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STUDY OF THE EFFECT OF TWO DIFFERENT EDIBLE COATINGS ON WALNUT KERNEL SHELF LIFE

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ABSTRACT Edible coatings are protective layers capable of reducing oxidation in food containing lipids. In this study the effects of two different major edible coatings namely; 3% pectin-based edible coating and 2% CMC-based coating as well as other additives like sorbitol, PG, Lecithin and also antioxidants like vitamin E and BHT on the shelf life of walnut kernels were investigated. Kernels were dried in open air then stored in polyethylene zipped bags and were kept at 25°C and 23% relative humidity for 4 months. Every two months, kernels were observed based on their color, weight loss, and rancidity. Finally, the taste trial survey was performed on coated kernels. The results proved that CMC-based coatings preserved rancidity of kernels much better than that of pectin-based ones. Particularly, CMC based coatings added with vitamin E or BHT had more acceptable performance comparing to pectin based coatings. The most promising results came from samples coated with CMC combined with vitamin E.

Keywords: pectin-based coating, CMC- based coating, rancidity, Carboxy Methyl Cellulose (CMC) Butylated Hydroxy Toluene (BHT).

INTRODUCTION Walnut kernels contain between 60% and 75% oil (Garcia, Agar, 8 5 Streif, 1994; Savage, 2001). The oil contains high levels of 18:2, 18:3 and 18:1 fatty acids (Garcia et al., 1994; Avage, 2001; Zwarta Sacage 8 Mc.Neil, 1999) although the values do vary between cultivars (Greve et al., 1992; vergano, Botta, 8 Radicati, 1995;Zwarts et al;(999). Walnuts provide appreciable amounts of proteins (up to 24.16%) , fiber (1.5-2%) walnut seed weight), carbohydrates (12-16%), fiber (1.5-2% and minerals (1.7-2%) (Lavedrine, Ravel. Villet, Ducros, & Alarg. 2000; Wardlaw, 1999). Walnut oil contains approximately 7% saturated , 20% monounsaturated and 73% polyunsaturated fatty acids; these high levels of poly unsaturated fatty acids make walnuts prone to oxidation (Stark, McNeil, & Savage, 2000; Vergano et al.,1995). A number of storage experiments have been carried out on the storage of in-shell walnuts, walnut kernels and walnut oil. Temperature, light, moisture and exposure to oxygen have been found to be the main contributing factors to oxidation (Jan et al., 1998; Koyuncu & Askin. 1999; Mate, Salveit

& Krochta, 1996 Stark et al., 2000). Savage, Mc Neil and Osterberg (2001) reported that fresh walnut kernels had peroxide values ranging from 0.15 to 0.29 meqO₂/kg oil and they could be stored in-shell at room temperature (mean 25°C) for up to 12 months with only modest rises in peroxide levels.

Shelled walnuts can be stored for 10-12 months at 5°C and 55-65% relative humidity while unshelled walnuts can be stored for up to 18 months under the same conditions. (Koyuncu & Askin, 1999). Stak et al., (2000) found that walnut oil stored at room temperature (mean 24°C) in the dark, in sealed bottles, showed only small rises in peroxide levels after four months storage and remained an acceptable product in terms of its organoleptic properties. Although improperly handled walnuts, almonds, pecans, and pistachios can become rancid, the problem is most obvious with walnuts. This is at least partially because walnuts have an especially high proportion of unsaturated linoleic and linolenic acids. (Romas E.D., 1998). Various anti-oxidant chemicals have been used to control rancidity in shelled walnuts during storage and marketing. Well and Barber reported that in packages labelled as "antioxidant treated" in the retail stores were much superior to the untreated; about 95% of the nuts from these packages were rated good to excellent in flavour, odour and color. This study pointed out the significance of protecting shelled nuts during unfavourable temperatures and intense light exposure in the retail stores. (Salunkhe.D.K & Desai.B.B. 1984).

Edible coatings have been used to reduce rancidity of kernels, by providing a barrier to oxygen and moisture, and to improve appearance by adding gloss. Bilayer coating of whey protein and acetylated monoglycerides reduced oxidation of walnuts, while acetylated monoglyceride coatings reduced sogginess of chopped almond (Adams et al, 1995). Edible films made out of potato starch were used to coat walnuts to improve their storage characteristics. (Hurtado et al., 2000). The study of the effect of packaging material O₂ barrier, lighting conditions and temperature on quality of shelled walnuts as a function of storage time (Mexis, et al., 2009). Rancidity in pecan kernels that stored at ambient temperatures for 5 and 9 months was lower in kernels coated with CMC than in the uncoated control. (Baldwin, 2006). Walnut kernels were stored in 20°C at least 12 months in PET- SiO_x/IPE-N₂ pouches slightly higher quality than those exposed to light. (Mexis et al., 2008).

MATERIAL AND METHOD Fresh, shelled walnuts were acquired from Bavanat gardens, Fars province, Iran. Nuts were then cleaned in commercial cleaning facility. They were bagged and kept in cool storage before shipment. Nuts were randomly selected. After shelling, kernels were placed in plastic Zip-lock bags and again retained in clod stage. In this study kernels were coated by dipping for 30 s, drained and air dried. The coated and uncoated kernels were stored in zip-lock bags (5 bags with 200g kernels/bag) with four 1-mm holes to allow entrance of oxygen. Kernels were stored at 20 to 24°C, periodically evaluated by taste panels and, in some cases, analyzed for color and peroxide value during storage. A preliminary experiment determined which concentration of two coatings (CMC; Pectin) would be most effective to cover the kernels. After determining that 2% CMC and 3% pectin are the best to coating for the kernels, subsequent experiments were conducted with these film formers (Table 1). We combined other additives with the cellulose film formers including sorbitol, propylene glycol (PG) as plasticizers, and lecithin a surfactant and emulsifier which are surface – active agents and macromolecular stabilizers, respectively (Cuppectt, 1994). Also added to coating

formulations were α -tocopherol (vitamin E), butylated hydroxytoluene (BHT), antioxidants which inhabit the free- radical autoxidation process (Shermin, 1990). All chemicals were purchased from sigma- Aldrich Co (St. Louis, Mo.).Kernels were treated as indicated in Table 1.

Coating formulation
Uncoated control
2) 2% CMC ,PG 45% CMC in DI water
5) 2% CMC ,sorbitol 45% CMC in DI water
9) 3% pectin, sorbitol 45% pectin in DI water
10)2% CMC, 0.2% lecithin, sorbitol 45%CMC, 0.5% Vit E
11) 2% CMC, 0.2% lecithin, sorbital 45% CMC, 1% BHT
12) 3% pectin, 0.2% lecithin, sorbital 45%pectin , 0.5 % Vit E

Table1. Walnut coating treatments (CMC= car boxymethyl cellulose, Pectin, PG = propylene glycole, BHT= butylated hydroxytoluene, sorbitol, vitaminE, lecithin.

Surface color development Colorimetric measurements of the kernel surface were carried out with a Hunterlab colorimeter equipped with an optical sensor .Three kernels from each treatment were chosen to be exposed individually to the colorimeter for four sides of each kernel and the corresponding chromaticity parameters *l* and *b* were registered for each kernel respectively. Afterwards, Duncan's test was conducted on chromaticity results.

Extraction of fat-peroxide value Five grams of blended powder of walnut were put on a separator funnel and 100 ml of diethyl ether and 10 ml of distilled water were poured on. The funnel was agitated for a few minutes and was left for 24 hrs. After this period, fifty ml of the above sample were put in water bath at 40°C. The diethyl ether evaporated and the oil phase got separated. The extracted oil got dried in an oven at 105° C for 3 min, and the residue was used for determination of the peroxide value. The peroxide value was determined according to the official EC method.

GC analysis conditions The oil samples (50-100 mg) was converted to its fatty acids methyl esters (FAME). The methyl esters of the fatty acids (1 μ l) were analyzed in a gas chromatography (Shimadzu, Japan) GC-17A with a FID detector. A capillary column BPX 70 was used. The GC oven was programmed as follows: the temperature was initially set at 90 °C for 7 min, and then raised at the rate of 5 °C/min to 240°C. The injector temperature was set to 270 °C in split mode (2:1 split ratio) and detector temperature was kept at 330° C. Flow rate of the helium carrier gas was 0.8 mL/min. For thermal desorption was performed using HP GC Chemstation software for Windows.

Taste Trial Survey The taste trial survey were performed by 25 panel members. Panelists were chosen using the following criteria: ages between 18 and 60, non-smokers, without reported cases of food allergies who consumed dried nut products regularly. Approximately 20g of walnuts were placed in small plastic cups coded with 3-digit random numbers. The samples were presented to panelists in random with a glass of water to wash their mouth.

Statistical analysis Data were subjected to analysis of variance (ANOVA) using the software SPSS 16. Means and standard deviations were calculated, and, then Duncan's test was significant of the $p < 0.05$ level.

Results Kernels humidity was about $2.4\% \pm 0.7$ and total fat contained were between $66.50\% - 72.77\% \pm 0.90$ in all treatments (Fig.1). High-oil nuts may develop rancidity during storage if they are not dried and packaged properly. Shalunkhe D.K & Desai B.B (1984). The fatty acid profile of walnut oil varies between cultivars. The fatty acid composition of walnut kernel oil was determined by gas chromatography as follows: Linoleic acid (64.4%) was present in the highest concentration, followed by oleic acid (13.2%), Linolenic acid (15.2%), Palmitic acid (6.5%) and Stearic acid (2.7%).

Color analysis The result showed an initial preference for appearance of coated kernels. Even though CMC coated kernels exhibited added shine and pectin based coatings showed darkness in kernels (Fig.2) the treatments included pectin and pectin with vitamin E were darkened. Treatment 2 after four months of storage was the shiniest among the treatments. Other treatments did not show any significant difference. Another parameter in color was *b* shown in (Fig.3) did not show any significant difference during the storage time.

Peroxide value The initial value peroxide value (PV) of fresh walnuts was very low (0.3 meq O₂/kg) walnut oil). Fig.4 demonstrates the effect of storage time and coating material in kernels.

Taste Trail Survey Results Pectin coated kernels taste slightly bitter and CMC coated kernels were tastier than pectin ones. Treatments coated with CMC and vitamin E were the most tasteful one among other treatments. And treatment 2 just coated with CMC and PG was tasteful as well. Treatment coated with Pectin and vitamin E did not prevent rancidity and were distasteful.

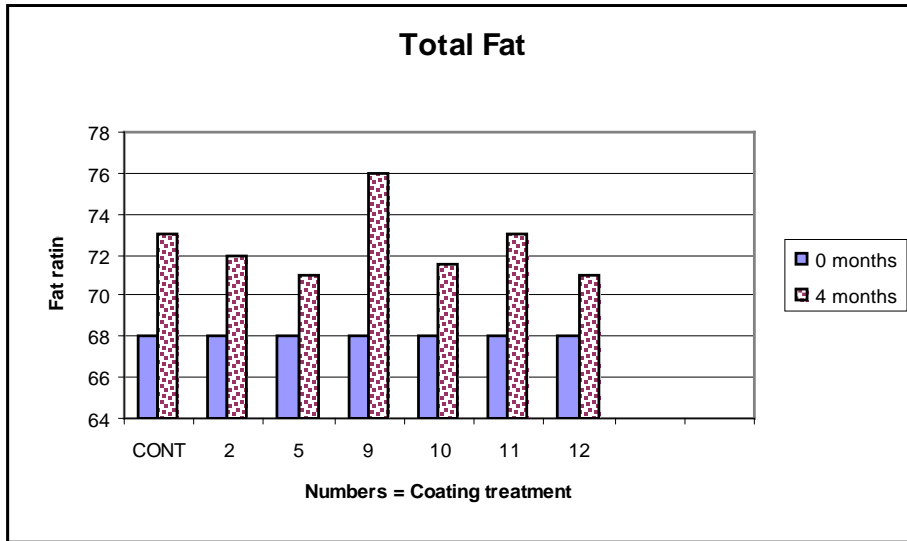


Fig.1 .The fatty acid value have shown in all treatments

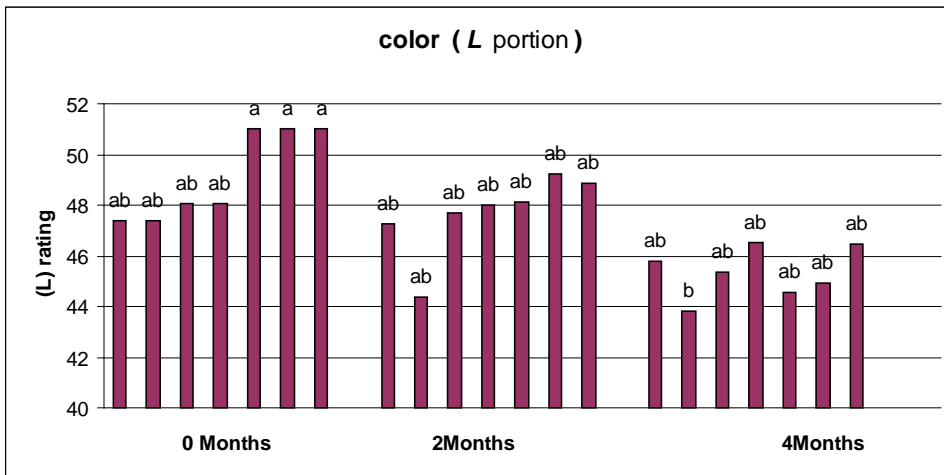


Fig.2. Effect of time on walnut kernels color.

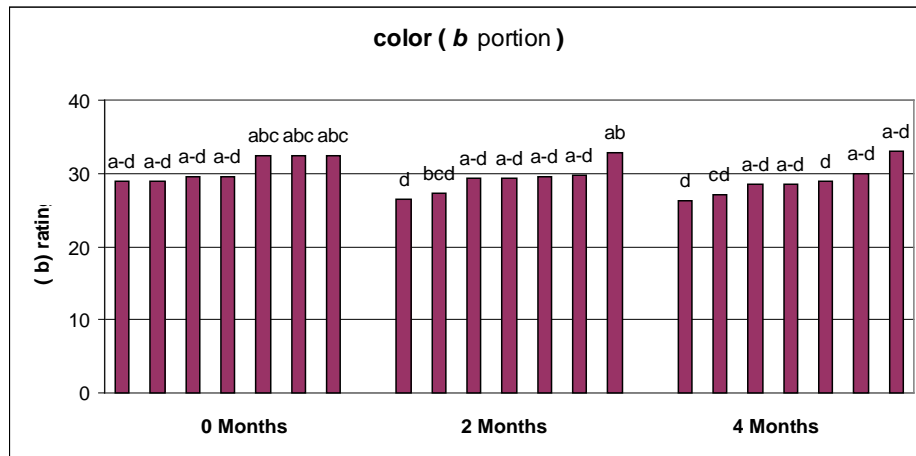


Fig.3.

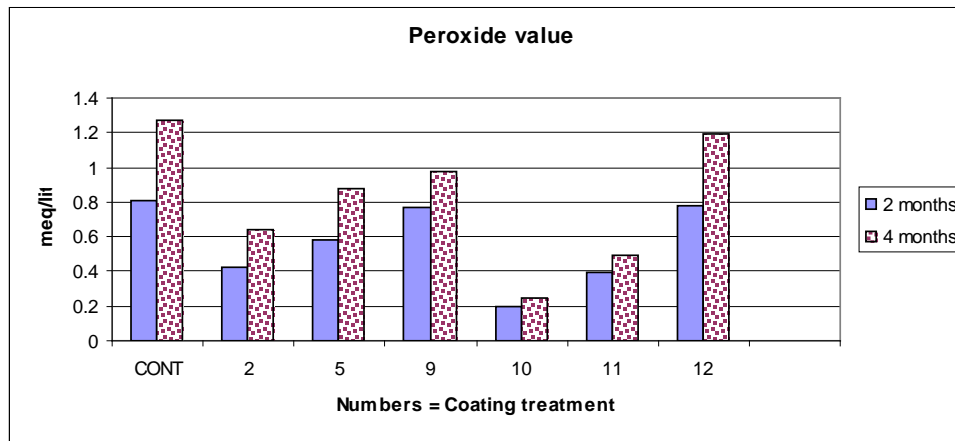


Fig.4. Peroxide value in coating treatments

CONCLUSION The present study investigated the effect of two edible coatings CMC and Pectin based with other additives on walnut kernels at room temperature. It was shown that walnuts retain acceptable quality for 4 months with CMC based coating than pectin based one. Treatments included Vitamin E as an antioxidant with CMC based coating is low rancid and pectin based coating showed more rancidity in walnut kernels.

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