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EVALUATION OF THE ANTIOXIDANT AND ANTIBACTERIAL EFFECTS OF PISTACIA PALAESTINAAND SALVIA DOMINICAMETHANOLIC EXTRACT ON SLICED BEEF MORTADELLA

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ABSTRACT

Three different mortadella formulations were prepared, involving the addition pistacia palaestina and salvia dominica methanolic extract. These include control, without the addition of plant extract, which was also present in all of the experimental formulations. After cooking, the mortadella samples were stored at 4°C for up to 40 days and tested at intervals to determine their oxidative rancidity (TBA), pH, color and microbial content as evaluated by Aerobic Plate Count (APC) and coliforms. Results indicated that during storage, the TBA values of pistacia palaestina and salvia dominica added mortadella was lower than that of the control. No significant differences in pH and color measurement were found between the three treatments.

APC increasing by at least 6.0 log10 units and coliforms increasing by at least 4.0 log10 units by the first month of storage. By increasing storage time and after 10 weeks of storage the APC and coliforms counthas been reduced for all samples. It could be concluded that the two substances used at the level added were not sufficient to have an inhibitory effect against microorganisms.

KEYWORDS: *Mortadella, Oxidative Rancidity, Phenolic Content, Pistacia Palaestina and Salvia Dominica*

Article History

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INTRODUCTION

The consumption of meat and meat products has been increased with an increase in household income (Nam and Lee, 2010). Meat is a highly perishable product in which deteriorative changes begin soon after bleeding the animal (Ray, 2010). Meat (livestock and poultry) preservation, in general, is the set of all treatment processes for keeping the product properties; taste, texture, and color as raw, partially cooked, or cooked meats and keeping them edible and safe to consume (Bitterman, 2010). One of the most common and highly demanded processed meat products in Jordan is mortadella because of its pleasant taste and texture, high nutritional value and ease of incorporation into sandwiches (Alla, et al., 2015; Abdullah, 2004). Mortadella is a cured emulsified sausage meat product with characteristic pink color and specific texture and flavor (Alla, et al., 2015; Quasem, et al., 2009).

Nowadays, there has been a growing interest in natural ingredients to be used in food and food products as preservatives instead of synthetic chemicals that may cause health hazards, because natural ingredients have greater

application for increasing consumer acceptability, palatability, stability, and shelf-life of food products. Consequently, search for natural additives, especially of plant origin, has notably increased in recent years (Naveena, et al., 2008).

Due to the increasing interest in the use of natural food ingredients and additives, efforts of scientists have been directed towards the development of new natural ingredients for use in foods to avoid the harmful effects of synthetic food additives.

Pistaciapalaestina or Terebinth, which known in Jordan as Bottom, is a species that offers a combination of products and services, and it is belonging to the Anacardiaceae family. The extract from Pistacia palaestina leaf had nearly 12-times higher antioxidant capacity than those of BHA and ascorbic acid, While in Pistacia palaestina fruits showed noticeable metal-chelation properties as compared to EDTA and high radical scavenging activity similar to the standards (Bozorgi, et al.,2013). Salvia dominica (Dominica sage, known traditionally as Khowwekha) is a medicinal plant of the family Lamiaceae. It is generally native of the Mediterranean area especially Jordan, Palestine, Lebanon, and Syria. It has been used traditionally to treat various conditions such as colic, diarrhea, common cold, cough, flu, liver sickness, bacterial infections, febrile attacks, sores in the body, and abdominal trouble and used as a purgative (Ben Khedher, et al., 2017; Abdallah, et al., 2013). The information on the antioxidants and antimicrobial activity of Pistacia palaestina fruit and Salvia dominica leaves extracts in the region is limited; accordingly, the objectives of this study are to Extraction and identification of phenolic compounds for both Pistacia palaestina and Salvia dominica, and evaluation of antioxidant and the antimicrobial activity of the extracts from both plants on sliced beef mortadella.

MATERIALS AND METHODS

The fruits of Pistacia palaestina were fat extracted using petroleum ether by Soxhlet apparatus for 8 hours following the AOAC (2011) methods. The defatted grinded fruits were air-dried at room temperature for about 24 hours to remove residual solvent and then grinded into flour using a coffee grinder (moulinex, France). From the ground defatted fruits of Pistacia palaestina a ratio of 1:20 (w/*v)* of methanol was soaked. The mixture was then placed in an incubator shaker at temperature 30˚C and 150 rpm for 24 hours. The mixture was filtered through Whatman no. 4 filter paper. After filtration, the solvent was evaporated under vacuum rotavapor (Heidolph Instruments, Schwarbach, Germany) at a temperature below 70°C and residue were recovered by sterile distilled water (Al-Ismail *et al* 2006). The process was repeated until reach a concentrated extract contains 500 mg polyphenols /100 g extract. Then stored at 4°C until further use.

Determination of the Total Phenolic Compounds

The phenolic compounds present in methanol, water and ethyl acetate extracts of the fruit of Pistacia palaestina and the leaves of salvia dominica were determined by the Folin-Ciocalteu Reagent (FCR) according to the method of Al-Ismail *et al* (2006). Samples of 100 µl of each plant extract (0.1 mg/ml) were transferred into a 10 ml test tube and the volume was completed to 3 ml with distilled water. An amount of 0.5 ml of FCR was added and mixed well. After 3 min, 2 ml of 20 % (w/v) sodium carbonate solution was added. The solution was left to stand for 60 min and the absorbance of the sample was then measured at 650 nm using spectrophotometer (Labomed spectrophotometer, model UVD-2900, Labomed, USA). The concentration of the total phenolic compounds (mg/100g) was calculated by comparison with the absorbance of different concentrations of gallic acid and the total phenolic compounds content of the plant extracts was expressed as gallic acid equivalent.

Formulation of Mortadella Samples

Samples of mortadella were prepared at a local meat factory (Nabeel factory) as described by Abdullah (2004). The recipe of a local meat factory was used to prepare the products. Frozen beef meat was tempered at 2 ˚C for 24 hours before processing. The tempered meat was coarsely ground, chopped and blended in two stages: first, ground meat was blended in a bowl chopper (Alpina, Geneva, Switzerland) at low speed for 2 minutes at a temperature of 0 ˚C. Sodium chloride (salt), ascorbate, sodium tripoly phosphate, and ice-water were added and blended for 2 minutes at high speed, at this stage, the temperature of the mixture reached -2 ˚C. Finally, starch, soya, and spices were added and the mixture was blended for 3 minutes at low speed, after which the temperature of the final meat blend was 8 ˚C. pistacia palaestina and salvia dominica extracts was added and mixed to form the final treatments, these treatments were:

- Control samples; without the addition of extract and using modified atmosphere packaging technology (MAP) and stored under refrigeration temperature.
- Samples with the addition of 500 ppm Pistacia Palaestina methanolic extract and using modified atmosphere packaging technology (MAP) and stored under refrigeration temperature.
- Samples with the addition of 500 ppm Salvia Dominica methanolic extract and using modified atmosphere packaging technology (MAP) and stored under refrigeration temperature.

Then, the treatments were transferred to the filling machine (Handtmann, Biberach, Germany), loaded into the funnel of the machine and vacuum-stuffed into the polythene casing. The vacuum was created by a vacuum pump, which constitutes part of the filling machine.

The casing was a laminate of polythene terephthalate and polyvinylidene dichloride. This is a high-barrier film with good resistance to permeation by oxygen and water vapor. After stuffing, the casing was closed and sealed with a metal clip.

Cooking and Storage

Mortadella Batches Were Thermally Cooked in a Steam Oven as Follows (Abdullah, 2004):

- Cooked at an oven temperature of 60 ˚C, achieved within the first 3 h (internal product temperature 50 ˚C);
- Oven temperature increased to 85 ˚C, achieved within the next 2 h; and
- Cooled in the oven (cold water spray) for 1 h, to decrease core temperature of mortadella to 55 ˚C.

The mortadella was removed from the oven to temper at room temperature for 2 hours, by which time a product temperature of 20 ˚C was reached, and then refrigerated, achieving a temperature of 4 ˚C within 2 hours. The cooling regime was designed to achieve a core temperature in the mortadella of 4 ˚C within 6 hours. The cooked mortadella was retained in its original casing and held at 4 ˚C throughout the duration of the experiment.

The Samples after and during Storage (0, 4 And 10 Weeks) were Analyzed for:

Lipid Oxidation

The extent of lipid oxidation was determined by the thiobarbituric acid reactive substances values (TBARS) method of the Faustman, et al., (1992). Ten grams portions of mortadella were combined with 25 ml of 20% trichloroacetic acid (TCA) (Labchem, USA) and 20 ml warmed distilled water and homogenized using a stomacher (Model AES, France,

Laboratory) for 30 seconds. The homogenate was filtered through Whatman No.1 filter paper and 2 ml of the filtrate was combined with 2 ml of 0.02 M aqueous 2-thiobarbituric acid (TBA) (Labchem, USA) in a test tube. The tubes were incubated at 22°C in the dark for 20 hours. In the end, the absorbance of the resulting solution was measured at 532 nm using spectrophotometer (Labomed spectrophotometer, model UVD-2900, Labomed, USA). The TBARS number was expressed as milligrams of malondialdehyde per kilograms of the sample using a conversion factor of 7.8 (Cheah and Hasim, 2000).

$$TBA_{value} = Abs_{(532)} \times 7.8$$

pH Determination

The pH values were determined by blending 10 gm of mortadella with 100 ml distilled water (1:10), homogenized with a homogenizer (Ultra-Turax T25, IKA-Labortechnik, Germany) for 2 minutes and measuring the pH value of the homogenate in triplicate runs using pH meter (HANNA instruments, Italy).

Determination of Product Color

Color measurements of the prepared and stored mortadella samples (*L*, *a* and *b* values) were obtained using a colorimeter Hunter Lab ColourFlex (Chroma Meter, CR-400, Konica Minolta, Sensing, INC., Japan). The Hunter values of *L*, *a* and *b* values correspond to lightness (*L*), redness (+*a*), and yellowness (+*b*), respectively.

Microbial Analyses

For microbial analyses, samples of 10 g mortadella were removed aseptically and diluted in sterile peptone water and blended in a stomacher (Model AES, Laboratory) for 120 seconds, and further decimal dilutions were prepared. Numbers of colony-forming units (CFU) of the following microorganisms were counted (Cook, 1991):

Aerobic plate count (APC): Pour plates of the plate count agar (PCA; Prodilab, Barcelona, Spain) were incubated at 25 ˚C 3 days.

Detection of coliforms: pour plate technique of 1 ml sample dilution was carried out using violet red bile agar (oxide, United Kingdom). Plates were incubated at 37 ˚C for 24 hr.

Statistical Analysis

Statistical analysis of data was carried out using the statistical analysis system package (SAS Inc., 2007). Analysis of variance (ANOVA) using the general linear model (GLM) procedure was used following a Complete Randomized Design. Least Significant difference (LSD) test was used to test differences between the means.

RESULTS AND DISCUSSIONS

Total Phenolic Compounds (TPC)

The TPC was expressed as gallic acid equivalents (GAE)and calculated from linear regression n equations of GAE ($y = 0.066x$, $R^2 = 0.980$). the total phenolic compounds were 25.1 mg GAE/g extract for *pistacia palaestina* and 10.6 mg GAE/g extract for *salvia dominica* methanolic extracts. Phenolics or polyphenols are secondary plant metabolites that are existing in plants and plant products. They have been shown to contain high levels of antioxidant activities (Razali *et al*., 2008). Generally, the mechanisms of phenolic compounds for antioxidant activity are neutralizing free radicals and preventing decomposition of hydroperoxides into free radicals (Javanmardi *et al*., 2003; Li *et al*., 2009).

Lipid Oxidation

Meat scientists are focusing on lipid oxidation and their free radicals due to their important effect on meat quality and their freshness (Al-hijazeen, et al., 2017). Recently, improvement in antioxidant capacity of the meat by incorporates the suitable and safer antioxidant getting more attention. Lipid oxidation values measured by TBARs in mortadella treatments during storage are illustrated in Table 1. In general, storage time has significant influence($P < 0.05$) on lipid oxidation in the sliced beef mortadella. pistacia palaestina extract showed good protection against lipid oxidation in sliced beef mortadella. As could be seen, the TBA was the highest for the control samples after 4 and 10 weeks of storage (1.3 and 1.7 mg/kg) respectively. The TBA values measured for samples containing pistacia palaestina extract showed lower increased values during storage for 4 and 10 weeks (0.9 and 1.0mg/kg), respectively. The TBA values measured for samples containing salvia dominica extract showed also lower increased values during storage for 4 and 10 weeks (0.9 and 0.9 mg/kg), respectively, However, lipid oxidation values increased significantly ($P \leq 0.05$) in all treatments during storage. These oxidation-reduction effects of pistacia palaestina and salvia dominica extract may be due to the presence of phenolic compounds such as phenolic acids. This difference of TBA values during storage between the control and the treatments samples proves the clear antioxidant effect of both plants extract, and this is in agreement with Bastida et al. (2009) who reported other extracts rich in condensed tannins from carob fruit which were successfully applied to reduce fat deterioration in cooked meat during chilled and frozen storage. Retardation of lipid oxidation by different plants was demonstrated also using lotus leaf powder (0.1 and 0.5%) in cooked ground pork (Choe et al., 2011). Similar results were shown with another natural antioxidant such as rosemary extracts (0.03%) (Lara et al., 2011) or Radix Pueraria extracts (1%) in precooked pork sausage (Jung, et al, 2012).Kulkarni et al. (2011) studied the antioxidant effect of grape seed extract on pre-cooked, frozen, re-heated beef sausages in different concentrations and they found that its reduced lipid oxidation. Rosemary and oregano extracts were added to raw pork batters by Hernandez-Hernandez et al., (2009) and they reduced TBARS and maintained color. Mohamed (2011) studied the antioxidant synergistic effect of rosemary aqueous extract (RE) and green tea extract (TE) in buffalo meatloaves. He found that a combination of the two extracts had stronger antioxidant activity compared to the single extract. He explained this result by the fact that green tea extract contained a higher number of –OH groups that increased free radical scavenging, moreover, TE is more effective in inhibiting iron release from heme during cooking. Studies have shown that the natural plant antioxidants can scavenge free radicals, inhibit lipid oxidation and extend the shelf life of food products.

Table 1: TBA Values (Mg MDA/Kg) of Control, Pistacia Palaestina and Salvia Dominica Added Mortadella during the Storage Period.

Treatments	Time (Weeks)		
	0	4	10
Control	$_{C}0.9^{a}$	$_{B}1.3^{a}$	$_{A}1.7^{a}$
Pistacia Palaestina Added Mortadella	$_{B}0.8^{a}$	$_{AB}0.9^{b}$	$_{A}1.0^{b}$
Salvia Dominica Added Mortadella	$_{B}0.8^{a}$	$_{A}0.9^{b}$	$_{A}0.9^{b}$

- Values are the mean of three independent experiments.
- Values within the same column with different letters (smalls) are significantly different ($p < 0.05$) according to LSD.
- Values within the same row with different letters (capitals) are significantly different ($p < 0.05$) according to LSD.

pH Determination

The pH values of the control and the treatment samples are shown in table 2. Results indicated that pH decreased significantly (P≤ 0.05) in each treatment during storage periods. The highest pH values of all treatment were observed at zero time. During the first4 weeks of storage, the pH values were slightly decreased for control, pistacia palestina and salvia dominica added mortadella (6.32, 6.22 and 6.25), respectively. After 10 weeks of storage, the pH values of all treatment samples were sharply decreased to become 5.3 for control and 5.0, 5.2 for pistacia palestina and salvia dominica added mortadella, respectively. This decrease in pH values is due to the deterioration and acidification of the control and treatment mortadella. Hydroperoxides are the primary products of lipid oxidation, but they are unstable and simply break up into secondary compounds such as aldehydes, ketones, or organic acids, which may lead to changes in the pH (Sun, et al, 2011). These results are similar to those obtained by Al-Shuibi and Al-Abdullah (2002) when they substitute sodium nitrite in mortadella by sorbate. The pH for their treatments stored at 4 °C for 14 weeks was ranged from 6.5 to 6.8. They ascribed this decrease in pH to the microbial activity during storage of mortadella, especially lactic acid bacteria. Hasani and Hasani (2014) found an increase in pH values of all treatments of carp fish fillets treated with grape extract and stored in 4 °C but this increase was less than of control treatment without grape extract. They concluded that pH is an important and effective indicator of meat quality. Lower pH of fillets treated with grape extract compared to control may be due to the antimicrobial activities. Phenolic compounds can act as antimicrobial, protecting fillets against the internal protease, and inhibit chemical deteriorations such as lipid and protein breakdown and amine production that elevate pH.

Table 2: Ph Values of Control, Pistacia Palaestina and Salvia Dominica Added Mortadella During Storage Period.

Treatments	Time (Weeks)		
	0	4	10
Control	$_{A}6.4^{a}$	$_{B}6.32^{a}$	$_{C}5.3^{a}$
Pistacia Palaestina Added Mortadella	$_{A}6.4^{a}$	$_{B}6.22^{b}$	$_{C}5.0^{b}$
Salvia Dominica Added Mortadella	$_{A}6.35^{a}$	$_{B}6.25^{b}$	$_{C}5.2^{b}$

- Values are the mean of three independent experiments.
- Values within the same column with different letters (smalls) are significantly different ($p < 0.05$) according to LSD.
- Values within the same row with different letters (capitals) are significantly different ($p < 0.05$) according to LSD.

Determination of Product Color

Appearance is one of the major factors that the consumer uses to evaluate the quality of food products. The appearance of a product as represented by its color can often be used to determine the pigment content of a product, which in turn is often an index of quality. it is well-known that mortadella color is effectively the most important organoleptic property (Francis 1995).

The color measurements results are shown in Table 3. Table 3 shows the lightness (*L*) values of mortadella treatments during storage periods. Although no significant differences werefound($P < 0.05$) between the control and the treatment samples lightness at the beginning of storage, the control had a lighter red color than the treatments. Moreover, it can be observed from the results that no significant difference were found ($P < 0.05$) in the lightness of the control sample during the whole time of storage, while in the case of the pistacia palaestina and salvia dominica added mortadella there is

a significant difference ($P < 0.05$) between the lightness during the time of storage (decreasing in the lightness of the treatment samples as the time proceed). There is a negative correlation between lightness and the TBARS values (Hernández-Hernández et al., 2009). In other words, as oxidation increased, lightness decreased (the samples became darker). The results are in agreement with that of Viuda-Martos*et al* (2011) study on the effect of packaging conditions on shelf-life of mortadella made with citrus fiber washing water and thyme or rosemary essential oil and they found that the lightness decreased as the storage time increased.

Values of redness (a) are presented in Table 3. For the redness value (a), the storage time, did have a significant effect, and the (a) value fell in the control (from 17.9 to 15.9 at the end of the experiment) and in pistacia palaestina added mortadella (from 17.7 to 14.0) and in salviadominica added mortadella (from 17.8 to 13.8). This parameter is affected by the structural integrity of the food, the content, and disposition of the pigment (water or lipid-soluble) and surface water availability (Fernández-López et al., 2005). In regards tothe composition of the food, the water/oil relations of the product also play an important role. A study by Sánchez-Escalante, *et al*., (2003) reported that myoglobin oxidation to brown metmyoglobin was associated with a reduction in reddish color in beef patties.

Table 3 shows the Hunter yellowness (*b)* values of mortadella treatments during storage For the yellowness parameter (b), the storage time led to an increase ($P < 0.05$) in this parameter in the control samples, which increased from 12.4 to 16.1 at the end of the experiment, in the pistacia palaestina added mortadella from 12.5 at day zero, increasing to 16.1 at the end of the experiment and in the salvia dominica added mortadella from 12.8 to 16.6. The behavior of (b) depends to a great extent on the food matrix, and it is recognized that changes (pH, oxidation extent, water activity, etc.) in the matrix have a great influence on this coordinate in many foods (Cofrades, et al., 2004). Furthermore, an increase in these values may be related to a fading of the color of cured meats (American Meat Science Association, 1991).

In a study to evaluate the effect of olive leaf extract (OLE), blueberry extract (BE), and *Zizyphus jujube* extract (ZE), at two levels (500 and 1000 ppm) on *L*, *a*, and *b* color values of meatball stored for 10 days (Gök and Bor, 2012), they reported that *L* (lightness), *a* (redness), and *b* (yellowness) values decreased during storage. *L*, and *a* value were higher in samples in order of BE>OLE>ZE. The initial and final *L* values of meatball with 500 and 1000 ppm OLE were 45.05-34.28 and 45.95-37.52, respectively. *a* value was 19.40-12.70 and 19.91-14.18, respectively. *b* values were 15.30-13.79 and 15.05-13.53, respectively. Another study by Jouki, et al., (2012) on breast turkey stored at -18 °C for six months and determination of color parameters showed that the *L* values increased during storage, while *a* value decreased significantly after two months of storage, which may be related to oxidation of heme pigments. However, *b* values changed slightly.

Table 3: Color Measurements (Lightness (L), Redness (A) and Yellowness (B)) of Control, Pistacia Palaestina and Salvia Dominica Added Mortadella During the Storage Period.

Storage Time (Weeks)	Lightness (L)			Redness (A)			Yellowness (B)		
	Control	Pistacia Palaestina Added Mortadella	Salvia Dominica Added Mortadella	Control	Pistacia Palaestina Added Mortadella	Salvia Dominica Added Mortadella	Control	Pistacia Palaestina Added Mortadella	Salvia Dominica Added Mortadella
0	$_{A}52.2^{a}$	$_{A}52.7^{a}$	$_{A}53.9^{a}$	$_{A}17.9^{a}$	$_{A}17.7^{a}$	17.8^{a}	$_{B}12.4^{a}$	$_{B}12.5^{a}$	$_{B}12.8^{a}$
4	$_{A}50.0^{a}$	$_{A}52.4^{a}$	$_{AB}51.3^{a}$	$_{B}17.3^{a}$	$_{B}16.1^{b}$	15.4^{b}	$_{B}13.2^{a}$	$_{B}13.4^{a}$	$_{B}13.6^{a}$
10	$_{A}49.2^{a}$	$_{B}48.8^{a}$	$_{B}48.2^{a}$	$_{B}15.9^{a}$	$_{C}14.0^{b}$	13.8^{b}	$_{A}15.8^{b}$	$_{A}16.1^{a}$	$_{A}16.6^{a}$

- Values are the mean of three independent experiments.
- Values within the same column different letters (capital) are significantly different ($p < 0.05$) according to LSD.
- Values within the same row for each treatment with different letters (small) are significantly different ($p < 0.05$) according to LSD.

Microbial Analyses

Table 4 shows the microbial results for all treatments at different storage time. As expected, bacterial loads as APC increased considerably during storage. However, the APC counts are considered fairly satisfactory when colony counts are 3-5 $\log_{10}$ CFU/log, and unsatisfactory when they reached more than 6 $\log_{10}$ CFU/log (Riettel, et al., 1991). Initially, the APC and coliform count of the three treatments were equal. Thus, this indicates that the cooking process of the product was effective in eliminating these organisms and the results suggest that the raw materials used were of good microbial quality. During storage of the mortadella and after 4 weeks, the APC and coliform counts have been greatly increased for the three treatments and reached a 6 $\log_{10}$ CFU/g for the APC count and 4 $\log_{10}$ CFU/g for the coliform count. This indicates that the added concentrations of both pistacia palaestina and salvia dominica had no inhibitory effect on the microbial growth in mortadella. It could be concluded that the two substances used at the level added were not sufficient to have inhibitory effect, and this suggests a need to increase the concentration of these added substances. Increased storage time, and after 10 weeks the APC and the coliform counts have reduced to $4.5x10^3$, $2.1x10^3$ and $1.5x10^3$ CFU/g for the control, pistacia palaestina and salvia dominica containing samples respectively. Also, the coliform counts have been decreased to $4.2x10^2$,$2.5x10^2$ and$5.7x10^2$CFU/g for the control, pistacia palaestina and salvia dominica containing samples respectively. This is due to the fact that the mortadella samples have reached an advanced level of spoilage and also reached the death stage which is characterized by a net loss of culturable cells. Even in the death phase, there may be individual cells that are metabolizing and dividing, but more viable cells are lost than are gained so there is a net loss of viable cells (Tortora,*et al*., 2004).

Also, this suggests that the sliced mortadella, whether the control sample or those containing pistacia palaestina and salvia dominica extracts could not have more than 4 weeks of shelf life.These findings are in agreement with that done by Sudarshan, *et al* (2010) who reported that ginger was contaminated with microorganisms which increased a total number of bacteria in mincemeat, and it did not have any preservative effect during storage. Another study by Al-Assaf and Abdullah (2007)on the effects of garlic, coriander and paprika on microbiological and sensory characteristics of beef frankfurters, the results showed that during storage, APC remained virtually static for the first 13-20 days before increasing

by at least 6 $\log_{10}$ units by the 48th day. They suggested that the added spices have no distinct effect on microbial growth in the sausages, but their contribution to the initial microbial load resulted in a shorter product shelf-life when judged on a microbiological basis. These findings are contrary to those found by Duarte, et al (2005) In evaluating of different plant extracts, including *Mentha piperita, Rosmarinus officinalis, Arrabidaeachica, Tabebuia avellanedae, Punicagranatum*and *Syzygiumcumini* against *Candida* species, They found that the extracts obtained from the selected plants had anti-*Candida* activity as they inhibited its growth, which could be due to its polyphenolic contents.Korukluogu, *et al*., (2010) investigated the inhibitory effect of acetone olive leaf extract on *Salmonella enteritidis, Bacillus cereus, Klebsiella pneumoniae, Escherichia coli, Enterococcus faecalis, Streptococcus thermophilus* and *Lactobacillus bulgaricus.* They found that the extract of olive leaves had an antibacterial effect against the testedmicroorganisms.

Yadav et al(2002)in their study on the Effect of garlic extract and cinnamon powder on microbial profile and shelf life of minced chicken meat, they found that extract/powder of spices like garlic and cinnamon are effective in improving the microbial quality and shelflife of minced chicken meat both at ambient and refrigerated temperatures.

Table 4: Microbial Analysis of Control, Pistacia Palaestina and Salvia Dominica Added Mortadella during Storage Period

Storage Time (Weeks)	Aerobic Plate Count (CFU/G)			Coliform (CFU/G)		
	Control	Pistacia Palaestina Added Mortadella	Salvia Dominica Added Mortadella	Control	Pistacia Palaestina Added Mortadella	Salvia Dominica Added Mortadella
0	$^{a}6.1x10^{1}$	$^{a}6.2x10^{1}$	$^{a}6.1x10^{1}$	$^{a}<10$	$^{a}<10$	$^{a}<10$
4	$^{a}4.8x10^{6}$	$^{a}3.15x10^{6}$	$^{a}2.6x10^{6}$	$^{a}9x10^{4}$	$^{a}4.5x10^{4}$	$^{a}2.8x10^{4}$
10	$^{a}4.5x10^{3}$	$^{a}2.1x10^{3}$	$^{a}1.5x10^{3}$	$^{a}4.2x10^{2}$	$^{a}2.5x10^{2}$	$^{a}5.7x10^{2}$

- Values are the mean of three independent experiments.
- Values within the same row for each treatment with different letters (small) are significantly not different ($p < 0.05$) according to LSD.

CONCLUSIONS

The results presented here suggest that pistacia palaestina and salvia dominica is a potential source of natural antioxidant and can be successfully used to decrease lipid oxidation and improve the shelf life of sliced beef mortadella. Pistacia palaestina and salvia dominica used at the level added to mortadella was not sufficient to have a microbial inhibitory effect, and this suggests a need to increase the concentration of these added substances.

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