Selection of groundnut variety for making a good quality peanut butter

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Abstract Flavor and compositional quality are the ultimate criterion of the desirability of any food product. The nutritive value of any peanut product is closely associated with the fatty acid composition of its oil content, which influences its quality. Peanut butter was prepared using seven groundnut varieties commonly grown in major groundnut producing states of India. The flavor and compositional quality were determined using the standard procedures. The color code to the butter preparation was assigned by visually comparing the color of the butter with those given in the handbook of standard colors. On the basis of a combined evaluation, it could be recommended that the groundnut variety *Somnath* is the best-suited variety for producing peanut butter amongst the selected varieties.

Keywords Peanut butter · Groundnut variety · Flavor · Texture · Quality

Introduction

Groundnut (*Arachis hypogaea* L.) is a major oilseed crop of India. However, unlike other oilseeds, groundnut can be

consumed directly as food. With the growing awareness among people about the importance of balanced diet, demand for low calorie-high protein foods is increasing as people tend to avoid consumption of high-fat foods lest it should cause obesity and associated health problems (Blundell and Macdiarmid 1997; Kuller 1997).

Dairy butter, produced generally from the cow or buffalo milk, contains almost 100 per cent fat without any protein while the peanut butter contains about 20 per cent protein besides 50 per cent fat and also contains all other nutrients that are naturally present in the groundnut. Hence, consumption of groundnut in the form of peanut butter is more beneficial on the basis of economic and health aspects. It is already quite popular in USA and other European countries. In India, however, this product is available commercially only in the metropolitan cities and mega-malls. In times to come, the demand for peanut butter in India is likely to grow owing to its nutritional value. For expulsion of oil at the oil mills, groundnut shell is added to the kernel as a crushing aid. Thus, the groundnut protein, which is obtained almost entirely in the form of groundnut cake, is no more useful for human consumption as it contains several extraneous substances, crushed shells, dust particles, insects and microorganisms. However, when groundnuts are processed for preparing peanut butter, no portion, except the red skin, is lost and hence the kernels are utilized rather in a wholesome manner as all the nutrients become available for human consumption (Desai et al. 1999).

Thus, popularization of peanut butter can go a long way in combating the problems of malnutrition. Consumers/vendors would prefer the peanut butter to be easily spread and also have a long shelf life. Peanut butter can also gain popularity among candy, snack and cookie manufacturer. In candy production, peanut butter coating cost about one-

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third as much as chocolate coatings, and can be used to enrobe cake portions, cookies, candy centres and other snack foods as reported by Salunkhe et al. (1992) and Sanders (2003). However, there is no extensive information available on the quality of peanut butter prepared from Indian groundnut varieties. Therefore, it would be of interest to study the flavor and compositional quality of peanut butter prepared from some of the Indian groundnut varieties in order to fulfill the ones more appropriate to elaborate this product.

Materials and methods

Selection of variety

Seven groundnut varieties commonly grown in major groundnut producing states of India were selected for the study. The pods of selected groundnut varieties were obtained from the Directorate of Groundnut Research (ICAR), Junagadh, Gujarat, India. The pods were decorticated manually to obtain the medium grade size sound kernels.

Peanut butter preparation

The peanut butter was prepared by following the procedure described by Tressler and Woodroof (1983). The sound peanut kernel, lot of 150 g for each sample, was spread over a petri dish of 177 cm² area, roasted at 130 °C for 60 min using laboratory digital electrical oven (sensitivity 1 °C). The kernels were cooled with forced air and then split to remove the skin and hearts. The weight of these roasted, blanched and split kernels devoid of hearts was recorded. Grinding was done in two steps. The blanched seeds were ground for 1 minute at full speed in a domestic grinder and then the additives salt and sugar were added at the rate of 1 per cent and 4 per cent, respectively, of the weight of sample used for grinding. The mixture was again ground at full speed for 22 min. The butter samples were stored in the glass jars with airtight plastic lids.

Proximate determination

For determination of moisture content, butter samples (10 g) were dried at 110 °C for 10 h in a hot air electrical oven (sensitivity 1 °C). The oil and its fatty acid composition along with protein content of the butter prepared from selected groundnut varieties were determined following the standard procedures. The oil content was determined gravimetrically by extracting the meal (10 g) with n-hexane in a Soxhlet extraction assembly for over 6 hours.

Fatty acid composition of peanut butter was determined by liberating the fatty acids from triglycerides by alkaline hydrolysis. The liberated fatty acids were first converted into their methyl esters. These methyl esters were then separated on Nucon Gas Chromatograph (AIMIL, India; model 5700) fitted with a DEGS column (2 mm internal diameter, 180 cm length). The temperature of the column was kept at 195 °C while that of injection and flame ionisation detector ports were kept at 250 °C. The flow rates of carrier (nitrogen), fuel (hydrogen) and air (oxygen) were kept at 40, 30 and 30 ml per minute, respectively. The printing speed of chart was adjusted at 0.85 mm per second (2 inches per min). A typical gas-liquid chromatogram of methyl esters of fatty acid composition of peanut butter was obtained as depicted in Fig. 1. As shown, the fatty acids were identified by comparison of their retention time with those of their corresponding standards. The area of a peak as fraction of the total area under all the peaks was expressed as per cent. The stability index (SI) was defined as the ratio of oleic acid (O) to linoleic acid (L) as described by Ahmed and Young (1982). The nitrogen content was determined by micro-Kjeldahl method using a Kjeltech auto nitrogen analyzer and the protein content was obtained by multiplying the nitrogen content of meal with a factor of 5.46 given by St. Angelo and Mann (1973).

Peaks: A- solvent; B- palmitic; C- stearic; D- oleic; E- linoleic; F- linolenic; G- arachidic, and H- behenic

Fig. 1 Typical gas-liquid chromatograph of methyl esters of fatty acid composition of peanut butter. Peaks: A- solvent; B- palmitic; C- stearic; D- oleic; E- linoleic; F- linolenic; G- arachidic, and H- behenic

Textural quality measurement

Textural quality was measured using Texture Analyser of Stable Micro Systems, UK (Model: TA-XT2i). The conical Perspex probe (code: P/45C) of 45° was penetrated into the sample by 14 mm with the pre-test, test and post-test speed as 2, 1 and 10 mm/s, respectively. The peanut butter samples were taken in a glass beaker (5.5 cm depth×2.5 cm diameter) and placed atop the load cell. The crosshead was set to move downward and penetrate the peanut butter sample for a distance of 14 mm. At the point of maximum penetration the crosshead direction of travel was automatically reversed and the probe was withdrawn at 10 mm/s speed. Results were expressed as maximum force (g) required for cone penetration and withdrawal from peanut butter column. The adhesiveness measurements were selected according to the definition established by Friedman and Whitney (1963). The spreadability and firmness of butter was recorded in terms of maximum adhesive force required for cone penetration and withdrawal with the distance travelled by the probe. The probe used, represented the palate and the force required to remove the material from the probe complies with the definition of adhesiveness set by Ahmed and Ali (1986).

Sensory evaluation

The sensory evaluation of peanut butter samples was carried out through a panel of nine well-experienced panellists. About 10 g peanut butter from each treatment was tasted by the Panellists using flat toothpicks. The Panellists used a scale of 0 (most difficult to spread) to 9 (easiest to spread) to evaluate the flavor for each of the

treatments. They were served with water and unsalted crackers during the tests. The results were analysed statistically using Analysis of Variance and Duncan's New Multiple Range Test (Ranganna 1986).

Color

The color code was assigned to butter preparations by visually comparing the color of butter preparation with those given in Methuen Handbook of Color (Kornerup and Wanscher 1978).

Results and discussion

Nutritional quality

As an item of table-food both the nutritional as well as textural quality of the final product plays an important role in the overall acceptability of the product. The total oil and protein content are important from nutritional point of view. The oil content of butter prepared from selected groundnut varieties was varied between 45.6 and 51.1 per cent. The lowest oil content was found in ICGV86325 and highest in case of GG6 variety of groundnut. Similarly, the protein content varied from 19.5 to 24.2 per cent (Table 1).

Also, the shelf life of butter is determined by the Stability Index (SI), which is the ratio of oleic to linoleic acid (O/L ratio). The butter of BAU13 variety exhibited the highest SI followed by variety *Somnath*. Ahmed and Young (1982) reported that the stability index of 2.0 and more implies a good compositional quality of the product having the better shelf life. Hence, the butter prepared from the

Table 1 Analyses of peanut butter prepared from different groundnut varieties

Descriptor		Groundnut variety							Difference
		ICGV86325	<i>Somnath</i>	DRG12	GG6	JL24	ICGV37	BAU13	
Moisture (%)		0.56	0.56	0.54	0.68	0.74	0.58	0.74	0.20 NS
Oil (%)		45.6	49.0	49.4	51.1	50.4	50.1	49.4	5.5*
Protein (%)		19.5	21.1	19.7	23.2	24.2	21.6	22.4	4.7*
Unsaturated fatty acids	Oleic (%)	10.6	6.2	4.6	4.1	10.0	16.0	12.5	—
	Linoleic (%)	8.1	3.1	3.4	3.1	7.9	11.7	3.7	—
	SI	1.3	2.0	1.4	1.3	1.3	1.4	3.4	2.1*
Colour [#]		AL	GO	GO	AY	RG	RG	AL	NS
Maximum adhesive force (dyne)	Penetration	82.0	63.2	94.3	63.3	90.8	66.9	108.4	45.2*
	Withdrawal	52.4	38.4	56.6	38.9	81.2	45.6	81.7	43.3*
Mean flavour properties [^]		5.7bc	8.3a	4.9c	7.6a	7.1ab	6.4b	5.0c	3.4*

[#] AL Autumn leaf; GO Greyish orange; AY Apricot yellow; RG Reddish golden

NS not significant at $P \leq 0.05$; *=significant at $P \leq 0.05$

[^]Mean within each row followed by the same letter (a, b, c) are not statistically different

groundnut varieties BAU13 and *Somnath* exhibited the better shelf life amongst the peanut butter prepared. The butter prepared from other varieties recorded SI value less than 2.0 and thereby implying relatively a poor shelf life of the peanut butter. The moisture content of peanut butter samples was varied in the range of 0.54 and 0.74 per cent (Table 1). It implied that the moisture content of all the samples was within the permissible limit of less than 1 per cent reported by Desai et al. (1999).

Textural quality

As shown in Table 1, the results of force of adhesiveness were significantly different for the peanut butter prepared from the selected varieties of groundnut. The butter prepared from *Somnath* variety of groundnut recorded the lowest adhesive force required for cone penetration and withdrawal and this realized the ease in spreadability and firmness. It was statistically at par with the butter prepared from GG6 and ICGV37 varieties of groundnut. The maximum adhesive force for cone penetration and withdrawal was required for the peanut butter prepared from the BAU13 followed by the butter prepared from DRG12, JL24 and ICGV86325 varieties of groundnut. The results revealed that amongst the selected groundnut varieties *Somnath* is the most appropriate followed by GG6 and ICGV37 for the production of peanut butter.

Sensory quality

The analysis of variance for measuring the effect of groundnut varieties on flavor attribute of butter during sensory evaluation indicated that the results were significant at 5 per cent probability level. The samples, which were significantly different from the others, were determined using ‘Statistical Analysis System’ of the Duncan’s New Multiple Range Test (DNMRT) procedure. The data indicated that there was no significant difference in flavor of butter prepared from *Somnath*, GG6 and JL24 varieties. However, the highest mean sensory score of 8.3 was obtained for *Somnath* followed by 7.6 and 7.1 for GG6 and JL24 varieties of groundnut, respectively. This revealed that the groundnut variety *Somnath* exhibited better flavor followed by GG2 and GG13 varieties of groundnut. The other varieties exhibited poor flavor characteristics and thereby proved unsuitable for making the butter.

Color

While comparing the color attribute of the butter prepared from the selected varieties, it was observed that those

prepared from *Somnath* and DRG 12 reflected the most preferable greyish orange color. However, the differences among the colors of butter prepared from various varieties were non significant.

Conclusion

Amongst the selected varieties of groundnut, the butter prepared from the kernels of *Somnath* yielded better firmness and spreadability during the textural measurements. Also, the butter prepared using the kernel of this variety was found superior while evaluating the flavor and other proximate. Therefore, on the basis of combined evaluation the groundnut variety *Somnath* could be recommended for the production of peanut butter having the better flavor and other compositional quality amongst the selected varieties of groundnut.

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