Sensory and Oxidative Stability of Roasted Peanuts Coated with Arabic Gum and A Synthetic Antioxidant During Storage

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Abstracts: The impact of coating formulations containing Arabic gum (AG) and Arabic gum with 100 ppm BHT on the oxidative stability and sensory attributes of roasted peanuts during a 120-day storage period at room temperature (RT) was investigated and compared to roasted, uncoated peanuts (control). The oxidative stability of raw peanuts (P), roasted peanuts (RP), roasted and coated peanuts with Arabic gum (RCP-AG), and roasted and coated peanuts with Arabic gum and 100 ppm BHT (RCP-AG-BHT) was determined based on parameters such as free fatty acids percentage (FFA%), peroxide value (PV), p-Anisidine value (pAV), Totox value (TV), and sensory properties at intervals of 0, 30, 60, and 120 days.The estimated coating percentage (CP %) for all treatments is about 2.5% and the yield of oil from hydraulic pressed peanuts kernels and treatments were ranged from 35.6 to 47.1%. Nine fatty acids were identified from raw and roasted peanuts oil and characterized by large percentage of unsaturated fatty acids (USFAs) (82.1 %) with large proportion of oleic acid (49.45%) and linoleic acid (31.92%), while saturated fatty acids were 17.9%, with large proportion of palmitic acid (11.36%) followed by stearic acid (3.48%) in RP. The FFA (%) of extracted raw peanuts oil was 0.68%, this percentage was increased after roasting significantly ($p< 0.05$) in all treatments and control, but it didn't increase during storage period. An increase in PV values of roasted and treated samples were noticed throughout the storage time. After 4 months of storage, the maximum value of PV was (75.1 meq/kg) recorded by the roasted sample (RP), whereas the minimum value was (43.9 meq/kg) recorded by (RCP-AG- BHT). pAV increased significantly after roasting and during storage time in all peanuts samples. However, RP-AG-BHT showed no significant differences in pAV after one month of storage. An increase in TV values of roasted and treated samples were noticed throughout the storage time, while the TV for RP-AG and RP-AG-BHT where less when compared with the control (RP). There were no significant differences ($P < 0.05$) in the color, hardness and crunchiness between control and treatments after 2 months of storage. However, Glossiness, rancidity and off-flavor were significantly affected.

Keywords: Roasted Peanuts Coated, Arabic Gum, BHT, Sensory and Oxidative Stability

1. INTRODUCTION

Peanut (*Arachis hypogaea L*.) is an important crop in many parts of the world, and China is considered the largest peanut producer with more than 8000 verities [1]. Due to its high contents of oil and protein, pleasant aroma, unique nutty flavor and smooth crisp texture large proportion of peanut production is used for domestic foods [2]. Dry peanut seeds typically contain approximately 20-27% proteins, 10-13% carbohydrates, 6-8% fibers, 2-3% ash and 45-54% oil. Peanut oil contains approximately 41-67% oleic acid (18:1) and 30-35% linoleic acid (18:2) [3][4]. Owing to their high oil content and elevated unsaturated fatty acid concentration, peanuts are susceptible to developing rancidity and off-flavors through lipid oxidation [5]. The oxidation reactions lead indirectly to the formation of numerous aliphatic aldehydes, ketones and alcohols [6]. Simultaneously, off-flavours like oxidised, cardboard and painty increase in peanuts products [7][8][9][10].

The oxidation products show harmful effects for human health such as heart disease, emphysema, mutagenesis and carcinogenesis [11]. Synthetic antioxidants, such as butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT) and propyl gallate (PG), are used in many foods to prevent rancidity. However, their safety for human health is questionable [12]. Natural antioxidants like essential oils and tocopherols can act as natural antioxidant [13][14], and their activity has been evaluated in peanut product with the goal to decrease deterioration process and to increase their shelf life [15][13]. The antioxidant effect of these compounds is not enough in many cases. Then, edible coatings could be an alternative to replace them or to complement the preserving effect on the product.

Edible films and coatings play an important role in the quality, safety, transportation, storage and display of a

wide range of fresh and processed foods. These food coatings are an innovation within biodegradable active packaging concept, which interacts with food to extend shelf life and improve safety and/or functional or sensory properties and improving the stability in lipid-containing foods, thus preventing a loss in sensory and nutritional quality [5]. Edible films may prevent moisture loss and oxygen diffusion, and may be used as a vehicle for additives such as antioxidants.

Edible coatings can be classified into three categories: hydrocolloids, lipids and composites [16]. In addition, edible coatings prepared with hydrocolloid compounds can decrease the oil absorption in fried food products. High oil content in fried products as banana chips or oil-roasted peanuts shortens the shelf life of the product. Edible coating prepared with guar or xanthan gums solutions has a remarkable effect of reducing the amount of oil absorption making that this kind of fried product, healthier snacks for consumers.

Researchers have shown that peanuts treated with several coatings like CMC, MC, WPI and ZEIN (corn protein) coatings become more stable and increased their shelf life [17][18][19]. Roasted peanuts coated with edible film may preserve the intensity ratings of their sensory attributes for longer because of edible coatings act as oxygen barrier decreasing deterioration process [20][21][22]. Arabic gum has excellent edible film forming capability [23][24]. It is composed of complex branched, heteropolysaccharide with a inked galactopyranose or arabinose units terminating in rhamnose or glucuronic acid or 4-O-methylglucuronic acid residues [25]. All the components of AG consisted multiple polar (–OH and C═O) groups.

Natural antioxidant activities of essential oils and vitamin E has been used to increase the shelf life of peanut products, but their activities were low [15][13], thus edible coatings like Arabic gum with or without synthetic antioxidants can be an alternative to enhance the oxidative stability and sensory attributes of roasted peanuts. The purpose of this work is to evaluate the sensory and oxidative stability of raw, roasted, roasted and Arabic gum coated peanuts.

2. MATERIEL AND METHODS

Imported and vacuum packed raw and mature seeds of the peanut (crop 2020, China) was purchased from BRAVO company in Amman (Jordan). Before processing, peanuts were inspected, and damaged or bruised kernels were removed manually.

Sample treatments for the experiment was as follows: Raw peanuts (P) and uncoated roasted peanuts (RP) as control samples, roasted and coated peanuts with Arabic gum (RCP-AG), roasted and coated peanuts with Arabic gum and 100 ppm BHT (RCP-AG-BHT).

2.1. Arabic Gum Edible Coat Preparation

The Arabic gum granules (Hashab, Sudan origin) offered by BRAVO roasting company was prepared in ratio of 1:1 (w/v) by soaking with water. The solution of Arabic gum was prepared as follows; 500 g of Arabic gum granules with and without 100 mg BHT (dispersed separately in 20 ml ethanol) was mixed with 500 ml of distilled water followed by stirring the mixture (using magnetic stirrer) until the gum granules was completely dissolved.

2.2. Peanuts Roasting and Coating

Peanuts was roasted using domestic rotating (centrifugal) roaster at 140 °C, rotating at 28 rpm for around 20 min, then 20 kg of roasted peanuts was coated (while hot) with 1 liter of Arabic gum suspension (1:1) using centrifugal forces through the previously used rotating roaster by gradual pouring of Arabic gum coat suspension with and/or without BHT at Bravo company (Amman- Jordan). The drying off process after roasting and coating was performed with the objective to leave the product with its characteristic moisture (between 1.2 and 2.0%) by spreading coated or roasted peanuts on perforated stainless-steel tray until reaches RT. The coating percentage (CP) (%) was determined calculated according to equation (1)

$$CP\ (\%) = \frac{\text{weight of coated peanut kernels} - \text{weight of original peanut kernels}}{\text{weight of original peanut kernels}} * 100 \quad (1)$$

2.3 Storage Conditions and Samplings

After preparation, samples were placed in perforated plastic bags. The samples were stored at 23°C ± 2°C (room temperature). Samples from each product were removed from storage bags to evaluate chemical and sensory indicators of lipid oxidation. Samples were taken at 0, 30, 60 and 120 days. This storage time was chosen because roasted peanut product has atypical shelf life of less than 120 days for commercial brands in Jordan. Therefore, it is possible to draw conclusions about the effects of treatments in the shelf life,

2.4 Chemical Analysis

2.4.1 Peanut Oil Extraction; Oil was extracted from the roasted peanuts using a hydraulic press machine equipped with heater (Oilmaster, Dongguan Chuguan Electric Appliance Co., Ltd, Dongguan, China). The obtained oil was used for chemical analysis: peroxide value, P- Anisidine value, free fatty acid (%) and Totox value.

2.4.2 Peroxide Value (PV) was evaluated according to AOAC method [26], and was expressed as milliequivalents of active oxygen per kilogram of oil.

2.4.3 Free Fatty Acids (%) was evaluated according to AOAC method [26], and was expressed as oleic acid

2.4.4 p-Anisidine Value (pAV). pAV was evaluated following the IUPAC method (IUPAC, 1987) at 350 nm using UV-Visible spectrophotometer (Model UVD-2950, Labomed, Inc.). The p-anisidine value was calculated by the formula: AV= 25x (1.25 (As-Ab)/w where “As” is absorbance of the fat solution after reaction with the p-anisidine reagent, “Ab” is the absorbance of the fat solution and “w” is the mass of peanut oil in grams.

2.4.5 Totox Value (TV). Totox value was calculated using the PV and AV results according to the formula: Totox value = 2 PV + AV.

2.4.6 Fatty Acids Composition. Fatty acid methyl esters (FAMEs) of the oil extracted from the olive fruits were prepared according [27].

2.4.7 Sensory Analysis. the following quality attributes after 2 months of storage: appearance, texture and taste and flavor. A 9 points hedonic scale (1= dislike extremely to 9= like extremely) according to [28] was used to evaluate the acceptability of samples. Samples were coded using random three-digit numbers in a randomized serving order.

2.4.8 Statistical Analysis. Statistical calculations were performed using statistical analysis system, SAS program [29]. A significant difference among means of treatments was determined using LSD test. Differences at $P<0.05$ was considered significant.

3. RESULT AND DISCUSSION

3. 1. Moisture Contents, Coating Percentage (CP %) and Yields of Oil from Peanuts Pressing

Table 1 shows the moisture contents and hydraulic press yields of oil in raw and treated peanuts. The roasted samples showed values of moisture content (1.78- 1.90%) which were lower than raw sample (5.57%), to exposure to high temperatures during roasting (140C/ 20 mints). There were no significant differences observed in moisture content after roasting between control (RP), roasted and coated peanuts with Arabic gum (RCP-AG) and roasted and coated peanuts with Arabic gum and 100 ppm BHT (RCP-AG-BHT), indicating a similar behavior of water evaporation from Arabic gum coating suspension during holding period of peanut kernels at roasting temperature.

The estimated coating percentage (CP %) for all treatments is about 2.5%, as calculated from equation 1. This may add economic benefit to producers due to the increase in yield of peanuts after coating.

The yield of oil from hydraulic pressed peanuts kernels was ranged from 35.6 to 47.1% (Table 1). The roasted peanuts yielded higher percentage of oil than that of raw peanuts; this was probably due to the peanut's protein denaturation due to roasting which could improve yield of oil pressing. Oil content of peanuts was reported to be 45-54% [22], and the variation in results may due to the efficiency of oil extraction which is highly affected by the sample composition, extraction time and temperature [30]. In our study, the target was to study the quality of the obtained oil after extraction and we did not consider the yield of oil as a goal.

Table1. Moisture contents and yields of oil from hydraulic press in raw and treated peanuts

Treatments	Moisture content (%)	Yield of oil extraction (%)
Raw (P)	**5.57 ± 0.04a**	**35.0**
Roasted (RP)	**1.81 ± 0.08b**	**47.1**
Roasted and coated with Arabic gum (RP-AG)	**1.78 ± 0.05b**	**46.3**
Roasted and coated with Arabic gum and BHT(RP-AG-BHT)	**1.90 ± 0.02b**	**39.6**

Each value represents the mean of two replicate ± SD, Different superscript within the same column is significantly different (P≤0.05).

3.2 Fatty Acids Profile of Peanuts Oil

Table (2) summarizes the composition of raw and roasted peanuts oil from Saturated and unsaturated fatty acids. Nine fatty acids were identified and characterized by large percentage of unsaturated fatty acids (USFA) in raw and roasted peanuts oil (82.4 and 82.1 %, respectively) with large proportion of oleic acid (49.69 and 49.45%, respectively) and linoleic acid (31.89 and 31.92, respectively %,). The linolenic fatty acid (0.69 and 0.63%, respectively) and palmetoleic acid (0.09 and 0.08%, respectively) were present in low proportion. The total saturated fatty acids (SFA) in raw and roasted peanuts oil were 17.6 and 17.9%, respectively. The predominant SFA in roasted peanuts oil was the palmitic acid (11.36%) followed by stearic acid (3.48%). The fatty acids profile of raw and roasted peanuts was almost similar and roasting did not affect highly the fatty acids composition. [22] Reported that the unsaturated fatty acids composition of peanuts oil was about 80% and oleic acids were ranged from 45-50%, and linoleic acids were ranged from 30-35% in different cultivars. Our results are in agreements with previous reports on fatty acids composition of peanuts oil from unsaturated fatty acids. However, this high composition of unsaturated fatty acids will expose the peanuts to oxidation which may affect the consumer's health and off-flavor formation which affect consumer acceptability of the product.

Table 2. Fatty acids composition (%) of raw and roasted peanuts oil.

Fatty Acid	Raw (%)	Roasted (%)
Saturated Fatty Acids (SFA)	**17.6**	**17.9**
C16:0➔Palmitic	**11.15**	**11.36**
C17:0➔Heptadecanoic acid	**0.06**	**0.07**
C18:0➔Stearic	**3.42**	**3.48**
C20:0➔Eicosanoic	**1.24**	**1.17**
C22:0➔Behenic acid	**1.68**	**1.82**
Unsaturated Fatty Acids (USFA)	**82.4**	**82.1**
C16:1➔Palmitoleic	**0.09**	**0.08**
C18:1➔Oleic	**49.69**	**49.45**
C18 :2 ➔ Linoleic	**31.89**	**31.94**
C18:3➔Linolenic	**0.69**	**0.63**

3.3. Effect of Storage on Free Fatty Acid (%) Of Peanuts Oil in Raw, Roasted and Treatments

Analysis of variance (ANOVA) was conducted to find the significant (P<0.05) in the variation of the mean values of FFA (%) throughout storage for raw and treatments of peanuts sample. Table (3) shows that there was a significant difference (p<0.05) between the acidity (%) of raw peanuts and treatments. However, there were no significant differences between treatments and control (RP) throughout the storage period. The values of FFA% of the raw samples was 0.68%, this percentage was increased during storage period due to lipase activity. However, after roasting the FFA (%) was increased significantly in all treatments and control, but didn't increased during storage period, and this may due to liberation or splitting of some fatty acids due to high roasting temperature at the beginning and inactivation of lipase enzyme which eliminate further development of acidity during storage period. In this study, the peanuts oil acidity (%) was not increased during storage and remains below 2%, which is the quality standard of codex for virgin oils [31].

Table 3. Effect of roasting, coating and storage on FFA (%) of peanut`s oil.

	Storage period (months)	Treatments			
		P	RP	RP-AG	RP-AG- BHT
FFA(%)	0	0.68±0.02b, i	0.90 ±0.07a,ii	0.90±0.04a,ii	0.87±0.05a,ii
	1	0.88±0.05a, ii	0.91±0.03 a, ii	0.92±0.06a, ii	0.88±0.03a, ii
	2	0.90±0.03a, ii	0.91±0.04a, ii	0.92±0.03a, ii	0.90±0.04a, ii
	3	0.91±0.04a, ii	0.92±0.06a, ii	0.93±0.05a, ii	0.91±0.02a, ii
	4	0.93±0.06a, ii	0.93±0.02a, ii	0.95±0.01a, ii	0.90±0.03a, ii

Each value represents the mean of triplicate ± SD, Different superscript (a,b,c and d) within the same column is significantly different (P≤0.05). Different superscript with Latin number (i and ii) within the same row is significantly different (P≤0.05).

3.4. Effect of Roasting, Coating and Storage on Peroxide Value (PV) Of Peanuts Oil in Raw, Roasted and Treatments.

A gradual increase in PV values of roasted and treated samples were noticed throughout the storage time as shown in table (4). The similar behavior of increase in PV was noticed in [7] study on fried-salted peanuts. After storage for 4 months, the maximum value of PV was (75.1 meq/kg) recorded by the roasted sample (P), whereas the minimum value was (43.9 meq/kg) recorded by the sample coated with Arabic gum and BHT (RP-AG- BHT) at room temperature. Data analysis showed that there were significant differences in PV values of raw peanuts (P) after one month of storage at room temperature; however, the changes in PV were not significant from 1 to 4 months of storage and remains below15 meq/kg, which is the quality standard of codex for virgin and cold press oils [31].

The sharp and significant increase in PV was noticed in the control sample (RP) in the second and forth months of the storage, while no significant differences was found after roasting and 1 month of storage. For example, the PV of the RP (control) stored for 4 months at room temperature was 75.0 meq/kg) which is twice greater than the value recorded by the same sample after direct roasting (34.97 meq/kg). Regarding the effect of treatment on the PV, data showed that there was a significant reduction in PV for the sample RP-AG and RP-AG-BHT when compared with the control (RP) at storage condition. For example, the PV for sample RP-AG and RP-AG-BHT stored at room temperature for 4 months were 47.6 and 43.9 meq/kg, respectively, while in control it was 75.1 meq/kg. The low oxidative stability of roasted peanuts and formation of primary products resulted from propagation of radicals due to low content of natural antioxidant vitamin E (8.3 mg/ 100g).

coating roasted peanuts with Arabic gum act as barrier to moisture and oxygen and improve significantly the stability of roasted peanuts oil when compared with control.

Table 4. Effect of roasting, coating and storage on peroxide value (PV) of peanuts.

	Storage Time month	Treatments			
		P	RP	RP-AG	RP-AG-BHT
Peroide value PV (meqO2/kg)	0	1.44±0.51b,i	34.97±0.82d,ii	31.51±1.41b,ii	33.11±2.01b,ii
	1	2.80±0.72a,i	36.71±1.30 d,ii	33.30± 2.06b,ii	33.80±1.83b,ii
	2	2.85±0.41a,i	50.63±0.91c,iii	44.94±1.34a,ii	42.90± 0.97a,ii
	3	2.88±0.46a,i	65.22±1.91b,iii	45.13±1.22a,ii	42.34± 0.62a,ii
	4	2.92±0.53a,i	75.10±0.85a, iv	47.62±0.91a,iii	43.92±1.11a,ii

Each value represents the mean of triplicate ± SD, Different superscript (a,b,c and d) within the same column is significantly different (P≤0.05). Different superscript with Latin number (I, ii, iii, iv) within the same row is significantly different (P≤0.05).

3.5. Effect of Roasting, Coating and Storage On P-Anisidine Value (Pav), Of Peanuts Oil in Raw, Roasted and Treatments.

p-Anisidine value (pAV) measures the secondary products of oxidation resulted from peroxide radical degradation to give volatile compounds like aldehydes primarily 2-alkenals and 2,4-alkadienals generated due to hydroperoxide decomposition, and it is more sensitive to unsaturated aldehydes in oil and fat [32]. pAV increased significantly with storage time in all treated peanuts samples including raw peanuts (P). Marked increase in AV is noticed during storage after 1 month with respect to control (3.95), RP-AG (3.77) and RP-AG-BHT (3.70). However, RP-AG-BHT had the lowest pAV and showed no significant differences after one month of storage until the end of the study rather than RP-AG and RP. Our results are in agreement with [33], who reported that roasted peanuts coated with WPI stored at ranges of temperatures (40-60 C) for 31 weeks were oxidized slower than control. Also, [21] showed that peanuts coated with CMC and natural antioxidant from pomegranate improved the oxidative stability of roasted peanuts during storage. In this study, RP-AG-BHT and RP-AG showed more oxidative stability during storage than the control and AV values were less than 10, which is the quality standard for an oil to be acceptable [34]. Sensory deterioration of roasted peanuts (P), the control, was noticed after 2 months of storage but it was not detected in other treatments by panelists indicating more stability of treatments.

Table 5. Effect of roasting, coating and storage on p-Anisidine value (pAV) of peanut`s oil.

	Storage period (months)	Treatment			
		P	RP	RP-AG	RP-AG-BHT
p-Anisidine value	0	0.8±0.05d, i	1.92±0.04 d, ii	1.67±0.11 d, ii	1.71±0.13 b, ii
	1	1.14±0.02c, i	3.95±0.15c, ii	3.77±0.06 c, ii	3.70±0.14a, ii
	2	1.80±0.04b, i	4.60 ±0.11 b, iii	3.96±0.02b, ii	3.91±0.09 a, ii
	3	1.96±0.09 a, i	5.10 ±0.13 a, iii	4.06±0.00b, ii	3.93±0.05 a, ii
	4	2.08±0.08a, i	5.32±0.20 a, iii	4.25 ±0.10a, ii	3.91±0.20 a, ii

Each value represents the mean of triplicate ± SD, Different superscript (a,b,c and d) within the same column is significantly different (P≤0.05). Different superscript with Latin number (I, ii, iii, iv) within the same row is significantly different (P≤0.05).

3.6. Effect of Roasting, Coating and Storage on Totox Value (TV) Of Peanuts Oil in Raw, Roasted and Treatments.

Totox value measured both primary and secondary products (PV and pAV) of oil and fat oxidation. After formation of primary products, some of these products are oxidized more and split to give secondary products like aldehydes or ketons. Results reported in table (6) shows the lipid oxidation behavior and primary and secondary products of oxidation measured as TV for control and treated samples of peanuts oil during storage for 3 months at room temperature. An increase in TV values of roasted and treated samples were noticed throughout the storage

time. After storage for 4 months, the maximum value of TV was (155.5) recorded by the roasted sample (P) at room temperature, whereas the minimum value was (91.75) recorded by the sample RP-AG- BHT at room temperature. There were no significant differences in TV values of raw peanuts (P) after one month of storage at room temperature. The significant increase in TV was noticed in the control sample (RP) in the second month of storage, while no significant difference was found after roasting and 1 month of storage. Data of this study showed that there was a significant reduction in TV for the sample RP-AG and RP-AG-BHT when compared with the control (RP) at storage condition in the second and fourth months. For example, the TV for sample RP-AG and RP-AG-BHT stored at room temperature for 4 months were 99.49 and 91.75, respectively, while in control it was 155.5. The low oxidative stability of roasted peanuts and formation of primary and secondary products resulted from propagation and subsequent termination of radicals. German society for fat sciences recommended a Totox value of less than 20 for refined and virgin vegetable oils [35].

Researchers reported that CMC, MC and whey protein coatings protect roasted peanuts and walnuts against the deterioration and improved the chemical and sensory indicators [36] [20][21][22]. Thus, coating roasted peanuts with Arabic gum act as barrier to moisture and oxygen and improve significantly the stability of roasted peanuts oil when compared with control.

Table 6. Effect of roasting, coating and storage on Totox value (TV) of peanut`s oil.

	Storage period (months)	Treatment			
		P	RP	RP-AG	RP-AG-BHT
Totox value	0	3.68± 0.51b,i	71.86± 0.82e, iii	64.69 ± 1.41d,ii	67.93 ± 2.01b,ii
	1	6.76±0.72a,i	77.37± 1.30 d, iii	70.37± 2.06c,ii	71.30 ± 1.83b,ii
	2	7.52 ± 0.41a,i	105.32±0.91c, iii	93. 84±1.34b,ii	89.71 ±1.97a,ii
	3	7.72± 0.64a,i	135.54± 1.91b, iv	94.32±1.22b,iii	88.61± 0.62 a,ii
	4	7.92±0.53a,i	155.52±0.85a, v	99.49 ± 0.91a, iii	91.75 ± 1.11a,ii

Each value represents the mean of triplicate ± SD, Different superscript (a,b,c and d) within the same column is significantly different (P≤0.05). Different superscript with Latin number (I, ii, iv) within the same row is significantly different (P≤0.05).

3.7. Sensory Analysis

A nine-point hedonic scale for sensory analysis of all samples was performed by 30-member panel from the department of nutrition and food technology at the university of Jordan for roasted peanuts (RP) and treatments after 2 months of storage. The evaluation of the sample was performed with the use of six descriptors which were previously provided by a sensory panel: brown color, glossiness, hardness, crunches, rancid and off-flavor. All samples were evaluated in partitioned booths at room temperature. Hundred grams (100g) of the control (RP), RP-AG and RP-AG-BHT samples were placed into plastic dish with lids coded with two digits random numbers. Means ratings of sensory attributes obtained are presented in table 7. Results of this study showed that there are no significant differences ($P < 0.05$) in the color, hardness and crunchiness between control and treatments. Glossiness, rancidity and off-flavor were the attributes that highly and significantly affected. Glossiness deterioration was observed in control sample (RP), also the intensity of rancidity was increased. The coating process improved the glossiness of roasted peanuts significantly; however, the flavor deterioration of roasted and uncoated peanuts was mainly related to the rancid flavor. In general, the roasted and coated peanuts showed higher values of acceptance among panelists than control using the nine-point hedonic scale. Similar researchers showed that coating peanuts with different edible films (CMC, MC, honey) could improve the crunchiness and intensity of other attributes [22][33]. Correlations between chemical tests of treatments and rancid, and off-flavor after 2 months of storage were detected through the study, because results of PV and pAV were significantly higher in control (RP) than treatments.

PV and pAV are often used to evaluate the lipid oxidation in oils with sensory data. [37] showed that the correlation between sensory and PV and pAV data was very poor because lipid hydroperoxides resulted from lipid oxidation were not responsible for off-flavor formation due to its broken down to secondary oxidation products

during the later stages of oxidation and low PV did not necessarily indicate that the lipids are not oxidized. Also, he showed that pAV in some samples was high despite a high flavor acceptability score. This finding could indicate that the sensitivity and specificity of this method is too low to detect the changes in concentrations of volatiles responsible for the off-flavor formation.

Table 7. Different sensory attributes (9-points hedonic scale) of roasted peanuts and treatments after 2 months of storage.

Treatment	Color	Glossiness	Hardness	Crunchiness	Rancid	Off-flavor
RP	7.10± 0.71a	4.23± 0.21 b	7.00± 0.37 a	7.13± 0.23 a	5.44± 0.34 b	4.01± 0.42 b
R+AG	7.43±0.46 a	7.25± 0.51 a	7.23± 0.35 a	7.28± 0.18 a	7.15± 0.25 a	7.55± 0.52 a
R+AG+BHT	7.83±0.27 a	7.51± 0.28 a	7.32± 0.40 a	7.33± 0.26 a	7.18± 0.41 a	7.33± 0.62 a

Each value represents the mean of 30 panelists scoring ± SD, Different superscript (a,b,c and d) within the same column is significantly different (P≤0.05).

CONCLUSIONS

Arabic gum suspension with water in ratio of 1:1 is the best formulation to coat roasted peanuts and peanuts roasting resulted in an increase in FFA (%), PV and p-AV and limits the shelf life of roasted peanuts during storage. Arabic gum coatings with or without BHT improve the stability of roasted peanuts and make it more resistant to lipid oxidation, preserve the sensory properties, improved the glossiness, reduces the off- rancid flavor and elongate the shelf life of the products.

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