Peanut butter incorporation to improve nutritional composition of biscuits

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ABSTRACT : Biscuits prepared with different levels of hydrogenated fat (vanaspati) and peanut (*Arachis hypogaea* L.) butter (PB) *i.e.* (50:00, 40:10, 30:20, 25:25) were evaluated for their physico-chemical properties. Protein content was minimum in biscuits (20% PB), which increased with increasing proportion of PB in the biscuits. Fat content showed a decreasing trend upon increasing proportion of PB and was lowest in biscuits (50% PB). Overall sensory parameters of biscuits improved when 50% vanaspati replaced by PB in the standard biscuits recipe. Biscuits prepared with 50% incorporation of PB had better composition of protein and fat with balanced oil quality and also had a greater overall acceptability.

Key Words : Biscuit preparation, peanut (*Arachis hypogaea* L.) butter (PB), vanaspati, sensory evaluation.

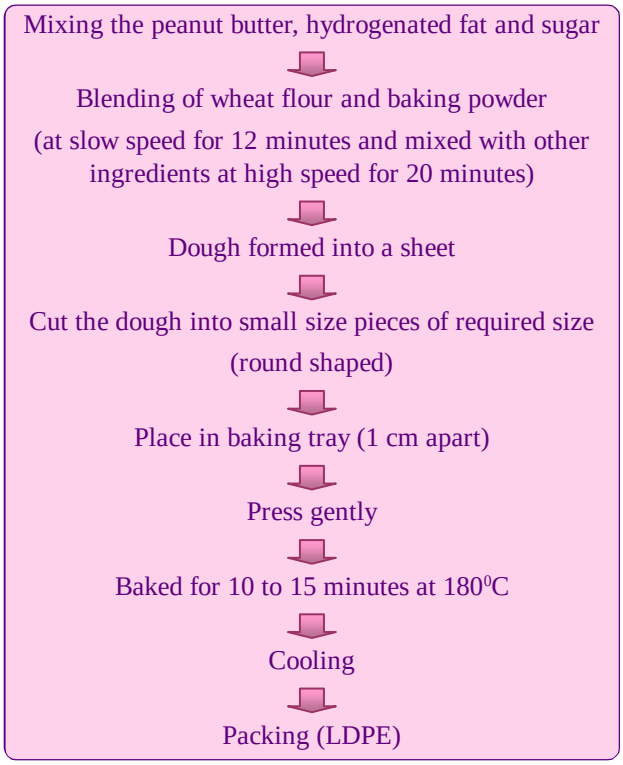
The term biscuit was derived from the Latin word biscoctus, meaning twice cooked (Macrace *et al*., 1993). Biscuits are popular foodstuff, consumed by a large number of people today, due to their pleasant taste, prolonged shelf life and easy availability at fairly low cost (Gandhi *et al*., 2001). Fat is necessary part of diet and it imparts flavor, texture and appearance of the baked product (Pyler, 1988). On the other hand, excess intake of fat in diet may lead to higher risk of diseases like obesity, coronary heart disease and cancer (Akoh, 1998). As biscuits generally have higher fat content, it becomes difficult to prepare biscuits by reducing fat contents in their formulation to lower the risk of such diseases. To reduce the quantity of fat in bakery products fat replacers like peanut butter are used (Sanchez *et al*., 1995). Peanut is an important legume which has attracted researchers in recent times (Azeket *et al*., 2005), food having peanut are highly accepted by consumers because of their divine flavour. Peanut butter is a dispersion of peanut oil in peanut solids which results, when roasted peanuts are ground. Peanut butter is a good source of protein and fiber, and low in fat. It is continually applied for the preparation of low calorie improved food products (Woodroof, 1983). The confectionery formulations contain vanaspati (hydrogenated fat), which lowers the nutritional value due to presence of large amount of saturated fatty acids. The biscuits can be used as a source of desirable and essential fatty acid supplementation by utilizing part of peanut butter in place of vanaspati. Keeping in view all the above facts this research was designed to cut down the amount of fat in biscuits by reducing saturated fats with the peanut butter. Moreover, effect of incorporation of peanut butter on physicochemical and sensory quality was also investigated.

Materials and Methods

Refined wheat flour, sugar, hydrogenated fat (vanaspati), peanut (*Arachis hypogaea* L.) butter (PB), eggs and baking powder were procured from local market of Allahabad and experiment was conducted in the Department of Food Process Engineering, Vaugh School of Agricultural Engineering and Technology (SHUATS), Allahabad (Uttar Pradesh) India.

Biscuits preparation

The biscuits were prepared as per standard recipe



(AACC, 2000) the process flow chart of biscuits is given.

The treatment plan used in the preparation of biscuits is given in Table 1.

Table-1: Treatment plan: Hydrogenated fat (vanaspati) to peanut butter ratio in standard recipe of biscuits.

Treatment	Hydrogenated fat (vanaspati) : Peanut butter
T_0	50 : 00 (100% Vanaspati)
T_1	40 : 10
T_2	30 : 20
T_3	25 : 25

Chemical analysis (Nutritional Properties)

The proximate analysis *i.e.* moisture , protein, crude fat and ash contents of biscuits were determined as per (AACC, 2000).

Moisture content of biscuits was measured by the hot air oven (Scientronic Instruments, New Delhi) method. 5g of the sample which has been thoroughly grounded and uniformly mixed was weighed in the dry dish. After removing the lid of the dish it was heated in an oven at 130°C for 2 hour. After 2 hours the dish was removed from desiccator and allowed to cool and weighed. Again the dish was kept in the oven for another 1 hour and was cooled and weighed again. The process was repeated until change in weight between two successive observations could not exceed 1 mg. The difference in weight was determined for the determination of the moisture per cent by using following formula:

$$\text{Moisture \%} = \frac{W_1 - W_2}{W} \times 100$$

Where, W1 = Weight in g of the dish with the material before drying,

W2 = Weight in g of the dish with the material after drying and

W = Weight in g of the sample taken

The protein content was determined from the organic Nitrogen content by Kjeldahl method. The percentage of Protein was calculated by the following formula:

$$\text{Nitrogen \%} = \frac{\begin{array}{c}(\text{Sample titre} - \text{Blank titre}) \times \\ \text{Normality of HCL} \times 14 \times \\ \text{Volume made up of the digest}\end{array}}{\begin{array}{c}(\text{Aliquot of the digest taken} \times \\ \text{Wt. of the sample taken} \times 1000)\end{array}} \times 100$$

$$\text{\% Protein} = \text{\% N x } 6.25$$

The ash content was measured using muffle furnace. 5g of the ground sample was weighed into a silica dish. The material was kept at 550°C for 4 hours in a muffle furnace (Meta Instruments, Mumbai). The dish was cooled and weighed. The process was repeated till constant weight was obtained. The total ash content was calculated by difference in weights and was expressed as per cent.

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

The crude fat is extracted by using Soxhlet apparatus (EIE Instruments Pvt. Ltd., Ahmedabad). The fat was calculated by the following formula:

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

Sensory evaluation

The samples were subjected to sensory evaluation to determine consumer preferences for colour, taste, aroma, flavour and overall acceptability by the method described by (Ranganna, 2008). A panel of 9 judges was involved in the sensory evaluation exercise. The samples were offered in coded in identical transparent polyethylene bags and were tested individually. The order of presentation of samples was completely randomized. The panelists rinsed their mouth thoroughly with water after testing each sample and waited for a minute before proceeding to test the next sample. The sensory evaluation was based on a 9-point hedonic scale, where (9) represented “like very much” and (1) is “disliked very much”.

Statistical analysis

The analytical data of samples with equal number of replications (nos.3) for individual parameters were subjected to analysis of variance of completely randomised design (CRD) following the procedure described by (IASRI, 2011).

Table-2 : Mean values of chemical constituents of biscuits.

Treatment	Fat content (%)	Protein content (%)	Moisture content (%)	Ash content (%)
T_0	21.10a	9.77b	3.12ab	1.82d
T_1	18.50b	8.12d	3.30a	2.41a
T_2	17.36c	8.29c	2.94c	2.21b
T_3	16.20d	10.54a	2.80d	1.89c
CV (%)	2.98	11.04	6.18	11.50

Table-3: Effect of hydrogenated fat (vanaspati) substitution with peanut butter on sensory parameters.

Treatment	Colour	Taste	Aroma	Flavour	OAA
T_0	8.60a	8.00c	8.00b	8.20b	8.20b
T_1	6.70d	7.70d	7.20d	7.60d	7.20c
T_2	8.20c	8.10b	7.60c	8.00bc	7.00d
T_3	8.40b	8.20a	8.20a	8.60a	8.40a
CV (%)	9.39	2.33	4.95	4.45	7.89

Results and Discussion

Effect of peanut butter incorporation on physico-chemical properties of biscuits

Fat content : Fat content was higher (21.10%) in treatment T_0 (50: 00) which gradually decreased with increasing proportion of PB, which was statistically different ($\leq$ 0.05) from other treatments (Table-2). The lowest fat content (16.20%) was found in treatment T_3 (25:25) in which 50% quantity of vanaspati was replaced by PB. This was due to the high content of SFA in vanaspati and low content in PB. These findings are in accordance with the findings of (Wekwete and Navder, 2009), who observed that peanut butter, had lower fat content than hydrogenated vegetable shortening. Hence, with increasing levels of peanut butter as a substitute for hydrogenated vegetable shortening the fat content of biscuit decreased, which is good for health.

Protein content : Protein content gradually increased with increasing levels of peanut butter in biscuits (Table-2). The highest protein (10.54%) was observed in T_3 which was statistically higher than other treatments. Lowest protein content (8.12%) was recorded in treatment T_1 (40:10). (Banureka and Mehendran, 2009) reported that pulses and nuts have high amount of protein, when these protein rich sources are added to biscuits they add protein to it.

Moisture and Ash content : There was a change in moisture and ash content in biscuits with the incorporation of peanut butter (Table-2). The highest moisture and ash content (3.30 and 2.41%, respectively) were recorded in treatment T_1, which was statistically different with all the other treatments and showed a decreased trend among the treatments, but, on an average the content of both was higher than the control treatment. The increase in moisture content might be attributed to higher amount of fiber in peanut butter and fiber has strong affinity for water and products containing fiber. (Yadav *et al*., 2012) also reported that with the addition of partially de-oiled peanut meal flour ash content of biscuits increased slightly.

Effect of peanut butter incorporation on organoleptic characteristics of biscuits

Significant (P = 0.05) variations were found among biscuits prepared with different levels of peanut butter with respect to their color, taste, aroma, flavour and overall acceptability.

Color : The results showed that the biscuits became darker with incorporation of peanut butter. Highest score (8.3) was recorded for T_3 among the treatments. Lowest score (6.70) was recorded in T_1, where 80% vanaspati and 20% peanut butter were used as raw ma-

terials to prepare biscuits. The reason of darker color of the biscuits might be due to high level of protein present in the peanut butter. The colour development is contributed by the Maillard reaction *i.e*. reaction between sugars and proteins of product that results in brown colour (Singh *et al*., 1993). Other factors that may be responsible for colour development are time and temperature of baking, composition, humidity in oven *etc*. (Lingnert, 1990) and (Wade, 1988).

Flavour and Aroma : Flavour and aroma of biscuits progressively increased with increasing levels of peanut butter (Table-3). The highest score was recorded for T_3, while lowest score was recorded for treatment T_1. Similar results were observed by (Yadav *et al*., 2012) who found that the typical peanut flavour and aroma was highly acceptable by the panel members.

Over all acceptability : Biscuits' acceptability was in acceptable range (Table-3) with maximum score of (8.40) for biscuits prepared with 50% PB in place of hydrogenated fat (vanaspati) T_3 while minimum score (7.00) for biscuits prepared with 40% PB in place of vanaspati (T_2). (Adair *et al*., 2001) reported that product acceptability was declined when fat was substituted by more than 50% with mung bean paste. Shrestha *et al*. (2002) found greater acceptance of kinema- supplemented (which was prepared from natural fermentation of soybean) biscuits in comparison with full-fat soybean flour supplemented biscuits.

It is concluded that biscuits prepared with the incorporation of PB to reduce the quantity of vanaspati had shown maximum overall acceptability, this substitution of PB for vanaspati of the biscuits not only increased the protein content but, also decreased fat content. The most acceptable formulation was vanaspati: peanut butter (25:25). PB also imparted better flavour to biscuits. The finding are based on the one year experimentation and the same may be repeated for the confirmation.

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