Research Article

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Effect of prickly pear and algarrobo pod syrup coatings on consumer acceptance and stability of roasted almonds

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Abstract

BACKGROUND: The objective of this study was to evaluate the oxidative stability of roasted almonds coated with prickly pear and 'algarrobo' pod syrups and the effect of these coatings on consumer acceptance.

RESULTS: Prickly pear syrup had higher moisture, proteins, ashes and lipids, and lower carbohydrate content, than algarrobo pod syrup. Phenolics and antioxidant activity such as inhibition percentages of diphenyl picryl hydrazyl radical were higher in prickly pear syrup than algarrobo pod syrup. Roasted almonds had higher protein and lipid contents and lower total carbohydrates than coated almonds. Three main fatty acids detected in all almond products were palmitic (63.2 g kg^{-1}), oleic (727.0 g kg^{-1}) and linoleic (208.0 g kg^{-1}) acids. The overall acceptance means in roasted almonds, roasted almonds coated with prickle pear syrup and roasted almonds coated with algarrobo pod syrup were 6.83, 6.65 and 6.70, respectively, on a 9-point hedonic scale. The peroxide and anisidine values increased in all products. The increase was higher in roasted almonds without coating.

CONCLUSION: These results indicated that the syrup coatings provided protection against lipid oxidation in almond products. Prickly pear syrup showed better protection against lipid oxidation.

Keywords: almond; coating; *Opuntia*; *Prosopis*; stability; sensory

INTRODUCTION

The algarrobo tree, *Prosopis* spp., is found in America, Africa, Europe (Spain) and West Asia. *Prosopis* spp. are considered an important human and animal food source in arid and semi-arid regions of the world.[1] In Argentina, *Prosopis* spp. are located in the west-central areas of arid regions. Previous research on *Prosopis* spp. indicates that pods have 400–550 g kg^{-1} carbohydrate content. Because of their high sugar content, different food products have been obtained from the pods. One of them is a kind of syrup called 'arrope de algarrobo'. This dark and thick syrup is obtained by boiling the algarrobo' pods.[2–5] Antioxidant activity was found in leaves and pods of Chilean *Prosopis* spp.[6] The activity was related to the total phenolic content, consisting mainly of catechin components.

The prickly pear, *Opuntia ficus-indica*, originates from Mexico and the Caribbean. In Argentina, this species has economic importance since it is grown for fruit production in arid regions. These fruits are consumed as fresh fruit or cooked to produce syrup, jelly and jam. The processed fruits cooked in their juice until the sugar is concentrated result in a sweet and dark syrup called 'arrope de tuna'. The consistency of this syrup is similar to honey and it has an intense sweet flavor and high energetic value.[5] Researchers have found antioxidant properties in extracts from prickly pears.[7] Betalain pigments (betanin and indicaxanthin) contribute to the antioxidant activity as a result of their reducing properties.

Almonds belong to the group of dry fruits and are consumed as raw or roasted products. Fat content (500–650 g kg^{-1}) is the main fraction in almond. During the roasting process, high temperatures provoke changes in color, flavor and texture of the almonds. Various physical and chemical processes such as dehydration and non-enzymatic browning can affect lipid stability in the almond kernels resulting from roasting.[8,9]

Edible coatings in almond products may prevent moisture loss and oxygen diffusion, may be used as a vehicle for additives such as antioxidants and flavoring agents, and may improve some sensory attributes, increasing consumer acceptance of the product. For that reason, edible coatings could be used as a method for increasing the shelf-life of food products and improving the stability of lipids and lipid-containing foods, thus preventing loss of sensory and nutritional quality.[10,11] In previous works, honey was used in the coating, showing a positive effect regarding

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consumer acceptance and product stability.[12,13] Prickly pear and algarrobo pod syrups ('arropes') could be use as an edible coating layer considering their chemical composition and their potential antioxidant properties. In addition, these edible coatings of syrups ('arropes') could also affect sensory properties of the product, roasted almonds making them sweeter and with different texture, increasing the hardness and crunchiness.

The objective of this study was to evaluate the oxidative stability of roasted almonds coated with prickly pear and algarrobo pod syrups and the effect of these coatings on consumer acceptance.

MATERIALS AND METHODS

Materials

Sound and mature kernels of raw almonds (*Prunus amygdalus* Basch) (crop 2006, Non Pareil variety) were obtained from Coquimbito, Maipú, Mendoza, Argentina. Before processing almonds were inspected, and damaged and bruised kernels were manually removed.

Syrup elaboration

Syrups called 'arropes' were elaborated from fruits of *Opuntia ficus-indica* (prickly pear) and *Prosopis* spp. (algarrobo) obtained from Quillino, Córdoba, Argentina. Five hundred grams of selected and clean fruits, 125 g sugar and 200 mL water were boiled for 1 h. These cooked fruits were cooled and ground. The preparation was then filtered and the solid residues were discarded. Finally, the liquid part was boiled for one more hour.[5]

Product elaboration

Roasted almonds (RA)

Almonds were roasted at 140 °C in an oven (Memert, model 600, Schwabach, Germany) for 30 min.

Roasted almonds coated with prickle pear syrup (RA-P)

This product was prepared with 850 g kg^{-1} RA and 50 g kg^{-1} prickle pear syrup and 100 g kg^{-1} dried-solid mix. A dried-solid mix was elaborated with 700 g kg^{-1} impalpable sucrose, 200 g kg^{-1} impalpable salt and 100 g kg^{-1} corn starch. RA was placed into a stainless steel coating pan rotating at 28 rpm. The syrup was then applied to the RA. Finally, dried-solid mix was poured into the coating pan to separate the kernels.

Roasted almonds coated with algarrobo pod syrup (RA-A)

This product was prepared using the same procedure described for RA-P: 850 g kg^{-1} RA, 50 g kg^{-1} algarrobo pod syrup and 100 g kg^{-1} dried-solid mix.

RA-P and RA-A samples, after the coating process, were heated again at 140 °C for 10 min to eliminate the extra moisture added with the coating layer.

Chemical analysis

Proximate composition of syrups and almonds samples

Moisture, lipids, proteins and ashes were analyzed according to AOAC methods.[14] The nitrogen content was converted to protein percentage using the factor 6.25. Carbohydrate content was estimated by difference of the other components using the following formula: carbohydrate content (g kg^{-1}) = 1000 − (moisture + protein + oil + ash).

Reducing sugars, apparent sucrose and total sugars in the syrups

Reducing sugars in the syrups were quantified following the Fehling–Causse–Bonans volumetric method.[15] The apparent sucrose and total sugars were quantified following the same method on hydrolyzed syrups with chlorhydric acid.[16]

Total phenolic compounds in the syrups

The phenolic content of the syrups was determined spectrophotometrically using the Folin–Ciocalteu method according to Waterman and Mole.[17] Phenolics were extracted from syrups with methanol (Anedra, San Fernando, Buenos Aires, Argentina). The reaction was developed using Folin–Ciocalteu reagent (Anedra), and absorbance was measured with a PerkinElmer spectrophotometer (Lambda 25 UV-visible spectrometer, Beaconsfield, UK) at 760 nm. The concentration of total phenolic compounds in the extracts was determined by comparison with the absorbance of gallic acid 1-hydrate (Panreac, Montplet & Esteban SA, Barcelona, Spain). Total phenolic content was expressed as g gallic acid kg^{-1} dry syrup.

Radical-scavenging activity of the syrups

The radical-scavenging activity of the syrups was determined using diphenyl picryl hydrazyl radical (DPPH) (Aldrich, Milwaukee, WI, USA) according to Schmeda-Hirschmann *et al.*[18] Absorbance of solutions was measured at 517 nm with a PerkinElmer Lambda 25 UV-visible spectrometer). The radical-scavenging activity was expressed as % DPPH inhibition.

Fatty acid composition of almond products

Fatty acid methyl esters were prepared from oils from raw almonds and roasted almonds (RA, RA-A and RA-P) by transmethylation with a 3 g L^{-1} solution of sulfuric acid in methanol. The fatty acid methyl esters of total lipids were analyzed on a Hewlett Packard HP-6890 gas–liquid chromatograph (Palo Alto, CA, USA) equipped with a flame ionization detector (FID HP-3398). An HP-INNO-Wax capillary column (30 m × 0.32 mm × 0.5 nm) was used. Column temperature was programmed from 200 °C (held for 1 min) to 230 °C (20 °C min^{-1}). The separated fatty acid methyl esters were identified by comparing their retention times with those of authentic samples purchased from Sigma Chemical Co. (St Louis, MI, USA). Quantitative fatty acid analysis was performed using heptadecanoic acid methyl ester (Sigma) as internal standard.[19]

Sensory analysis

Consumer test of almonds products

Panelists (n = 100) were from Córdoba (Argentina) and were recruited according to the following criteria: (a) people between the ages of 18 and 65; (b) non-smokers; (c) people without food allergies; and (d) people who consumed roasted almonds and/or almond products at least twice a week. For sample evaluation, 5 g almond samples were placed into plastic cups with lids coded with 3-digit random numbers. Samples consisting of roasted and coated almonds RA, RA-P and RA-A (three replications of each one) were prepared for each panelist. Samples were presented to panelists in random order during the test day. Samples were presented with water and paper ballots on a plastic tray. Panelists were instructed to consume the whole sample and rinse their mouths with water between samples to minimize any residual effect. A 9-point hedonic scale ranging from 1 (= dislike extremely) to 9 (= like extremely) was used to evaluate overall acceptance from the samples.[20]

Storage stability of almond products

Storage conditions and sampling

After preparation of RA, RA-P and RA-A, samples were packaged in 27 × 28 cm plastic bags (Ziploc, Johnson & Son, Buenos Aires, Argentina) of high-density polyethylene with low oxygen barrier (1500 cm^3 m^{-2} 24 h^{-1} bar^{-1}). The samples were stored at 40 °C for 60 days under accelerated storage conditions. Samples of each product were removed from storage for chemical analyses on days 0, 15, 30, 45 and 60.

Chemical analysis of stored almond products

Approximately 20 g almond oil was obtained by cold pressing 100 g almond samples using a 20-ton press (HE-DU, Hermes I Dupraz SRL, Córdoba, Argentina). The following chemical indicators were determined on the oil samples.

- *Peroxide value* (PV) was evaluated following the AOAC[14] method using 5 g oil from each roasted almond sample. PV was expressed as milliequivalents of active oxygen per kilogram of oil (meq O_2 kg^{-1}).
- *p-Anisidine value* (AV) was evaluated following the IUPAC[21] method. Absorbance of samples was measured at 350 nm in a spectrophotometer (UV-visible diode array spectrophotometer, Hewlett Packard HP 8452 A).
- *Conjugated dienes* (CD) were measured in a spectrophotometer (UV-visible diode array spectrophotometer, Hewlett Packard HP 8452 A) at 232 nm and 268 nm. The results were reported as the sample extinction coefficient E (1%, 1 cm).[22]

Statistical analysis

The experiment was replicated three times. Data were analyzed using InfoStat software, version 1.1 (Facultad de Ciencias Agropecuarias, Universidad Nacional de Córdoba). Means and standard deviations were calculated. Analysis of variance and Duncan test were used to detect significant differences ($\alpha = 0.05$) in consumer responses and chemical analysis measurements. Lineal regression equations from the regression analyses were used to determine whether the independent variable (time) had an effect on the chemical variables.

RESULTS AND DISCUSSION

Proximate composition, sugars, total phenolics and radical scavenging activity of the syrups

Proximate composition (moisture, proteins, ashes, lipids and carbohydrates), sugars (reducing sugars, apparent sucrose and total sugars), total phenolic content and radical-scavenging activity (DPPH) for prickly pear and algarrobo pod syrups are presented in Table 1. The results indicate that prickly pear syrup had higher moisture, proteins, ashes and lipids, and less carbohydrate content than algarrobo pod syrup.

Demaio *et al.*[5] found 8 g kg^{-1} protein, 7 g kg^{-1} lipids, 1.9 g kg^{-1} pectin, 1 g kg^{-1} fiber, 60 g kg^{-1} carbohydrates and 900 g kg^{-1} water in fresh fruit of prickly pear.

Algarrobo pod syrup had higher reducing sugars and lower apparent sucrose and total sugar contents than prickly pear syrup.

Prickly pear syrup showed higher phenolic content than algarrobo pod syrup. Phenolics were related to radical scavenging activity, and prickly pear had also a higher inhibition percentage of DPPH than algarrobo pod syrup.

Butera *et al.*[7] and Demaio *et al.*[5] reported antioxidant properties in extracts from prickly pear fruits. In both studies, low polyphenol content (2.37 g kg^{-1}) was found in the pulp, suggesting that betalain pigments (betanin and indicaxanthin) contributed to antioxidant activity due to the presence of these pigments in concentrations of 0.077–0.095 g kg^{-1} edible pulp.

Astudillo *et al.*[6] studied proximate composition, phenolic content and percentage of DPPH inhibition in pods and leaves of Chilean *Prosopis* spp. They found values of 73–124 g kg^{-1} moisture, 84–125 g kg^{-1} proteins, 7–13 g kg^{-1} lipids, 26–43 g kg^{-1} ashes, 194–314 g kg^{-1} fiber, 56.8–64.5 g kg^{-1} nitrogen-free extract and 10–79 g kg^{-1} phenolic compounds. They also found percentage of DPPH inhibition between 250 and 290 g kg^{-1} for an extract with 100 µg mL^{-1} final concentration. They suggested that this antioxidant activity was related to polyphenols.

The preparation process of prickly pear syrup increased the carbohydrate content and decreased moisture in comparison with the fruit composition reported by Demaio *et al.*[5] Phenolics also increased in this syrup as a consequence of moisture decrease. The algarrobo pod syrup also showed higher carbohydrate content and lower moisture percentage. In this syrup, phenolics and percentage of DPPH inhibition were lower than in prickly pear syrup.

Table 1. Proximate composition, sugars, total phenolics and radical scavenging activity of prickly pear and algarrobo pod syrups

	Syrups[f]	
	Prickly pear	Algarrobo pod
Proximate composition		
Moisture[a]	328.1b	229.5a
Nitrogen[b]	01.9b	01.2a
Proteins (N × 6.25)[b]	12.1b	07.2a
Ashes[b]	34.3b	29.6a
Lipids[b]	03.2b	01.0a
Carbohydrates[b]	620.5a	732.1b
Reducing sugars[a]	71.05a	185.5b
Apparent sucrose[a]	191.1b	61.15a
Total sugars[a]	243.3b	200.0a
Total phenolic content[c]	2.7235b	1.1816a
DPPH Inhibition[d]	296.2b	165.0a
DPPH Inhibition of phenolic compounds[e]	977.8b	852.7a

[a] g kg^{-1} syrup sample.
[b] g kg^{-1} on dry base of syrup.
[c] Expressed as g gallic acid kg^{-1} dry syrup.
[d] Final concentration of dry extract from syrup in methanol (g L^{-1}).
[e] Final concentration of phenolics from the syrup in methanol (10 µg L^{-1}).
[f] Means followed by the same letter within each row are not significantly different at $\alpha = 0.05$.

Proximate composition of almond products

The proximate composition of raw almonds, roasted almonds and roasted almonds coated with prickly pear and algarrobo pod syrups is shown in Table 2. The results indicate that raw almonds had higher moisture than roasted almonds and roasted almonds coated with syrups (RA-P and RA-A). RA and raw almonds had higher protein content than coated almonds. Ashes were higher in RA-P and lower in raw almonds and RA. Lipid content was higher in RA than in raw almonds and coated almonds. Carbohydrates were higher in coated almonds than raw and RA.

Table 2. Proximate composition of raw almonds, roasted almonds (RA), roasted almonds coated with prickly pear syrup (RA-P) and roasted almonds coated with algarrobo pod syrup (RA-A)

Proximate composition	Almond products[c]			
	Raw almonds	RA	RA-P	RA-A
Moisture[a]	43.4c	14.2a	18.0b	15.5ab
Proteins (N × 6.25)[b]	246.0b	253.1b	220.9a	213.6a
Ashes[b]	32.3a	33.1a	44.2c	40.3b
Lipids[b]	550.1b	589.8c	510.2a	523.7a
Carbohydrates[b]	128.3a	109.8a	206.7b	206.9b

[a] g kg^{-1} syrup sample.
[b] g kg^{-1} on dry base of syrup.
[c] Means followed by the same letter within each row are not significantly different at $\alpha = 0.05$.

Gou *et al.*[23] reported the chemical composition of raw almonds of Desmayo Largueta variety: 60.5 g kg^{-1} moisture, 214.2 g kg^{-1} protein, 33.3 g kg^{-1} ashes and 603.6 g kg^{-1} fat. Non Pareil variety, studied in this work, showed higher lipid and lower protein contents than Desmayo Largueta variety. García-Lopez *et al.*[8] reported 536.2 g kg^{-1} fat content in 19 almond cultivars of the Non Pareil variety from different origins. These values were similar to those reported in this study (530 g kg^{-1}). Spiller *et al.*[24] also reported similar values for lipid and protein contents.

Fatty acid composition of almond products

Fatty acid composition did not show significant differences between almond samples. Roasting and coating processes did not affect the fatty acid profile of almonds. Palmitic acid (63.2 ± 3.9 g kg^{-1}), oleic acid (727.0 ± 4.5 g kg^{-1}) and linoleic acid (208.0 ± 2.6 g kg^{-1}) were the main fatty acids.

Gou *et al.*[23] reported the following fatty acid composition in raw almonds of Desmayo Largueta variety: palmitic acid (72.1 g kg^{-1}), oleic acid (648.6 g kg^{-1}) and linoleic acid (257.0 g kg^{-1}). Palmitic and linoleic acids were higher and oleic acid was lower with respect to Non Pareil variety studied in the present work. Garcia-Lopez *et al.*[8] reported similar values in Non Pareil variety.

Almond has a high lipid content and high unsaturated fatty acid concentration (oleic and linoleic acids). As consequence of this composition, almond kernels are susceptible to lipid oxidation and development of off-flavors.[10]

Consumer test

The consumer test results are shown in Fig. 1. Most consumers awarded 6 points ('like slightly') for RA (29%), 7 ('like moderately') for RA-A (29%) and 8 ('like very much') for RA-P (29%) on a 9-point hedonic scale. The overall acceptance means in RA, RA-P and RA-A were 6.83, 6.65 and 6.70, respectively. Significant differences ($\alpha = 0.05$) in consumer acceptability among the products (RA, RA-A and RA-P) were not found.

Sánchez-Bel *et al.*[25] studied the oil quality and sensory evaluation of almonds (*Prunus amigdalus*) stored after electron beam processing. In that work, the general acceptance quality attribute was assessed as a measurement of the acceptability of the product by the consumer using a scale from 'very unpleasant' (level 1) to 'very pleasant' (level 5). They reported a general acceptance of 3 (middle level in a scale of 5 points) analyzed in raw almonds. In the present study, the middle level in a 9-point hedonic scale was 5 ('neither like nor dislike'). We found out that consumer acceptance of roasted and coated almonds was around 7 ('like moderately'). This value was higher than the middle level in the hedonic scale of 9 points, indicating that roasted and coated almonds showed higher consumer acceptance than raw almonds.[25]

Storage stability of almond products

Changes in peroxide value, *p*-anisidine value and conjugated dienes during storage at 40 °C of RA, RA-A and RA-P are shown in Fig. 2. Peroxide and *p*-anisidine values and conjugated dienes increased during storage time for all products.

RA, RA-P and RA-A showed a significant difference ($\alpha = 0.05$) in PV and AV during storage. RA and RA-P had higher and lower PV and AV, respectively. PV increased during storage from 0.21 to 0.68 meq O_2 kg^{-1} in RA-P, from 0.27 to 1.00 meq O_2 kg^{-1} in RA-A and from 0.34 to 2.14 meq O_2 kg^{-1} in RA. AV increased during storage from 0.02 to 0.67 in RA-P, from 0.00 to 2.50 in RA-A and 0.00 to 3.23 in RA. These results indicate that the syrup coating had a protective effect against lipid oxidation and was higher in RA-P that in RA-A. Other authors reported similar peroxide values in almonds. Sanchez-Bel *et al.*[25] reported PVs of 0.3–5 meq O_2 kg^{-1} in almonds stored after electron beam processing. Gou *et al.*[23] observed peroxide values of 0.5–7 meq O_2 kg^{-1} in almonds of the variety Desmayo Largueta after various times and temperatures of roasting. They reported that PV increased with roasting time and temperature up to a maximum level, after which PV decreased because peroxide degradation was faster than its formation.

Conjugated dienes increased during storage from 1.78 to 2.28 in RA, from 1.63 to 2.31 in RA-P, from 1.64 to 2.24 in RA-A. RA

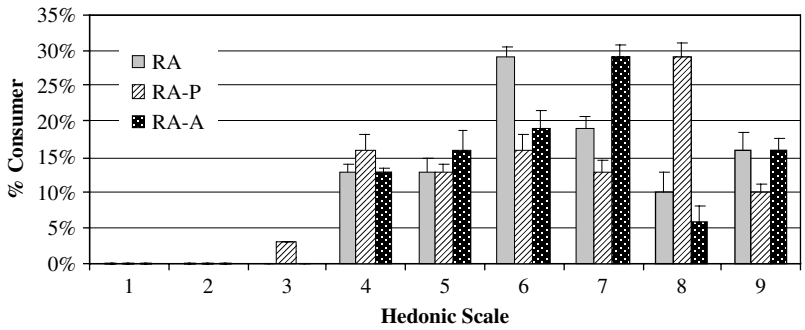

Figure 1. Answer percentages for each point in a 9-point hedonic scale (1 = dislike extremely, 5 = neither like nor dislike and 9 = like extremely) from the consumer test of almond products: roasted almonds (RA), roasted almonds coated with prickly pear syrup (RA-P) and roasted almonds coated with algarrobo pod syrup (RA-A).

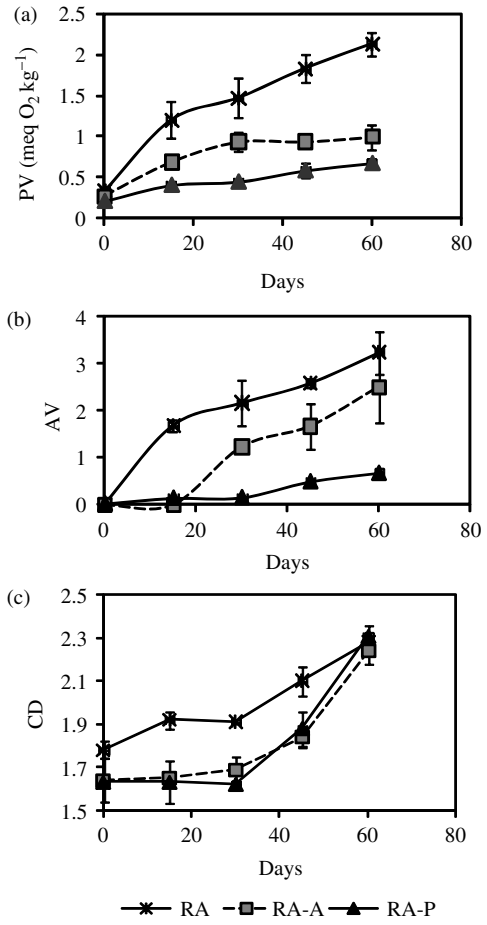

Figure 2. (a) Peroxide values (PV), (b) *p*-anisidine values (AV) and (c) conjugated dienes (CD) in roasted almonds (RA), roasted almonds coated with prickle pear syrup (RA-P) and roasted almonds coated with algarrobo pod syrup (RA-A) during storage time at 40 °C.

had higher CD values until day 30. The coated products (RA-P and RA-A) did not showed significant differences during storage.

The sensory analysis of coated almonds with algarrobo pod syrup and prickly pear syrup has shown good acceptability for consumers. These syrups used for coating roasted almonds have also been shown to be effective against lipid oxidation during storage by measuring chemical indicators (PV, AV and CD) of lipid oxidation. However, some sensory changes could have occurred in the product during storage. It is possible that some off-flavors can appear from the coating and/or that the product texture can change during storage. Sensory attribute changes were not evaluated in this study and it could be the subject of future research.

Regression equations at 40 °C for the PV and AV from each product (RA, RA-P and RP-A) are presented in Table 3. The dependent variables PV and AV showed $R^2 > 0.70$ in RA, RA-A and RA-P, indicating that these variables are good predictors. According to these regression equations, RA had a higher rate of increment for both indicators (PV and AV) than coated products (RA-P and RA-A). In addition, RA-P showed a lower slope in PV and AV than RA-A. Using the equation, PVs higher than 1 meq O_2 kg^{-1} were reached after 16 days in RA, 52 days in RA-A and 108 in RA-P. RA-P and RA-A had about four and seven times longer shelf-life than RA, respectively. *p*-Anisidine values higher than 1

Table 3. Regression equation and R^2 from peroxide value (PV) and *p*-anisidine value (AV) during storage time in roasted almonds (RA), roasted almonds coated with prickly pear syrup (RA-P) and roasted almonds coated with algarrobo pod syrup (RA-A)

Sample	Dependent variable	Regression coefficients[a] β_o	β_1	R^2
RA	PV	0.556	0.028	0.938
	AV	0.458	0.049	0.910
RA-P	PV	0.244	0.007	0.964
	AV	−0.036	0.011	0.909
RA-A	PV	0.426	0.011	0.796
	AV	−0.254	0.044	0.942

[a] Regression coefficients from the general regression equation: $Y = \beta_o + \beta_1 X$, where Y = dependent variable (PV and AV) and X = independent variable (days of storage).

were reached after 11 days in RA, 28 days in RA-A and 94 in RA-P. These results indicate that the syrup coatings provide protection against lipid oxidation in almond products. Similar results were observed using another edible coating in honey-roasted peanuts, increasing the shelf-life of this peanut product.[13] The protective effect could be related to these edible coatings (prickly pear and algarrobo pod syrups) because they could be acting as a barrier, thus decreasing oxygen diffusion to the almond lipids, or as a vehicle of natural antioxidants. Phenolics and antioxidant activity such as DPPH inhibition were low in both syrups. However, their protective effect was very significant. Total phenolic content was 2.7235 g kg^{-1} in prickly pear syrup and 1.1816 g kg^{-1} in algarrobo pod syrup (Table 1). This higher total phenolic content in prickly pear syrup could be the reason for a higher protective effect in RA-P than in RA-A.

Edible coatings of polysaccharides prevent oxidative rancidity, dehydration and surface browning, and extend shelf-life in food products.[26] Protein (wheat gluten protein) and cellulosic material (methyl cellulose and hydroxypropyl cellulose) were used as edible coatings. These materials showed effectiveness in delaying oxidative rancidity of roasted peanuts.[27] The prickly pear and algarrobo pod syrups are prepared by cooking the fruits in water. This product has a natural origin and the preparation process is very simple. These last two points are advantages of using these edible coatings based on prickly pear and algarrobo pod syrups compared with other carbohydrates used in edible coatings. In addition, these syrups have phenolic compounds that act as natural antioxidants, helping in prolonging the shelf-life of the food product. The disadvantage of syrups as an ingredient of the coating is that prickly pear and algarrobo pod syrups are regional products and these syrups are not produced industrially on a large scale. For that reason, these syrups are a limited product at present.

CONCLUSIONS

The use of coatings of prickly pear and algarrobo pod syrups in roasted almonds improved the stability of the products, making them more resistant to lipid oxidation and the development of rancid flavors. In addition, the syrup coatings in roasted almonds did not affect consumer acceptance of the product.

Prickly pear and algarrobo pod syrups could be used as edible coating in other similar food products with high lipid content,

increasing their shelf-life, improving their stability and preventing loss of their sensory and nutritional quality.

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