Influence of Storage and Roasting on the Quality Properties of Kernel and Oils of Raw and Roasted Peanuts

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Abstract: The changes in chemical properties of the peanut varieties (NC-7 and ÇOM) in the raw and roasted forms stored at 30°C for 8 months were monitored. Acidity and peroxide values of raw and roasted NC-7 and ÇOM kernel oils increased during storage. The unsaturated fatty acids such as oleic, linoleic acids of roasted peanut oils gradually decreased during storage. While the oleic acid contents of raw NC-7 oil changed 46.14% (month 0) and 43.14% (month 8), the oleic acid contents of roasted NC-7 kernel oils varied between 42.38% (month 8) and 45.61% (month 0) during storage. In addition, while the oleic acid contents of raw ÇOM kernel oil decreased from 49.87% (month 0) to 46.09% (month 7), the oleic acid contents of roasted ÇOM kernel oil decreased from 48.88% (month 0) to 45.24% (month 8) during storage. The highest linoleic acid were found in the initial periods of storage for raw and roasted NC-7 and ÇOM oils. In addition, the α-tocopherol contents of both raw and roasted peanut kernel oils changed between 20.38 mg/100 g (0.month) and 17.58 mg/100 g (month 8) to 21.45 mg/100g (month 0) and 18.64 mg/100 g (month 8) during storage, respectively. Significant variations were observed in tocopherol contents of peanut varieties due to processing.

Key words: peanut, roasting, storage, fatty acid composition, tocopherols

1 INTRODUCTION

Peanut (Arachis hypogaea L.) is an the important edible oilseed crop cultivated in tropical and sub-tropical countries. The peanut plays an important role in the economy of several countries¹. Peanuts contain important components for human nutrition including tocopherols, resveratrol, protein². In addition to cooking, peanut oil is also utilized in cosmetic, surfactants, pharmaceuticals and margarines manufacture³–⁶. Microwave energy and conventional heating are currently being employed in different food processing operations such as drying, tempering, baking, pasteurization, cooking and sterilization of foods⁷–⁹. The process temperature, unsaturated fatty acids contents and the occurrence of trace metals, enzymes, and antioxidants e.g. tocopherols may influence microwave heating¹⁰,¹¹. Roasting promotes different changes in the kernels¹⁰,¹². Gou et al.¹⁰ studied the influence of oven roasting on the physicochemical properties of almond observed an increase in rancidity when treatment time was increased attributed to autooxidation. The existing reports on the storage of peanut kernel investigated the effects of temperature, roasting, irradiation and packaging on different quality attributes of peanuts¹³. Peanuts are marketed in different commercial forms such as unshelled peanut, shelled kernels, roasted and salty kernels. Peanut kernels are good source of protein, lipid, and fatty acids for human nutrition. The fatty acid composition of endogenous fats plays an important role in determining the shelf life, nutrition, and flavour of food products. The lipids and proteins of cultivated peanut seeds have been widely studied⁶,¹⁴,¹⁵. Prevention of rancidity is one of the most important quality parameters during storage of peanuts. Consequently, delaying the onset of rancidity could lengthen the available market period of these products. The peanut kernels are stored until roasting, then marketed. During this storage, some chemical changes in the oil will be monitored during certain periods. The detailed chemical properties on the storage of raw and oven roasted peanuts (NC-7 and ÇOM...
varieties have not been reported. The objective of this work was to determine the effects of storage and oven roasting on the oil yield, peroxide value, acidity, protein content, fatty acid compositions and tocopherol contents of kernel and oils of raw and roasted two peanut varieties.

2 MATERIAL AND METHODS

2.1 Material

For this study, peanuts (NC-7 and ÇOM varieties) were obtained from Mersin district in Turkey. The kernels were packed in amber glass bottles and transported to the laboratory from Mersin district. The peanut pods were cleaned and shelled before analysis. The blanched samples (1 h/20 min) were used for all the chemical analyses.

2.2 Methods

2.2.1 Oven roasting

About 50 g of peanut kernels were distributed uniformly as a thin layer on the trays, and roasted in an oven (Nuve FNO55, Ankara, Turkey) at 200°C for 10 min. Overheating was avoided and roasting was controlled by monitoring the color change.

2.2.2 Storage of peanut kernels

About 1 kg raw and roasted peanut kernels (NC-7 and ÇOM cv) were stored at 30°C temperature in sealed cloth bag in the dark for 8 months. Each analysis was replicated 3 times. Moisture, oil content, acidity, peroxide value, fatty acid composition and tocopherol content were determined every 30 days for a total period of 8 months.

2.2.3 Proximate analysis

Raw and roasted peanut kernels were ground to pass through a 0.4 screen for subsequent chemical analysis. Determination of moisture content, crude oil, acidity and peroxide values were made according to AOAC approved methods. The determination of crude protein was based on nitrogen combustion method. The protein determination was made in Leco combustion analyzer and 6.25 was used as the conversion factor.

2.2.4 Fatty acid composition

The fatty acid profiles of raw and roasted peanut kernel oils (about 0.5 mg) were determined according to the Ce-62 method of American Oil Chemists’ Society. Fatty acid methyl esters of samples are analyzed using gas chromatography (Shimadzu GC-2010) equipped with a flame-ionization detector (FID) and capillary column (Tecnocroma TR-CN100, 60 m × 0.25 mm, film thickness: 0.20 μm).

2.2.5 Tocopherol analyses

Tocopherol contents of raw and roasted peanut kernel oils were performed according to Spica et al. 0.1 g of oil was dissolved in 10 ml of n-hexane and filtered through a 0.45 μm nylon filter. HPLC analyses of tocopherols were determined using Shimadzu-HPLC equipped with PDA detector and LiChroCART Silica 60 (4.6 × 250 mm, 5 μ; Merck, Darmstadt, Germany) column.

2.3 Statistical Analysis

A complete randomized split plot block design was used, and analysis of variance (ANOVA) was performed by using JMP version 9.0 (SAS Inst. Inc., Cary, N.C.U.S.A). All analyses were carried out three times and the results are mean ± standard deviation (MSTAT C) of independent peanut samples.

3 RESULTS AND DISCUSSION

The chemical properties of the raw and roasted peanut kernels (NC-7 and ÇOM) stored at 30°C for 8 months are given in Table 1. While the moisture contents of raw NC-7 kernels vary between 6.62% (4th month of storage) and 6.79% (initial of storage-month 0) during storage, the moisture contents of roasted NC-7 kernels changed between 3.57% (month 0) and 3.92% (month 8). For the moisture content of raw and roasted ÇOM kernels, while it change between 7.46% (month 4) and 7.87% (month 8), the moisture contents of roasted ÇOM kernels varied between 3.73% (month 0) and 4.74% (month 8), respectively. There are significant differences in the raw peanut moisture content in all cases at 0 month (p<0.05). While oil contents of raw NC-7 peanut kernels change between 30.45% (month 2) and 30.84% (month 8), oil contents of roasted NC-7 kernels varied between 31.56% (month 1) and 31.93% (month 8). In addition, protein contents of roasted NC-7 kernels were determined between 33.58% (month 1) and 33.95% (month 8). While acidity values of raw NC-7 oil change between 0.98% (month 1) and 4.86% (month 8), acidity values of roasted NC-7 oils ranged from 1.78% (month 1) to 3.89% (month 8). While oil contents of raw ÇOM kernels change between 36.62% (month 6) and 36.95% (month 1), oil contents of roasted ÇOM kernel were determined between 37.17% (month 1) and 37.93% (month 5). Also, while acidity values of raw ÇOM oils vary between 1.08% (month 1) and 4.67% (month 8), acidity values of roasted ÇOM oils changed between 2.25% (month 1) and 5.38% (month 8). In addition, while peroxide values of raw ÇOM oils change between 1.82 meqO _2/kg (month 1) and 4.21 meqO _2/kg (month 8), peroxide values of roasted ÇOM oils varied between 3.67 meqO _2/kg (month 1) and 7.94 meqO _2/kg (month 8). During roasting, while oil contents of both NC-7 and ÇOM peanut kernels increase, protein contents of both samples partly decreased during storage. Also, the protein content probably increased with decreasing moisture content during storage. In addition, both acidity and peroxide values of raw and roasted NC-7 and ÇOM kernel oils increased during storage. After 4th storage, the acidity value of raw peanut kernel oils was
## Table 1  Chemical properties of raw and roasted peanut kernel and oils.

| Storage (Months) | Moisture (%) | Oil (%) | Protein* (%) | Acidity (%) | Peroxide value (meq O₂/kg) | Moisture (%) | Oil (%) | Protein* (%) | Acidity (%) | Peroxide value (meq O₂/kg) |
|------------------|--------------|---------|--------------|-------------|----------------------------|--------------|---------|--------------|-------------|----------------------------|
| 0                |              |         |              |             |                            |              |         |              |             |                            |
| Raw              | 6.79 ± 0.98**a | 30.64 ± 1.25b | 36.21 ± 1.68a | 0.98 ± 0.09b | 1.67 ± 0.21b | 7.47 ± 1.18a | 36.83 ± 1.14b | 37.81 ± 1.25a | 1.08 ± 0.16b | 1.82 ± 0.32b |
| Roasted          | 3.57 ± 0.61b*** | 31.56 ± 1.53a | 33.58 ± 1.24b | 1.78 ± 0.11a | 2.64 ± 0.13a | 3.73 ± 0.67b | 34.26 ± 1.13b | 2.25 ± 0.49a | 3.67 ± 0.14a |
| 1                |              |         |              |             |                            |              |         |              |             |                            |
| Raw              | 6.73 ± 0.36a | 30.53 ± 1.61b | 35.89 ± 1.73a | 1.76 ± 0.13b | 1.94 ± 0.09b | 7.59 ± 0.45a | 36.95 ± 2.36b | 37.03 ± 1.17a | 1.59 ± 0.54b | 2.17 ± 0.13b |
| Roasted          | 3.64 ± 0.57b | 31.65 ± 1.27a | 33.71 ± 2.17b | 1.95 ± 0.21a | 2.97 ± 0.25a | 3.81 ± 0.42b | 37.33 ± 2.24a | 34.37 ± 1.42b | 2.67 ± 0.71a | 3.81 ± 0.43a |
| 2                |              |         |              |             |                            |              |         |              |             |                            |
| Raw              | 6.70 ± 0.44a | 30.45 ± 1.13b | 35.93 ± 1.89a | 1.93 ± 0.27b | 2.16 ± 0.43b | 7.56 ± 1.29a | 36.88 ± 1.09b | 37.64 ± 1.64a | 1.87 ± 0.45b | 2.67 ± 0.61b |
| Roasted          | 3.66 ± 1.13b | 31.74 ± 1.65a | 33.86 ± 0.96b | 2.14 ± 0.81a | 3.56 ± 0.47a | 3.78 ± 0.58b | 37.78 ± 1.17a | 34.56 ± 1.43b | 3.56 ± 0.38a | 4.18 ± 1.14a |
| 3                |              |         |              |             |                            |              |         |              |             |                            |
| Raw              | 6.75 ± 1.09a | 30.49 ± 1.09b | 35.97 ± 2.18a | 2.36 ± 0.35a | 2.56 ± 0.64b | 7.73 ± 0.89a | 36.85 ± 1.62b | 37.58 ± 1.57a | 1.94 ± 0.54b | 2.88 ± 0.21b |
| Roasted          | 3.71 ± 0.48b | 31.78 ± 1.14a | 33.79 ± 1.43b | 2.46 ± 0.49a | 3.95 ± 0.62a | 3.83 ± 0.67b | 37.92 ± 1.45a | 34.48 ± 1.78b | 3.78 ± 0.17a | 4.86 ± 0.98a |
| 4                |              |         |              |             |                            |              |         |              |             |                            |
| Raw              | 6.62 ± 0.71a | 30.52 ± 0.98b | 35.95 ± 1.56a | 3.17 ± 0.74a | 2.87 ± 0.35b | 7.46 ± 1.13a | 36.93 ± 1.51b | 37.41 ± 1.46a | 2.56 ± 0.52b | 3.13 ± 0.87b |
| Roasted          | 3.68 ± 0.86b | 31.83 ± 0.57a | 33.91 ± 1.24b | 2.67 ± 0.98b | 4.35 ± 0.23a | 3.88 ± 0.37b | 37.68 ± 1.49a | 34.61 ± 1.32b | 3.98 ± 0.43a | 5.32 ± 1.09a |
| 5                |              |         |              |             |                            |              |         |              |             |                            |
| Raw              | 6.73 ± 0.93a | 30.57 ± 1.45b | 35.88 ± 1.21a | 3.85 ± 0.67a | 2.96 ± 0.17b | 7.68 ± 1.28a | 36.74 ± 2.36b | 37.64 ± 1.73a | 2.98 ± 0.29b | 3.56 ± 0.38b |
| Roasted          | 3.71 ± 0.32b | 31.85 ± 2.32a | 33.83 ± 1.54b | 3.38 ± 0.87a | 4.79 ± 0.59a | 3.93 ± 0.41b | 37.93 ± 1.39a | 34.71 ± 1.45b | 4.29 ± 0.09a | 6.59 ± 0.41a |
| 6                |              |         |              |             |                            |              |         |              |             |                            |
| Raw              | 6.75 ± 0.13a | 30.63 ± 1.49b | 35.57 ± 1.43a | 4.17 ± 0.98a | 3.27 ± 0.32b | 7.84 ± 0.84a | 36.62 ± 1.27b | 37.73 ± 1.59a | 3.65 ± 0.25b | 3.78 ± 0.13b |
| Roasted          | 3.77 ± 0.21b | 31.79 ± 1.53a | 33.78 ± 1.38b | 3.53 ± 0.94b | 5.56 ± 1.19a | 3.95 ± 0.26b | 37.73 ± 1.76a | 34.79 ± 3.22b | 4.57 ± 0.46a | 6.98 ± 0.67a |
| 7                |              |         |              |             |                            |              |         |              |             |                            |
| Raw              | 6.81 ± 0.27a | 30.78 ± 1.61b | 35.78 ± 1.64a | 4.78 ± 0.25a | 3.68 ± 0.28b | 7.79 ± 0.98a | 36.74 ± 1.68b | 37.87 ± 1.83a | 3.93 ± 0.29b | 3.94 ± 0.21b |
| Roasted          | 3.83 ± 0.55b | 31.89 ± 1.26a | 33.89 ± 2.09b | 3.75 ± 0.48b | 6.95 ± 1.32a | 3.97 ± 0.64b | 37.56 ± 1.33a | 34.65 ± 0.98b | 4.91 ± 0.13a | 7.36 ± 0.74a |
| 8                |              |         |              |             |                            |              |         |              |             |                            |
| Raw              | 6.88 ± 0.24a | 30.84 ± 1.18b | 35.69 ± 1.07a | 4.86 ± 0.87a | 3.94 ± 0.46b | 7.87 ± 1.35a | 36.81 ± 1.28b | 37.81 ± 0.64a | 4.67 ± 0.21b | 4.21 ± 0.53b |
| Roasted          | 3.92 ± 0.39b | 31.93 ± 1.43a | 33.95 ± 1.35b | 3.89 ± 0.63b | 7.38 ± 1.67a | 4.75 ± 1.13b | 37.63 ± 1.43a | 34.58 ± 0.78b | 5.38 ± 1.28a | 7.94 ± 0.88a |

*Nx6.25, **mean ± standard deviation; ***Values within each column followed by different letters are significantly different (p<0.05); (n=3)
higher than that of roasted peanut. Whereas, this parameter did not change in ÇOM variety. However, the acidity value of roasted ÇOM peanut kernel oils were found to be higher than that of raw kernels during storage. In the NC variety, after 4th month of storage, the increase of the acidity may be due to the high enzyme activity in the kernels. In addition, the peroxide values of ÇOM variety was found to be high compared to NC-7 kernel oils during storage. The increase in peroxide value of ÇOM kernel oils may be probably due to the high initial values of peroxides in the ÇOM variety. The fatty acid of the roasted peanut kernel oils was found high compared to raw peanut oil. These differences in chemical properties of samples may be due to hydrolyses enzyme activity and heating during the storage conditions and roasting conditions in oven. The peroxide value of roasted peanut oil heated in oven was found higher than results of NC-7 peanut oil. This increase was attributed to genetic factors and the structure of peanut kernels during storage. Initial peroxide values of peanut kernel oils were significantly different among the two peanut varieties considered.

The fatty acid composition of raw and roasted peanut kernels oils are shown in Table 2. The palmitic acid contents of the roasted NC-7 peanut kernel oils increased after the first month of storage compared to raw NC-7 kernel oils, while the palmitic acid contents of the roasted ÇOM kernel oils increased partially after 5th month of storage. The palmitic acid contents of raw NC-7 oils changed from 9.17% (month 0) to 8.27% (month 8), while the roasted NC-7 oils change from 9.34% (month 3) to 8.98% (month 8). In addition, while the palmitic acid contents of raw ÇOM oils are determined between 11.59% (month 8) and 12.56% (month 0), the palmitic acid content of roasted ÇOM oil changed between 12.05% (month 8) and 12.36% (month 5). The palmitic acid contents of ÇOM oil were higher than the NC-7 oil. Stearic acid contents of raw NC-7 and ÇOM oils changed between 4.26% (month 3) and 4.76% (month 7) to 2.59% (month 8) and 2.98% (month 0), respectively. In addition, stearic acid contents of roasted NC-7 and ÇOM kernel oils varied between 4.08% (month 6) and 4.83% (month 7) to 2.75% (month 8) and 2.83% (month 1 and 3), respectively. With the roasting of peanut kernels, the unsaturated fatty acids such as oleic, linoleic acids of peanut oils gradually decreased during storage. Also, there was a partial increase in saturated fatty acids such as palmitic after 6th month of storage. While the oleic acid contents of raw NC-7 oil change between 43.14% (month 8) and 46.38% (month 0), the oleic acid contents of roasted NC-7 kernel oils varied between 45.61% (month 0) and 42.38% (month 8) during storage. In addition, while the oleic acid contents of raw ÇOM kernel oils are determined between 49.87% (month 0) and 46.09% (month 7), the oleic acid contents of roasted ÇOM kernel oil changed decreased to 48.88% (month 0) and 45.24% (month 8) during storage. The highest linoleic acid in levels both raw and roasted NC-7 and ÇOM kernel oils were found in the initial periods of storage. The amounts were gradually decreased with storage. Fatty acids, particularly oleic and linoleic, have a large effect on the stability and nutritional quality of peanut oil\(^{10}\). Pokorny et al.\(^{21}\) reported that Virginia and SunOleic peanut oils contained 12.2 and 6.2% palmitic, 3.1 and 1.9% stearic, 48.4 and 81.7% oleic, 30.5 and 2.7% linoleic and 0.9 and 2% eicosenoic acids. Megahed\(^{6}\) reported that freshly extracted peanut oils subjected directly to microwave heating showed increase of formation of conjugated trienes. Such oils are more stable against autoxidation on storage or heating than are conventional oils.

Tocopherol contents of raw and roasted peanut (NC-7 and ÇOM varieties) kernel oils at the selected on storage times are presented in Table 3. α-Tocopherol and γ-tocopherols were the major tocopherol of oils of both peanut varieties. While α-tocopherol contents of raw NC-7 oil change between 11.36 mg/100 g (month 8) and 17.29 mg/100 g (month 0), the α-tocopherol contents of roasted NC-7 oil were determined between 16.07 mg/100 g (month 8) and 17.98 mg/100 g (month 0). Also, while γ-tocopherol contents of raw NC-7 oil change between 15.02 mg/100 g (month 8) and 15.75 mg/100 g (month 0), the γ-tocopherol contents of roasted NC-7 oil varied between 15.08 mg/100 g (month 8) and 16.13 mg/100 g (month 0) during storage. In addition, α-tocopherol contents of both raw and roasted peanut kernels (NC-7 and ÇOM cv) changed between 17.58 mg/100 g (month 9) and 20.38 mg/100 g (month 0) to 18.64 mg/100 g (8th month) and 21.45 mg/100 g (month 0) during storage, respectively. While δ-tocopherol contents of raw NC-7 oil change between 0.43 mg/100 g (month 8) and 0.75 mg/100 g (month 2), δ-tocopherol contents of ÇOM oil varied between 0.47 mg/100 g (month 8) and 0.98 mg/100 g (month 1). In addition, δ-tocopherol contents of roasted ÇOM oil changed between 0.45 mg/100 g (month 8) and 1.17 mg/100 g (month 0). The highest γ-tocopherol were found on the initial period of storage in both raw and roasted NC-7 and ÇOM peanut kernel oil samples. As seen in Table 3, α-tocopherol and γ-tocopherol contents of both raw and roasted NC-7 kernel oils were found slightly lower compared to results of ÇOM oil during storage. The total tocopherol contents of the peanut oils changed between 30.81 and 33.57 to 31.58 and 35.31 mg/100 g for raw and roasted NC-7 oils and 37.84 and 42.52 to 39.16 and 45.19 mg/100 g for raw and roasted ÇOM oils, respectively. Significant variations in tocopherol contents of peanut varieties and processing differences were observed. However, the tocopherol contents of both peanut varieties increased gradually with roasting. Also, while the peroxide values of both peanut variety oils, the tocopherol contents increased, and unsaturated fatty acid composition were decreased depending on storage time. A statistically significant relation-
Table 2  Fatty acid composition of raw and roasted peanut oils (%).

| Storage (months) | NC-7         | COM         |
|-----------------|--------------|-------------|
|                 | Palmitic     | Stearic     | Oleic       | Linolenic   | Linolenic   | Arachidonic   | Palmitic     | Stearic     | Oleic       | Linolenic   | Linolenic   | Arachidonic   |
| 0 Raw           | 9.17 ± 0.56a | 4.37 ± 0.38a | 46.38 ± 1.16a | 37.21 ± 0.56a | 0.43 ± 0.09a | 0.98 ± 0.09a | 12.56 ± 0.45a | 2.98 ± 0.17a | 0.98 ± 0.74a | 0.37 ± 0.03a | 0.76 ± 0.18a |
| Roasted         | 9.11 ± 0.74a | 4.28 ± 0.27b | 45.61 ± 1.28b | 36.13 ± 0.45b | 0.33 ± 0.07b | 0.87 ± 0.13b | 12.24 ± 0.34a | 2.83 ± 0.21b | 0.88 ± 0.11b | 0.23 ± 0.02b | 0.73 ± 0.23b |
| 1 Raw           | 9.13 ± 0.68a | 4.44 ± 0.41a | 45.63 ± 0.97a | 36.58 ± 0.13a | 0.41 ± 0.03a | 0.86 ± 0.21a | 12.45 ± 0.21a | 2.93 ± 0.38a | 0.94 ± 0.23a | 0.35 ± 0.09a | 0.75 ± 0.43a |
| Roasted         | 9.04 ± 0.21a | 4.32 ± 0.64b | 44.38 ± 0.56b | 35.76 ± 1.21b | 0.27 ± 0.03b | 0.81 ± 0.07b | 12.18 ± 0.37b | 2.79 ± 0.53b | 0.48 ± 2.36b | 0.19 ± 0.10b | 0.74 ± 0.30b |
| 2 Raw           | 8.97 ± 1.17b | 4.28 ± 0.57a | 45.51 ± 1.61a | 36.35 ± 0.98a | 0.39 ± 0.03a | 0.83 ± 0.09a | 12.48 ± 0.46a | 2.91 ± 0.36a | 0.91 ± 0.23a | 0.36 ± 0.13a | 0.81 ± 0.23a |
| Roasted         | 9.28 ± 1.13a | 4.11 ± 1.32b | 44.27 ± 1.25b | 35.21 ± 0.74b | 0.25 ± 0.07b | 0.77 ± 0.03b | 12.09 ± 0.84b | 2.81 ± 0.73b | 0.47 ± 1.78b | 0.21 ± 0.09b | 0.76 ± 0.17b |
| 3 Raw           | 8.86 ± 0.57b | 4.26 ± 1.28a | 45.29 ± 1.13a | 36.13 ± 0.34a | 0.35 ± 0.09a | 0.80 ± 0.05a | 12.37 ± 0.56a | 2.89 ± 0.67a | 0.47 ± 2.47a | 0.39 ± 0.11a | 0.74 ± 0.13a |
| Roasted         | 9.34 ± 0.98a | 4.18 ± 1.27b | 44.09 ± 1.17b | 34.77 ± 0.47b | 0.23 ± 0.05b | 0.73 ± 0.07b | 12.01 ± 0.48b | 2.83 ± 0.46b | 0.46 ± 2.39b | 0.25 ± 0.13b | 0.69 ± 0.25b |
| 4 Raw           | 8.85 ± 0.11b | 4.35 ± 0.49a | 45.11 ± 0.37a | 36.08 ± 0.29a | 0.37 ± 0.04a | 0.78 ± 0.05a | 12.29 ± 0.93a | 2.78 ± 0.91b | 0.47 ± 2.67a | 0.34 ± 0.08a | 0.72 ± 0.43a |
| Roasted         | 9.33 ± 0.17a | 4.27 ± 0.64b | 43.96 ± 0.13b | 34.53 ± 0.46b | 0.26 ± 0.03b | 0.67 ± 0.03b | 12.17 ± 0.97a | 2.81 ± 0.85a | 0.46 ± 2.48b | 0.22 ± 0.03b | 0.61 ± 0.15b |
| 5 Raw           | 8.56 ± 0.85b | 4.41 ± 0.47a | 44.57 ± 1.43a | 35.89 ± 0.73a | 0.32 ± 0.01a | 0.83 ± 0.09a | 12.33 ± 0.86a | 2.73 ± 0.83b | 0.47 ± 2.89a | 0.39 ± 0.07a | 0.69 ± 0.13a |
| Roasted         | 9.17 ± 0.49a | 4.18 ± 0.56b | 42.88 ± 0.86b | 34.42 ± 0.85b | 0.24 ± 0.07b | 0.74 ± 0.11b | 12.30 ± 0.58a | 2.80 ± 0.38a | 0.46 ± 2.18b | 0.19 ± 0.03b | 0.57 ± 0.09b |
| 6 Raw           | 8.43 ± 1.56b | 4.48 ± 0.38a | 44.47 ± 0.66a | 35.74 ± 1.19a | 0.39 ± 0.03a | 0.81 ± 0.23a | 11.89 ± 0.49b | 2.75 ± 0.75b | 0.46 ± 3.28a | 0.34 ± 0.05a | 0.71 ± 0.20a |
| Roasted         | 9.13 ± 1.72a | 4.03 ± 1.09b | 42.68 ± 0.71b | 34.17 ± 1.61b | 0.23 ± 0.07b | 0.69 ± 0.15b | 12.13 ± 0.13a | 2.81 ± 0.73a | 0.45 ± 1.86b | 0.21 ± 0.03b | 0.63 ± 0.21b |
| 7 Raw           | 8.45 ± 1.15b | 4.76 ± 1.17b | 43.35 ± 1.25a | 35.48 ± 1.54a | 0.25 ± 0.05a | 0.78 ± 0.09a | 11.76 ± 0.21b | 2.70 ± 0.39b | 0.46 ± 1.67a | 0.29 ± 0.07a | 0.65 ± 0.09a |
| Roasted         | 9.06 ± 1.45a | 4.83 ± 0.23a | 42.52 ± 1.63b | 33.98 ± 0.86b | 0.19 ± 0.03b | 0.67 ± 0.08b | 12.24 ± 0.45a | 2.79 ± 0.66a | 0.53 ± 2.47b | 0.19 ± 0.03b | 0.54 ± 0.07b |
| 8 Raw           | 8.27 ± 1.14bc| 4.55 ± 0.19b | 43.14 ± 1.54a | 35.33 ± 0.98a | 0.21 ± 0.03a | 0.75 ± 0.13a | 11.59 ± 0.07b | 2.59 ± 1.18b | 0.46 ± 2.56a | 0.31 ± 0.07a | 0.61 ± 0.08a |
| Roasted         | 8.98 ± 0.68b | 4.68 ± 0.54a | 42.38 ± 1.31b | 32.84 ± 0.91b | 0.17 ± 0.06b | 0.64 ± 0.05b | 12.05 ± 0.35a | 2.75 ± 1.32a | 0.45 ± 1.89b | 0.23 ± 0.09b | 0.48 ± 0.11b |

*mean = standard deviation; **Values with in each column followed by different letters are significantly different (p<0.05); (n=3)
Table 3  Tocopherol of raw and roasted peanut kernel oils (mg/100 g).

| Storage (months) | NC-7 | COM |
|------------------|------|-----|
|                  | α-tocopherol | γ-tocopherol | δ-tocopherol | Total (mg/100 g) | α-tocopherol | γ-tocopherol | δ-tocopherol | Total (mg/100 g) |
| 0 Raw            | 17.29 ± 1.23*a | 15.76 ± 0.52b | 0.71 ± 0.13b | 33.57 | 20.38 ± 0.76b | 21.57 ± 1.11b | 0.98 ± 0.13b | 42.52 |
| Roasted          | 17.98 ± 1.18**a | 16.13 ± 0.87a | 0.93 ± 0.21a | 35.31 | 21.45 ± 1.26a | 22.57 ± 1.45a | 1.17 ± 0.07a | 45.19 |
| 1 Raw            | 17.23 ± 1.45a | 15.63 ± 0.43b | 0.75 ± 0.09b | 33.80 | 20.18 ± 1.13b | 21.36 ± 2.37b | 0.95 ± 0.13b | 42.86 |
| Roasted          | 17.41 ± 0.96a | 15.89 ± 0.89b | 0.89 ± 0.11a | 34.19 | 20.67 ± 0.87b | 22.09 ± 2.06a | 0.98 ± 0.09a | 43.74 |
| 2 Raw            | 16.96 ± 0.63b | 15.36 ± 0.47b | 0.68 ± 0.07b | 33.00 | 20.13 ± 0.45b | 21.35 ± 1.53b | 0.85 ± 0.21a | 42.33 |
| Roasted          | 17.11 ± 0.78a | 15.55 ± 0.33b | 0.81 ± 0.23a | 33.47 | 20.25 ± 1.28b | 21.78 ± 2.43b | 0.76 ± 0.03b | 42.79 |
| 3 Raw            | 16.13 ± 2.36b | 15.17 ± 0.36c | 0.61 ± 0.11b | 31.91 | 19.87 ± 1.45c | 21.14 ± 2.67b | 0.68 ± 0.01a | 41.69 |
| Roasted          | 16.98 ± 1.56b | 15.23 ± 0.32c | 0.73 ± 0.09a | 32.94 | 20.07 ± 1.63b | 21.46 ± 3.48b | 0.65 ± 0.07b | 42.18 |
| 4 Raw            | 15.78 ± 0.87c | 15.03 ± 0.98c | 0.57 ± 0.03b | 31.38 | 19.66 ± 1.38c | 20.89 ± 1.38c | 0.67 ± 0.12a | 41.22 |
| Roasted          | 16.67 ± 0.56b | 15.18 ± 1.28c | 0.69 ± 0.12a | 32.54 | 19.98 ± 1.24c | 21.15 ± 2.56b | 0.59 ± 0.09b | 41.72 |
| 5 Raw            | 15.88 ± 1.25c | 15.21 ± 1.45c | 0.51 ± 0.07b | 31.60 | 19.32 ± 1.89c | 20.56 ± 1.67c | 0.56 ± 0.05a | 40.44 |
| Roasted          | 16.45 ± 0.56b | 15.36 ± 1.76b | 0.63 ± 0.03a | 32.44 | 19.44 ± 2.36c | 21.03 ± 2.54b | 0.55 ± 0.01b | 41.02 |
| 6 Raw            | 15.67 ± 0.23c | 15.13 ± 1.68c | 0.46 ± 0.04b | 31.26 | 19.21 ± 2.56c | 20.33 ± 1.48c | 0.53 ± 0.07a | 40.07 |
| Roasted          | 16.35 ± 0.19b | 15.24 ± 1.93b | 0.58 ± 0.07a | 32.17 | 19.25 ± 1.56c | 20.67 ± 1.76c | 0.51 ± 0.11b | 40.43 |
| 7 Raw            | 15.55 ± 0.45c | 15.04 ± 1.34c | 0.47 ± 0.03b | 31.06 | 18.45 ± 1.87d | 20.14 ± 2.48c | 0.48 ± 0.07c | 39.07 |
| Roasted          | 16.13 ± 0.73b | 15.11 ± 1.46c | 0.57 ± 0.07a | 31.81 | 19.09 ± 1.34c | 20.28 ± 2.89c | 0.46 ± 0.09d | 39.83 |
| 8 Raw            | 15.36 ± 0.81c | 15.02 ± 1.33c | 0.43 ± 0.09b | 30.81 | 17.58 ± 0.98c | 19.79 ± 1.76d | 0.47 ± 0.03c | 37.84 |
| Roasted          | 16.07 ± 0.48b | 15.08 ± 1.29c | 0.46 ± 0.05a | 31.58 | 18.64 ± 1.09d | 20.07 ± 1.42c | 0.45 ± 0.07d | 39.16 |

*mean ± standard deviation; **Values within each column followed by different letters are significantly different (p<0.05); (n=3)
ship between in peroxide values and the reduction tocopherol contents were found. α-Tocopherol, γ-tocopherol and δ-tocopherol contents of Virginia and SunOleic peanut oils were determined as 162 and 201 mg/100 g, 134 and 214 mg/100 g and 6 and 11 mg/100 g, respectively. This agree with the results of some researchers.11, 22) Also, the oxidation of fatty acids becomes significant after an induction period during which antioxidants are destroyed11, 22). According to Zacheo et al.11, and Garcia-Pascual et al.13, shelf-life could be due to reduction of peroxidation, and natural antioxidants such as tocopherol could be increase. All the peanut samples showed differences in their tocopherol contents and fatty acid composition, and the differences were significant at the levels of p < 0.05. The influence of temperature on the rate of rancidity development must be taken into account when shelf-life studies are undertaken. The variety of peanut can play important role in composition and the shelf-life of the product. The composition and oil properties of plant kernels depends upon the variety, soil structure, climates, growing and processing conditions.

4 CONCLUSION

Moisture and oil contents were not affected by the storage e of the raw samples. Significantly in the roasted kernels in comparison to raw ones i.e. moisture content decreased whereas oil content increased. A significant relationship was found between the increase of the peroxide value and fatty acids and the decrease of tocopherol contents and fatty acid compositions of both raw and roasted peanut oils. Raw and roasted peanut kernels could be stored till 4-5 months without a serious loss in quality when they were stored in sealed cloth bag at 30°C. An increase in peroxide was observed throughout storage time. The tocopherol and fatty acids especially oleic, linoleic) contents decreased throughout the experiment in kernel of the two peanut varieties. The crude oil, peroxide value and free fatty acidity values, fatty acid composition and mineral contents of peanut and its oil were found to be different depending on the processing and analyses conditions. Oven roasting did not increase the oleic and linoleic of roasted peanut oil, while oven roasting increase peroxide values and tocopherol contents of roasted peanut oil. From acidity and peroxide value results obtained, raw and roasted peanut kernels of NC-7 cv and ÇOM peanut cv became unacceptable after 5 and 4 months storage, respectively. But, because of the high content of oil, protein, oleic and linoleic acid, α-, β- and δ-tocopherol contents of the ÇOM peanut variety, it is preferable to NC-7 cv.

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