human foods. *Plant Foods for Human Nutrition*, 41: 165-177.
- Timbadiya P (2013). Application of peanut butter to improve the nutritional quality of cookies. *M.Sc. Thesis* (*Unpublished*). *College of Agricultural, JAU*, *Junagadh*.
- Yadav DN, N Thakur and KV Sunooj (2012). Effect of partially de-oiled peanut meal flour (DPMF) on the nutritional, textural, organoleptic and physic-chemical properties of biscuits. *Food and Nutrition Sciences*, 3: 471-476.
- Yu J, Aahmedna M and Goktepe I (2007). Peanut protein concentrates: Production and functional properties as affected by processing. *Food Chemistry*, 103: 121-129.
- Yusuf AA, Ayedun H and Sanni LO (2008). Chemical composition and functional properties of raw and roasted Nigerian benni seed (*Sesamum indicum*) and Bambara groundnut ((*Vigna subterranean*). Food Chemistry, 111: 277-282.