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Effects of roasting and storage on proteins and oil in peanut kernels

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Abstract. Peanut kernels, untreated or soaked in salt solution, were roasted at 160 °C for 30 min in a hot air oven or oil roasted at 147 °C for 2 min and, stored at 27 °C and 5 °C up to 150 days. The heat treatments significantly decreased methionine, tryptophan and in vitro protein digestibility (IVPD) and, increased the soluble proteins and acid value of kernel oil. Storage of heated peanuts caused an increase in water-soluble proteins, IVPD, acid value and saponification value and a decrease in methionine, tryptophan and iodine value. The oil roasting was found to be more detrimental to nutritional quality and storage stability of peanuts as compared to dry roasting. The storage of heated peanuts at 5 °C was found to be beneficial in lowering the undesirable nutritional changes in the peanut kernels.

Introduction

Peanut is a major oilseed crop of the world. It is also a good source of dietary proteins. In India, more than 80% produce is used for extraction of edible oil and about 4–5% for direct consumption while in the United States, about 65% of the crop is processed into peanut butter, salted peanuts and confectionary products [1]. For such purposes, kernels are subjected to roasting or frying treatments. The dry roasted or fried peanuts are either eaten directly or used in candies, salads, desserts and traditional products like *chikki* in India. Both heated kernels and their products are often stored before consumption. The heat treatments to kernels although reduces moisture content and develops pleasant flavor [2], it can denature proteins, destroy amino acids, decrease nutritive value and induce undesirable changes in kernel oil during storage [3–8].

In India, peanuts are commonly dry roasted at 160 °C for 20–30 min or fried in boiling oil (147 °C) for 1 to 2 min to prepare roasted, salted or fried nuts. However, information on the effects of such heat treatments and subsequent storage on the quality of peanut kernels is limited. This paper

presents the results on changes in proteins and oil due to dry roasting or frying and, storage of heat treated peanut kernels.

Materials and methods

Peanuts

The dry pods of freshly harvested peanut (cv C-1-2) obtained from the Groundnut Breeder of the University were manually shelled to obtain kernels. The kernels were cleaned and processed immediately.

Heat treatments and storage

The peanut kernels (1 kg lot each) were subjected to dry roasting in hot air oven at 160 °C for 30 min or frying in peanut oil at 147 °C for 2 min. The raw kernels were separately soaked in 20% NaCl solution for 4 h, drained and dried at 60 °C to a constant weight. The salt-soaked kernels were then dry roasted or fried in boiling oil as described above. The unheated kernels were included as control. The heated and unheated kernels were stored at 5 ± 2 °C and 27 ± 2 °C in sealed polythene bags up to 150 days. The experiment was organized in factorial completely randomized block design with 5 heat treatments including control, 2 storage temperatures and 6 storage periods.

Nutritional analyses

The moisture and oil contents were estimated by using full-fat meal [9], while the crude proteins and in vitro protein digestibility [9], soluble proteins [10], methionine [11], and tryptophan [12] were determined from defatted samples. The kernel oil obtained in Sauxhlet extraction unit was used to estimate acid value, saponification value and iodine number by the procedure of AOAC [9]. The data obtained for each parameter were analyzed for statistical significance on Spectrum-1-micro computer. The values presented in Tables 1 and 2 are the means of 12 observations for each heat treatment, 10 observations for each storage period and 30 observations for each storage temperature.

Table 1. Effects of heat treatments, storage period and temperature on the contents of moisture, proteins, limiting amino acids and IVPD of peanut

Treatment/Storage condition	Moisture	Crude protein ($N \times 5.46$)	Soluble proteins	Methionine (g/16 g N)	Tryptophan (g/16 g N)	IVPD (%)
Heat treatments						
Control, unheated	5.79	47.2	25.8	0.91	0.60	79.8
Roasting	2.14	51.3	29.8	0.72	0.46	79.2
Soaking followed by roasting	2.15	50.3	28.5	0.71	0.43	78.1
Frying	2.33	51.9	23.0	0.65	0.41	73.5
Soaking followed by frying	2.85	50.1	22.4	0.65	0.40	68.1
LSD, 5%	0.07	0.42	0.31	0.03	0.03	0.47
Storage period, days						
Control, 0 day	3.11	49.7	22.9	0.86	0.51	70.3
30	3.08	49.9	24.3	0.82	0.47	73.7
60	3.06	50.2	24.7	0.75	0.45	76.2
90	3.04	50.3	24.8	0.69	0.43	78.5
120	3.02	50.4	26.6	0.65	0.42	78.4
150	3.02	50.4	27.2	0.64	0.40	77.3
LSD 5%	0.08	0.44	0.32	0.03	0.03	0.52
Storage temperature, °C						
5 ± 2	3.06	50.2	25.0	0.76	0.46	75.2
27 ± 2	3.04	50.2	25.0	0.71	0.43	76.3
LSD, 5%	–	–	–	0.02	0.02	0.45

Table 2. Effects of heat treatments, storage period and temperature on the quality of kernel oil of peanut

Treatment/Storage condition	Oil (%)	Acid value (mg KOH/g oil)	Saponification value	Iodine value
Heat treatments				
Control, unheated	48.6	0.47	195.4	94.5
Roasting	50.9	0.59	195.6	92.2
Soaking followed by roasting	50.2	0.66	196.9	91.2
Frying	52.4	0.72	198.7	94.4
Soaking followed by frying	51.6	0.71	199.5	93.0
LSD at 5%	0.6	0.02	2.52	1.21
Storage period, days				
Control, 0 day	50.7	0.34	186.6	94.7
30	50.7	0.41	192.7	94.0
60	50.7	0.46	197.7	93.5
90	50.7	0.51	200.0	92.7
120	50.8	0.62	202.2	92.0
150	50.8	1.50	204.2	91.3
LSD at 5%	0.4	0.015	3.46	1.82
Storage temperature, °C				
5 ± 2	50.7	0.54	195.3	93.5
27 ± 2	50.8	0.72	199.2	92.6
LSD at 5%	0.5	0.015	2.85	1.11

Results and discussion

Moisture, proteins, limiting amino acids and IVPD

The mean values for changes in moisture, crude protein, water-soluble proteins in kernels and, methionine, tryptophan and IVPD of kernel proteins are presented in Table 1. The heat treatments significantly reduced the kernel moisture and, methionine, tryptophan and IVPD of kernel proteins. However, the crude protein and water-soluble proteins were found to increase significantly after heat treatments. During storage, the water-soluble proteins content and IVPD were found to increase while both methionine and tryptophan contents were found to decrease significantly. The storage of peanuts at 27 °C resulted in greater losses in both methionine and tryptophan as compared to storage at 5 °C.

Oil quality

The mean values for crude oil in kernels and oil quality as determined by acid value, saponification value and iodine value of kernel oil are shown in

Table 2. The heat treatments caused a significant increase in crude oil content of kernel oil. The changes in saponification value and iodine value were however not significant. There was a continuous increase in acid value and saponification value, while a steady decrease in iodine value of kernel oil during storage of heat processed peanuts. The kernel oil from peanuts stored at 27 °C exhibited higher acid value and saponification value and, lower iodine value was compared to kernels stored at 5 °C. The results indicate that roasting of peanuts at 160 °C for 30 min or frying at 147 °C for 2 min, adversely affect the quality of proteins and oil in peanut kernels. In general, frying treatments had more deleterious effect on peanut quality than roasting. The heat processed kernels exhibited inferior shelf-life during storage. The storage of heated kernels at 5 °C was found to be useful in lowering the undesirable changes in nutritional quality of heated peanuts.

The values obtained for various chemical parameters of peanuts are in agreement with literature values [1, 13, 14]. An apparent increase in crude protein and oil in kernels after heat treatments can be attributed to the loss of moisture [5]. The decrease in methionine and tryptophan may be due to their heat destruction [5, 7] and a decrease in IVPD of kernel proteins can be attributed to the heat denaturation of proteins [4, 8]. Although the heat treatment destroys lipase and lipoxygenase activities, an increase in acid value and saponification value after heating and during subsequent storage may be due to nonenzymic catalysis [3] and breakdown of fatty acids during heating. Heating of peanut oil has been reported to cause significant losses in polyunsaturated fatty acids and iodine value [15, 16]. The use of salt containing low levels of calcium, copper and iron and storage under vacuum or nitrogen environment at cold temperature have been recommended to extend the shelf-life of heated peanuts [1]. The mild roasting or frying treatments to avoid losses in quality and more economical means to improve the storage stability of heat processesd peanuts need to be developed.

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