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Research Article

Potato and tomato peel extract – A natural antioxidant for retarding lipid peroxidation in lamb meat (Awassi) refrigerator storage

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Abstract

This work examined the utilization of potato and tomato peels, as antioxidants natural source for retarding lipid oxidation in slices of lamb meat (Awassi). Meat slices treated with potato peel extract (PPE) and tomato peel extract (TPE) in two different concentrations (0.1%, 0.5%). Then, lipid peroxidation and pH was determined in samples at three different periods with 5 days. We found low levels of peroxide value in samples due to treatment with natural antioxidants. Potato peel extracts were less effective than tomato peel extracts due to lower phenolic content 96.66 mg of Gallic acid /100 g in potato peel extract vs 130.53 mg of Gallic acid /100 g. We suggest using tomato peel extract for retarding lipid peroxidation in chilled storage of lamb meat.

Key words: lipid peroxidation -potato and tomato peel extract – meat

Introduction

Meat products are spoiled by two major causes: microbial growth and chemical deterioration. The most common form of chemical deterioration is oxidative rancidity (Kumar *et al.,* 2015).The alterations of oxidative rancidity occurred in meat and meat products can vary greatly, ranging from extensive flavor changes, color losses and structural damage on proteins (Bozin *et al.,* 2007) to a more subtle "loss of freshness" that discourages repeat purchases by consumers. Development of lipid peroxidation during the storage of meat is influenced by several factors such as packaging, storage, and other processing conditions.

The rate and extent of oxidative deterioration can be reduced by various means including curing, packaging in a vacuum or modified atmosphere, and adding antioxidants. Although synthetic antioxidants such as butylated hydroxytoluene (BHT) and butylated hydroxy anisole (BHA) have been used extensively, recent studies have implicated them to have toxic effects (Estévez and Cava, 2006). These findings together with consumer interest in natural food additives have reinforced the need for effective antioxidants from natural sources as an alternative to prevent deterioration of food during processing and storage. The antioxidant activity of a variety of extracts from natural sources has been investigated in meat model systems (Shahidi, 2002) and in a few storage experiments with meat (Haldeman *et al.,* 1987; Karastogiannidou *et al.,* 1999).

Incorporation of such extracts in meat not only preserves the wholesomeness of the food but also reduces the risk to humans of developing chronic diseases such as atherosclerosis and cancer (Kanatt *et al.,* 2008). Potato and tomato is one of the most commonly consumed vegetables throughout the world. Potato and tomato production worldwide stands at 293 million metric tons. A large quantity of potato and tomato peel waste is generated, which contains many phenolic compounds, some in free form and others that are bound (de Sotillo *et al.,* 1994). Potato peel extract consists of phytochemicals such as phenolic acids, flavonoids, coumarins, carotenoids, and terpenes (Shahidi, 2008). Tomato peel extract has a good nutritional value its high content of antioxidants such as flavonoids, phenolic acids, lycopene, and ascorbic acid (Elbadrawy *et al*., 2016). The antioxidant property of potato and tomato peel extract has been reported by Mansour and Khalil (2000), but its use as an antioxidant in meat chilled to control lipid peroxidation has not been studied. The objectives of the present study were to determine effectiveness of potato and tomato peels extracts, as a source of natural antioxidants in reducing lipid peroxidation and to find out their effects on pH and TBARS of meat in cold storage.

Materials and methods

Chemicals

Methanol (90%), Folin–Ciocalteu, Gallic acid, Butylated hydroxytoluene (BHT), 1,1-Diphenyl-2-picryhydrazyl (DPPH), Thiobarbituric acid (TBA, 20mM), Trichloroacetic acid (TCA, 5%), Sodium bicarbonate (6%).

Preparation of Potato Peel Extract

Potato (*Solanum tuberosum*) cultivar Sponta, was purchased from the local market, cleaned with tap water, and the peel was removed. The peels dried in a hot air oven at 55 °C for 72 h and powdered by a kitchen blender. For the preparation of methanol extract, 10 g of powdered peel was extracted with 100 ml of 90% methanol at room temperature overnight. The supernatant was collected in a separate bottle and the residue was re-extracted three times under the same conditions as mentioned above. The supernatant was filtered through Whatman No. 1. filter paper, the filtrate thus obtained was concentrated using a rotary evaporator (BUCHI, Switzerland) below 40 ºC (Farvin *et al*., 2012).

Preparation of Tomato Peel Extract

Tomato (*Lycopersicon esculentum*) cultivar Tala, was purchased from the local market, cleaned with tap water, and the peel was removed. The peels were dried in a hot air oven at 55 °C for 72 h and powdered by a kitchen blender. For the preparation of methanol extract, 10 g of powdered peel was extracted with 100 ml of 90% methanol at room temperature overnight. The supernatant was collected in a separate bottle and the residue was re-extracted three times under the same conditions as mentioned above. The supernatant was filtered through Whatman No. 1. filter paper, the filtrate thus obtained was concentrated using a rotary evaporator (BUCHI, Switzerland) below 40 °C (Farvin *et al*., 2012).

Determination of Total Phenolics

Total phenolic content in the extracts was determined by using Folin–Ciocalteu reagent as described by Singleton and Rossi (1965). An aliquot (100 *µL*) of extract was mixed with 0.75 mL of Folin-Ciocalteu reagent (diluted 10-fold with distilled water) and allowed to stand at room temperature for 5 min. Sodium bicarbonate (6%, 0.75 mL) was added to the mixture and incubated at room temperature for 90 min. The absorbance was measured at 725 nm using spectrophotometer (Spectrophotometer optizen 3000 plus). A standard curve was plotted using different concentrations of gallic acid and the amount of total phenolic was calculated as Gallic Acid Equivalents in mg/100 g of dried potato peel or tomato peel.

Radical Scavenging Activity Using DPPH Assay

The DPPH assay was performed according to the method of Brand-williams *et al.,* (1995). An aliquot of the extract (250 µL) was mixed with 10 ml of distilled water. Then took (250 µL) an aliquot of the extract and mixed with (2 ml) of the DPPH solution in methanol (100 µM), and the mixture was vortexes vigorously. The tubes were then incubated at room temperature for 60 min in the dark, and the absorbance was taken at 517 nm. % DPPH scavenging activity was calculated as Control absorbance-extract absorbance/Control absorbance×100.

Preparation sample meat

The leg of the lamb meat was taken from the same animal, and all the visible fat was removed from it. The meat was cut into slices in 10*5*1 cm dimensions and weight 100g. Then, half of samples were treated with potatoes peel extract (0.1 and 0.5% concentration). While the others were treated with tomato peel extract (0.1 and 0.5% concentration). Then the samples were put a closed bag of polyethylene. After that they stored at 4°C for 10 day. During this period we measured lipid peroxidation and pH at three time points: 0 day, 5 day and 10 day).

pH determination

A lamb meat sample (10 g) was homogenized in 100 ml distilled water for 1 min in a blender and the pH was measured using a digital pH-meter (HAANA,HI902 meter, Germany).Two readings were taken from each of the three lamb meat samples (Alassaf, 2003).

Lipid Peroxidation Measurement

Thiobarbituric acid reactive substances (TBARS) were evaluated using a method adapted from that of Alasnier *et al.* (2000). Four g of ground muscle were mixed with 10 µl Butyl Hydroxy Toluene (BHT) in ethanol (1g BHT/100 ml methanol) and 16 mL of Trichloroacetic acid (TCA 5%). Samples were homogenized for 20 s at 20,000 rpm and then filtered through Whatman filter (N° 40). Two mL of the filtrate was added to 2 mL thiobarbituric-acid solution (TBA 20 mM). The tightly closed tubes were heated at 70 °C for 30 min. The absorbance was read against water at 532 and 600 nm with a spectrophotometer. Results were expressed as malonaldehyde mg/ kg meat.

Statistical Analysis

All the measurements were performed in triplicate and the data are presented as mean ± SD. Differences between total phenolics and radical scavenging activity were significance by one-way ANOVA. The effects of the addition of natural antioxidant extracts and storage time were analyzed and the obtained data were subjected to analysis of variance (ANOVA) according to Experience randomized complete design sectors using the test GENERAL LINEAR MODEL. Determination differences among the mean values of the various treatments and storage periods were determined The TUKEY multiple range test (p 0.05) using Minitab14.

Results and Discussion

Total phenolics in tomato peel and potato peel extracts

Phenolics are constituted one of the major groups of compounds acting as primary antioxidants or free radical terminators and hence the total amount of phenolics in potato peel and tomato peel extracts was determined. In potato peel extract, total phenolic was 78.76 mg Gallic acid/ 100g potato peel when extracted by methanol (Fig. 1). This finding is in agreement with Al-Weshahy and Rao (2009). Who reported the high recovery of phenolic compounds from potato peel with methanol.

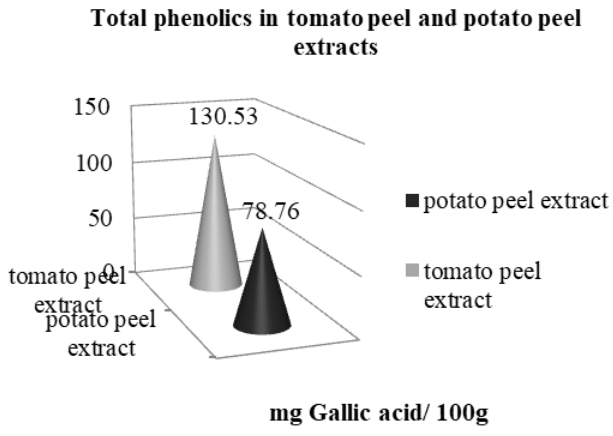

Fig. 1. Total phenolics content of potato peel and tomato peel extracts

The total phenolic content of the tomato skin extract was 130.53 mg Gallic acid/ 100g tomato peel. Stratil *et al.* (2006) have found the total phenolic content of tomato fruits was in the range of 10-200 mg of Gallic acid equivalent in 100 g of dry weight. The tomato peel results were compared with those of potato peel, which also belong to the plant family of Solanaceae. The comparison shows that tomato peel has the highest total phenolic content. Normally

vegetables have higher contents of phenolic compounds in the outer part. The total phenolic contents of potato and tomato strongly depend on plant variety, as well as on geographical, environmental factors, also the solvent type and extraction method.

Antioxidant activity of tomato peel and potato peel extracts

Scavenging of DPPH radical model is a widely used to evaluate antioxidant activity. DPPH is a stable free radical with characteristic absorption at 517 nm. Antioxidants react with DPPH and convert it to 2.2-diphenyl-1-picrylhydrazine (Van Gadow *et al.*, 1997). Fig. 2 shows DPPH radical-scavenging activity of the tomato peel and potato peel extracts when used two concentrations (0.1- 0.5%). Scavenging activities were 62.82% activity and 76.92% for samples treated with 0.1% and 0.5% potato peel extracts concentration respectively, while they were 67.49% and 84.62% for samples treated with 0.1% and 0.5% tomato peel extracts concentration respectively.

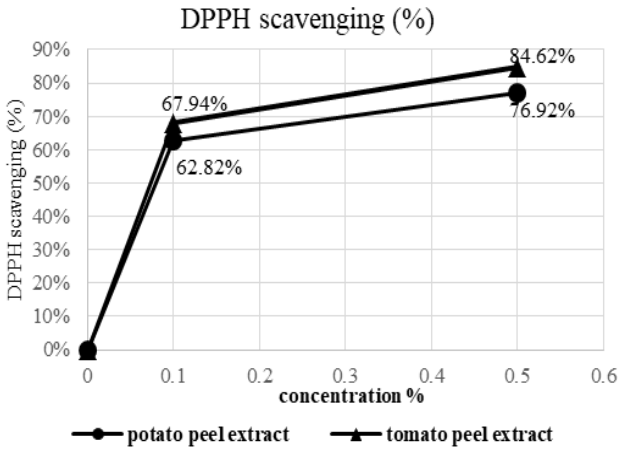

Fig. 2. Antioxidant activities of PPE and TPE by DPPH colorimetric assay

Table1: Effect of PPE and TPE concentration on PH change of lamb slices stored at 4°C for 10 days.

Concentration% \ Time (Day)		0	5	10
Control	0%	5.98±0.00a A	6.17±0.01a,b A	6.29±0.01b A
Concentrations of potato peel extract (%)	0.1%	5.98±0.01a A	6.13±0.01a,b A	6.19±0.01b B
	0.5%	5.98±0.00a A	6.08±0.01a B	6.17±0.01a B
Concentrations of tomato peel extract (%)	0.1%	5.98±0.00a A	6.02±0.01a B	6.14±0.01a B
	0.5%	5.98±0.00a A	5.99±0.01a B	6.13±0.01a B
		potato peel extract at pH=6.07		tomato peel extract at pH=5.89

Letters a-b to show significant differences ($P < 0.05$) between the same rows. Letters A-B to show significant differences ($P < 0.05$) between columns.

Table 2: Effect of PPE and TPE concentration on TBARS change of lamb slices stored at 4°C for 10 days.

Concentration% \ Time (Day)		0	5	10
		TBARS values (malonaldehyde mg/ kg meat)		
Control	0%	0.08±0.10a A	0.51±0.06b A	0.96±0.01c A
Concentration potato peel extract %	0.1%	0.08±0.01a A	0.42±0.01b B	0.77±0.02c B
	0.5%	0.08±0.00a A	0.36±0.04b C	0.53±0.02c C
Concentration tomato peel extract %	0.1%	0.08±0.01a A	0.35±0.02b C	0.67±0.01c D
	0.5%	0.08±0.00a A	0.26±0.15b D	0.48±0.01c E

Letters a-c to show significant differences ($P < 0.05$) between the same rows. Letters A-E to show significant differences ($P < 0.05$) between columns.

All tested extracts showed high scavenging activity particularly at concentration of 0.5%. In addition, tomato peel extracts were better than potato peel extracts. This attributed to its high content of lycopene and phenolic compounds, since antiradical scavenging activity is related to substitution of hydroxyl groups in the aromatic rings of phenolics, thus contributing to their hydrogen-denoting ability (Elbadrawy, *et al*., 2016). The higher concentration leads to higher free radical scavenging ability. In addition Fig. 2 shows linear correlation between radical scavenging activity and polyphenol content for potato and tomato peel extracts.

pH changes

pH value is considered as an important factor in the field of meat quality because of their effect on many characteristics including shelf life, color, water holding capacity and texture of meat and meat products.

Table 1 shows that effect of natural plant extracts under investigation on the pH values of lamb meat slices stored at 4°C for 10 days. At zero time the pH of the control and all tested samples had the same value (5.98). Control samples, generally, had higher pH values than the other samples throughout the storage. The pH values of the control and

sample lamb meat containing natural antioxidant extracts were significantly ($p<0.05$) increased gradually throughout the storage. During storage (5-10 days) it was noticed that the pH value of the control samples was higher (6.29) than the other tested samples. At the 10th day, meat containing potato peel extract (PPE) and meat containing tomato peel extract (TPE) at same concentration had the same pH value ($p>0.05$) which is similar to ground buffalo meat containing BHA/BHT antioxidants during refrigerated and frozen storage (McCarthy *et al.*, 2001). The increase in pH is due to the accumulation of metabolites by bacterial action in meat and deaminations of proteins (Jay, 1996).

Thiobarbituric acid reactive substances (TBARS)

Table 2 represents the changes of TBARS values in the lamb slices containing different concentrations (0.1 - 0.5%) of the tested natural extracts stored at 4°C for 10 days. The screened natural extracts were effective as antioxidants and had lower TBARS values than the control samples throughout the storage period. The effectiveness of the added natural plant extracts as antioxidants inhibiting lipid oxidation throughout storage time could noticed that increasing concentration helping in decreasing TBARS values when adding both natural extracts PPE and TPE. Results also show that the tomato peel extract was the most effective antioxidant. Which is a similar results for previous study carried out by the Elbadrawy *et al.* (2016). This is because the tomato peel extract gave a great ability to delay oxidation processes and reduce the peroxide value and gave effectiveness similar to industrial antioxidants BHT.

Conclusion

Tomato and potato peels have a good nutritional value because of its high content of antioxidants such as phenolic acids. The results of the present study indicated that addition of the extracts of potato and tomato peels at the concentration of 0.5 % provided best protection towards lipid oxidation in lamb meat slices store at 4°C for 10 days. Therefore, the peels fraction of tomato and potato consider as a value added ingredient in other food products where it could play an important role in improving antioxidant intake in the human diet, as well as the possibility of using them in pharmaceutical industry as antioxidant supplements. However, further studies are necessary to characterize the compounds present in the extract and to investigate if they have any positive or negative health effects.

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