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IMPACT OF NATURAL ANTIOXIDANT ON SHELF LIFE OF CHICKEN FILLET WITH SPECIAL REFERENCE TO ITS CHEMICAL QUALITY

By

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ABSTRACT

Chicken meat freshness is in permanent attention for all partners involved food chain. The present study was conducted to investigate the efficacy of edible natural antioxidants honey, rosemary and cinnamon essential oils (EOs) to enhance the shelf life of chilled chicken fillets.Chilled chicken fillets samples were divided into 8 equal groups. The 1st was control, the 2nd, 3rd were coated with honey at concentration 5% and10%, the 4th ,5 th,6 th,7 th were coated with rosemary and cinnamon essential oils(EOs) at concentration 0.5% and 1.5% and the 8th group was coated with honey, rosemary and cinnamon essential oils (EOs) with the smallest dose (5%, 0.5% and 0.5%) respectively, then examined at 0, 3, 6, 9, 12 days of the refrigeration storage at 4 ºC. Each group was undergoing organoleptic examination and analyzed chemically for determination of pH, Total Volatile Basic Nitrogen (TVB-N), Thiobarbituric Acid (TBA) and free fatty acids. The obtained results showed that chilled chicken fillets coated by the smallest concentration of the three natural antioxidants (honey, rosemary and cinnamon essential oils together) reduced the oxidative processes of chilled chicken meat (fillets) until 9th day of storage and still more acceptable compared with the control one at the same day. The edible coating of natural antioxidants was found to be a good alternative to increase the shelf life of chicken meat under refrigeration condition and resulted in great acceptability.

Keywords:

Chilled chicken fillet, chemical quality, honey, and rosemary and cinnamon essential oil.

INTRODUCTION

Poultry fillet are a very popular food commodity and its consumption has increased over the last decades **(Anshul *et al.*, 2016)**. Production of safe and high quality meat and meat products along with recent consumer's demand for all-natural and clean-label is challenging.

Lipid oxidation and growth of undesirable microorganisms in food products resulted in the development of spoilage, off flavor, rancidity and deterioration, rendering such products unacceptable for human consumption and yielding many compounds that contribute to the pathogenesis of cancer, atherosclerosis, heart and allergic diseases **Tang *et al.,* (2001), Bozin *et al.,* (2007) and Mielnik *et al*., (2008)**. Lipid oxidation is one of the most important parameters that influence the quality and acceptance of meat and chicken. The products of lipid oxidation are responsible for unacceptable off-flavors and off-odors in meat and limit its shelf life **Sampaio *et al*., (2012)**. Lipid stability of animal products during storage depends on the pro-oxidant and antioxidant content, fat content, the fatty acid profiles of fat and the degree of processing as well as storage conditions of products. It is well known that, the quality of dietary lipids and dietary supplementation with supranutritional amounts of antioxidants, such as α-tocopherol acetate (α-TA), significantly improves quality of poultry products (meat and eggs) through the improvement of lipid stability during storage **Bour *et al.,* (2009) and Schiavone *et al*., (2010)**. The products of lipid oxidation are responsible for limit the shelf life of meat. In contrast to raw meat, in which lipid oxidation occurs over days or week, these reactions proceed rapidly in cooked meat, such that oxidized flavors are detectable within hours of cooking **Kingston *et al*.,(2008)**. Use of either synthetic or natural antioxidants is one of the major strategies for preventing oxidation processes. Current recommendations restrict synthetic food additives, while encourages their replacement by naturally occurring ingredients with similar functions **Sasse *et al*., (2009).** Plants from the Lamiaceae family contains the substances for which the plant is used in the pharmaceutical, food or fragrance industries. Essential oils represent a small fraction of the plant composition; the main compounds are terpenes and sesquiterpenes, and several oxygenated derivatives compounds (alcohols, aldehydes, ketones, acids, phenols, ethers, esters, etc.) all of them responsible for the characteristic plant odor and flavor **Yanishlieva *et al.,* (2006)**.These compounds include natural flavorings such as sage, cinnamon, oregano and rosemary **Mariutti *et al*., (2011).** Refrigeration storage is usually the most common preservative method of meat products. In order to extend refrigerated storage time, antimicrobial and antioxidant additives especially those of synthetic origin such as butylated hydroxytoluene (BHT), butylated hydroxyanisole (BHA) are added to meat products. However, consumers increasingly demand for the use of natural products as alternative preservatives in foods, as the safety of synthetic additives has been questioned **Gilbert, (1998)**. Plant-derived essential oils EOs have shown remarkable

antimicrobial and antioxidant potency against spoilage and pathogenic microorganisms in meat and meat products **Dinesh and Cheorun,(2013) and Anshul *et al*., (2016)**. Much attention has been focused on extracts from herbs and spices to improve the sensory properties and extend the shelf-life of foods **Botsoglou *et al*., (2003)**. Consequently, the aim of the present study was to investigate the effect of honey rosemary and cinnamon essential oils, on the shelf-life extension of chilled chicken fillet, stored at 4 ºC.

MATERIAL AND METHODS

Honey and Essential oils (EOs):

The honey was purchased from local market at El - Gharbia Governorate Egypt. The ready-made herbal oil rosemary and cinnamon were purchased from Navaratri Co.,Cairo, Egypt. All the used chemicals were of analytical reagent-grade. These oils were stored in amber- colored bottles at 4 ºC until use.

Collection of samples:

A total of 10kg.chicken breast portions were collected from broilers recently slaughtered in local markets at El-Gharbia Governorate Egypt and immediately transported under chilled condition in ice boxes to the laboratory. Skin, bone and visible fat of chicken meat were removed to obtain fillet. The samples were divided into eight equal groups each contained 1.25 kg. The first group was kept as control without any supplementation. The 2nd and 3rd groups were coated by dipping in honey at average dose 5% and 10 %, according to **Sampaio *et al.*, (2012)**. The 4th and 5th groups were coated by dipping in conc. rosemary essential oil at average dose 0.5% and 1.5% respectively **Basaga *et al*., (1997) and Abdel bar, (2016).** The 6th and 7th groups were coated by dipping in conc. cinnamon essential oil at average dose 0.5% and 1.5% according to **Anshul *et al.*, (2016)**. The 8th group was coated by dipping in a mixture of both honey followed by rosemary oil and then by cinnamon oil at the smallest dose, 5%, 0.5% and 0.5%, respectively. The samples were examined to get the valid or suitable dose that maintains the chicken sensory attributes. All groups were packed in a separate sterile polyethylene bags then labeled and stored in refrigerator at 4 ºC. Each group was examined every 24 hours till the signs of deterioration occurred. The following chemical examinations were established to evaluate their freshness through determination of proteolysis and lipolysis indices.

Sensory evaluation:

The process of specific training, the selection and definition of the descriptors, and the quantification of the final sensory profile were carried out according to procedures of the **World's Poultry Science Association, (1987) and ISO, (1988)**. The different attributes were quantified on a rating scale from 1 to 3. The sensorial attributes analyzed were: meat color, meat consistency, elasticity and odor.The maximum score given was 12 points.Nine-12 points were excellent, 5 - 8 points were acceptable and less than 5 points were unacceptable.

Chemical evaluation:

Determination of pH Pearson, (2006).

The pH value was determined by using an electrical pH meter (Bye model 6020,USA). Calibration of pH meter by using two buffer solutions of exactly known pH (alkaline pH 7.01, acidic pH 4.01).

Determination of Total Volatile Basic Nitrogen (TVB-N):

The technique applied for determination of total volatile nitrogen (TVN) was recommended by **Food and Agriculture Organization "FAO" (1980).**

TVN/l00g = 26.88 x (2-T_1)

T_1 = volume of NaOH consumed in the titration.

Determination of Thiobarbituric Acid Number (TBA):

The method adopted for estimation of TBA by **Pikul *et al.* (1989)** was applied:

TBA test which depends on determination of malonaldehyde (MD) as an end product of lipid peroxidation. The extent of oxidative rancidity is normally reported as TBA number or values and expressed as milligrams of malonaldehyde equivalents per kilogram of samples. The optical density of sample against the blank was measured by using Spectrophotometer (UNICAM969AA Spectronic, USA) at a wave length of 538 nm.

Concentration of malonaldehyde (mg/kg) = R x 7.8

R = (the absorbance)

Determination of Free Fatty Acids (FFA):

Lipid Extraction Using the Folch Method Folch *et al.*, (1957):

The folch extractions were performed using the original extraction ratio of 20 parts of 2:1 dichloromethane/methanol to 1 part of the examined sample. A weak salt solution (0.66% NaCl) was then added to achieve a final ratio of 8:4:3 dichloromethane/methanol/ water including the water contained within the tissue.

Titration procedure Brake and Fennema, (1999):

This method was adapted to the quantity and nature of the sample. The lipid extract of the sample was evaporated with nitrogen and dissolved in ethanol previously neutralized with cresol purple and preheated to 60 °C. Three replicates per sample were used titrated with N NaOh to a violet end point Cresol purple has been proposed to increase the sensitivity of the method and has been used for the titration of lipid fish extracts **Ke and Woyewoda, (1978)**. In this case, 0.05 N NaOH was used for the titration of the extract to a violet end point cresol purple. Accordingly, FFA values were recorded as percentage of oleic acid.

% oleic acid = (ml NaOH X NaOH normality X 28.2) /weight of sample.

RESULTS AND DISCUSSION

Chicken meat is more popular in consumer market due to several advantages such as easy digestibility and acceptance by the majority of people **Fung, (2010)**. Although chilling or refrigeration is one of the methods of preservation, growth and metabolic activity of psychrotrophs are the reason for the spoilage of refrigerated meat when stored for long period. In addition, chemical enzymatic and non - enzymatic reaction could proceed at low temperatures leading to reduction of meat quality **Gram *et al*., (2002)**. Rosemary (*Rosmarinus officinalis L.)* extracts have a potent antioxidant activity, and they are widely used in food industry, as in the case of meat fillets, they were used as 200 - 1000 mg oil / meat kg **Stoick *et al.,* (1991) and Basaga *et al*., (1997)**. Both essential oils (Eos) cinnamon and rosemary at different concentrations had significant antibacterial activity against *Staph aureus* and antioxidant activity in all treated minced meat during storage period. The antibacterial activity of the EOs at a low concentration (0.5%) and (1%) caused considerable reduction of *Staph aureus*, although it could not completely eliminate. Cinnamon essential oil had significant difference in growth inhibition of *Staph aureus* at the 10^{th} day and the count was reduced to 99.55% **Abdel bar, (2016).**

Table (1): Mean score values of sensory evaluation of examined samples of fresh chicken fillet (zero time).

samples	External aspect (3)	Odor (3)	Color (3)	Muscular elasticity (3)	Overall score (12)	Sensorial quality
control	3	3	3	3	12	Excellent
Honey (5 %)	3	3	3	3	12	Excellent
Honey (10 %)	3	3	3	3	12	Excellent
Rosemary (0.5 %)	3	3	3	3	12	Excellent
Rosemary (1.5 %)	3	2	3	3	11	Excellent
Cinnamon (0.5 %)	3	3	3	3	12	Excellent
Cinnamon (1.5 %)	3	2	3	3	11	Excellent
H. (5%) + R. (0.5%) + C. (0.5%)	3	3	3	3	12	Excellent

H=Honey, R= Rosemary, C= Cinnamon

Table (2): Mean score values of sensory evaluation of examined samples of chilled chicken fillet stored at 4±1 °C for 3, 6, 9, and 12 days.

Samples	3days Score -quality	6days Score-quality	9days Score- quality	12days Score-quality
Control	5 Acceptable	2 Unacceptable	0 Unacceptable	0 Unacceptable
Honey (5%)	8 Acceptable	5 Acceptable	1 Unacceptable	0 Unacceptable
Honey (10%)	7 Acceptable	5 Acceptable	2 Unacceptable	0 Unacceptable
Rosemary (0.5%)	8 Acceptable	5 Acceptable	2 Unacceptable	1 Unacceptable
Rosemary (1.5%)	8 Acceptable	6 Acceptable	5 Acceptable	2 Unacceptable
Cinnamon (0.5%)	8 Acceptable	5 Acceptable	3 Unacceptable	1 Unacceptable
Cinnamon (1.5%)	7 Acceptable	5 Acceptable	3 Unacceptable	1 Unacceptable
H. (5%) +R. (0.5%) +C. (0.5%)	9 Acceptable	8 Acceptable	6 Acceptable	3 Unacceptable

H=Honey, R= Rosemary, C= Cinnamon.

Organoleptic evaluation:

Sensory analysis is one of the oldest means of quality control, but in principle is an essential part of the mandatory assessment of food quality. The first consumer purchase decision is depend on sensory parameter specially appearance of chicken meat. The data represented in (Table 1) indicated that, the mean score value of external aspect, color, odor and muscular elasticity of fresh chicken fillets at zero time of storage were excellent in sensorial quality in all groups but the overall score were 12 in control and other treated samples except rosemary (1.5%) and cinnamon (1.5%) were 11 because the high concentration of rosemary and cinnamon were affected on odor of samples**.**

Examined samples of chicken fillet stored at chilling temperature and evaluated organoleptically at 3, 6, 9 and 12 days in (Table 2) indicated that control sample acceptable at 3rd day of storage with low over all score 5, but honey 5% and 10 % were 8 and 7 respectively, rosemary (0.5%) and (1.5%) were 8 for both concentrations, cinnamon (0.5) and (1.5%) were 8 and 7, but the mixed group of honey plus rosemary and cinnamon with low concentration was excellent with high score 9. On the other hand, in 6th day the control sample was unacceptable, but all treated samples with honey, rosemary and cinnamon with different concentrations were acceptable by moderate and low score moreover mixed group was acceptable by high score 8. At 9th day of storage all groups were unacceptable except rosemary (1.5%) and mixed samples were acceptable by score 5 and 6. The mechanism of action of the plant essential oil partly associated with their hydrophobic attribute as they enter into the lipid fraction of cellular membrane and promote the cellular contents to exit the cell thereby disturbing their structure and also this nature enables them to interact well with mitochondria and cause permeabilization of the membranes **Marija *et al.,* (2013)**, while microorganisms sit in the hydrophilic portion. One possible explanation for the observed effect with the honey could be that, the sugar-containing provided a hygroscopic effect, thereby reducing moisture loss inter and intra muscular fibers. In addition, the protection of muscle membrane from lipid oxidation by applying lipid-soluble antioxidants can also maintain membrane integrity of muscle fibers and reduce moisture loss **Mitsumoto *et al.*, (1995), Faleiro, (2011) and de Oliveira *et al.*, (2013)**. Confirming to the sensory acceptability, the breast chicken fillets presented high sensory acceptability in case of mixed honey 5% plus rosemary 0.5 %, and cinnamon 0.5 %. No significant difference in acceptability between rosemary, cinnamon essential oil and honey with different concentrations these results were in agreement with the

study of **Sampaio *et al.*, (2012) and Abdel bar, (2016)**. The sensory evaluation indicated that, the use of mixed rosemary plus cinnamon and honey resulted in a pleasant flavor for chilled chicken fillet chicken.

Table (3): Mean value of pH in examined samples of chilled chicken fillet stored at 4 ±1 ºC.

Samples	Zero day	3rd days	6th days	9th days	12th days
Control	**5.7±0.012**	**6.04±0.043**	**6.78±0.14**	**S**	**S**
Honey (5%)	**5.7±0.013**	**5.96±0.04**	**6.5±0.05**	**S**	**S**
Honey (10%)	**5.6±0.012**	**5.91±0.038**	**6.4±0.05**	**7.2±0.03**	**S**
Rosemary (0.5%)	**5.6±0.011**	**5.93±0.04**	**6.3±0.02**	**7.3±0.01**	**S**
Rosemary (1.5%)	**5.7±0.013**	**5.85±0.034**	**6.4±0.01**	**6.9±0.06**	**7.17**
Cinnamon (0.5%)	**5.68±0.18**	**5.96±0.043**	**6.39±0.03**	**7.3±0.07**	**S**
Cinnamon (1.5%)	**5.69±0.017**	**5.91±0.031**	**6.4±0.04**	**6.8±0.04**	**7.29**
H (5%) +R (0.5%) + C (0.5%)	**5.64±0.017**	**5.80±0.02**	**6.2±0.05**	**6.23±0.05**	**7.04±0.05**

S=Spoiled samples, H=Honey, R= Rosemary, C= Cinnamon.

Evaluation of pH:

Examined samples of chicken fillet at chilling temperature stored for 0, 3, 6, 9, and 12 days were represented in (Table 3). pH in control samples in 0, 3, and 6 days were 5.7±0.012, 6.04±0.043 and 6.78±0.14, respectively. According to **Pearson, (2006)** the incipient spoilage occurred at 6.2, and increase in pH value in meat may be attributed to the partial proteolysis leading to the increase of free alkaline groups. In the present study the incipient spoilage was recorded after third day of storage in control sample and no variation in pH values in samples which treated by honey, rosemary and cinnamon in different concentration usage. On the other, hand pH values in samples treated with mixed of low concentrations of honey, rosemary and cinnamon in 0, 3rd, 6th, 9th, and 12th days in chilling temperature were 5.64±0.017, 5.80±0.02, 6.2±0.05, 6.23±0.05 and 7.04±0.05, respectively. The obtained results indicated that, the spoilage was occurred after 9 days. Furthermore, the chilled chicken meat in this treated group had long shelf life and good quality.One of the existent techniques for the microbial and chemical spoilage control is the addition of synthetic (chemical origin) or natural preservatives. In the last years, there has been a tendency to use and implement natural preservatives that may have a positive effect on human health **Burt, (2004) and Niño,**

(2009). Natural preservatives, essential oils (sage, cinnamon, oregano and rosemary) had presented great advances in their usage; their compounds are used to reduce microbial and chemical spoilage **Tuley, (1996) and Pessoa, *et al*., (2002).**

Table (4): Mean value of TVB-N (mg/100g) in examined samples of chilled chicken fillet stored at 4±1 ºC.

Sample	0day	3rd days	6th days	9th days	12th days
Control	**4.03±0.16**	**14.68±0.69**	**27.7±1.05**	**S**	**S**
Honey (5%)	**3.7±0.19**	**12.21±0.5**	**20.9±1.11**	**S**	**S**
Honey (10%)	**3.55±0.18**	**11.06±o.35**	**19.9±1.0**	**30.5±0.58**	**S**
Rosemary (0.5%)	**3.67±0.12**	**11.3±0.38**	**20.1±0.8**	**31.3±0.67**	**S**
Rosemary (1.5%)	**3.54±0.22**	**10.5±0.48**	**18.5±0.7**	**25.2±1.17**	**29±87**
Cinnamon (0.5%)	**3.66±0.19**	**11.77±0.41**	**20.4±0.95**	**32.2±0.3**	**S**
Cinnamon (1.5%)	**3.57±0.21**	**10.76±0.42**	**19.1±0.73**	**26.1±1.08**	**32.55**
H (5%) +R (0.5%) +C (0.5%)	**3.45±0.21**	**9.44±0.47**	**17.7±0.5**	**17.9±0.7**	**27.7±1.02**

S=Spoiled samples, H=Honey, R= Rosemary, C= Cinnamon.

Evaluation of TVB-N (mg/100g):

The data recorded in (Table 4) indicated that total volatile basic nitrogen (TVB-N) of the control fillet chicken samples storage at 4 ºC at 0, 3, and 6, days were 4.03±0.16, 14.68±0.69 and 27.7±1.05 respectively. According to **EOS, (2005)** the maximum permissible limit for TVB-N in poultry meat is 20 mg/100g. So the meat was completely unacceptable at 6 days of storage.In compared to samples treated by honey 5%, 10%, rosemary 0.5%, 1.5 and cinnamon 0.5, 1.5% at 6th day were 20.9±1.11,19.9±1.0, 20.1±0.8, 18.5±0.7, 20.4±0.95, and 19.1±0.73 respectively where these results indicated that these natural antioxidants were effective and treated chicken meat still relatively acceptable till 6 days. But TVB-N of last group which mixed with low concentration of honey, rosemary and cinnamon in, 6th, 9th, and 12th day were17.7±0.5, 17.9±0.7 and 27.7±1.02 respectively. Furthermore, the samples which treated with these mixed antioxidants had low level of TVB-N and still acceptable after 9 days of storage in refrigeration. TVB-N can be considered as a reliable indicative measure for quality of various food articles especially chicken meat. The reaction products of oxidation affect the generation of free radicals and the reaction speeds which promote the lipids and proteins

rupture and generate oxidation compounds which have an adverse effect on the quality attributes and nutritive value of meat products **Guillen and Chozas, (1998) and Badi *et al.*, (2004)**. Therefore, the usage of methods or processes which stop or decrease the oxidation reactions would increase the shelf life of the products.

Table (5): Mean value of TBA (mg MDA/Kg) in examined samples of chilled chicken fillet stored at 4 ±1 ºC.

Samples	0 day	3 days	6 days	9 days	12 days
Control	**0.063±0.008**	**0.46±0.03**	**1.05±0.04**	**S**	**S**
Honey (5%)	**0.06±0.005**	**0.37±0.03**	**0.92±0.05**	**S**	**S**
Honey (10%)	**0.05±0.005**	**0.31±0.03**	**0.83±0.05**	**1.2±0.04**	**S**
Rosemary (0.5%)	**0.04±0.008**	**0.33±0.02**	**0.89±0.07**	**1.2±0.03**	**S**
Rosemary (1.5%)	**0.036±0.006**	**0.24±0.03**	**0.78±0.04**	**0.99±0.01**	**1.16**
Cinnamon (0.5%)	**0.053±0.008**	**0.34±0.03**	**0.93±0.06**	**1.25±0.03**	**S**
Cinnamon (1.5%)	**0.04±0.009**	**0.29±0.02**	**0.81±0.03**	**1.07±0.04**	**1.34**
H (5%) +R (0.5%) +C (0.5%)	**0.03±0.005**	**0.196±0.02**	**0.68±0.04**	**0.78±0.047**	**1.09±0.04**

S=Spoiled samples, H=Honey, R= Rosemary, C= Cinnamon

The data obtained from Thiobarbituric acid reaction tests (TBA), in the application at different concentrations of honey, rosemary and cinnamon essential oil in chicken fillets were represented in (Table 5). The concentration of Malonaldehyde (MDA) in samples without any application of essential oils (control) were increased according to the storage time. It implies an increase in the chicken fillet oxidation. As recommended by **EOS, (2005)** TBA value must not exceed 0.9 mg /kg of chicken meat. It is possible to observe how the concentration values of Malonaldehyde (MDA) for fillets, which the application was performed with different concentrations of essential oil, did not display a significant increase from application (day zero) until day twelve, which shows that in the case of samples, rosemary essential oil has an antioxidant effect, as evidenced by **Chen *et al*., (2006)** due to the presence of the compounds: Carnosic, Carnosol, Rosmanol acids, Rosmariquinone and Rosmaridiphenol **Cuvelier *et al*., (1996)**. The values of TBA oxidation index for the different treatments had significant from 9th day of storage, contrasted with the obtained values for the control sample. In the case of rosemary essential oil showed in (Table 5) showed that, there were no

differences for the TBA values among the different concentrations used (0.5 and 1.5%). The values of TBARS oxidation index obtained for tests at different concentrations of cinnamon oil 0.5% and 1.5%, as well as in the case of rosemary, presented significant from ninth day of storage compared to the values obtained for the control test. This is because the oxidation processes in meat develop faster from the sixth day of storage. The reduction level in oxidation processes for the Rosemary and cinnamon essential oils application at different concentrations were showed in (Table 5). These results clearly suggests that, oils application generate a significant decrease in chicken fillets oxidation. However, in ninth day of storage it was observed how the used oils caused a reduction of the oxidation products. The high capacity antioxidants of honey is related to the flavonoids, ascorbic acid, tocopherols, catalase, phenolic compounds and Maillard reaction products **Mckibben and Engeseth, (2002) and Mariutti *et al*., (2011)**. The results from the analysis on the oxidative degradation of lipids from chicken breast fillets during refrigeration as measured by TBA, showed reducing the velocity of lipid oxidation in chicken meat was demonstrated after 3 days of refrigeration at 4 °C this indicated that, the TBA were lower than the control by adding the honey, 5 % and 10% as natural antioxidants in fillet chicken these results were in agreement with the study of **Mckibben and Engeseth, (2002) and Sampaio *et al.,* (2012**). The treatments with low concentration of honey, rosemary and cinnamon essential oils in chicken fillet prolonged the shelf life of meat till 12 days in chilling temperature. Furthermore, the mean values of TBA at 9^{th} and 12^{th} days of storage were 0.78±0.047 and 1.09±0.04, but TBA in control at 3^{th} and 6^{th} days were 0.46±0.03 and1.05±0.04.These results suggested that these antioxidants retarded lipid oxidation during storage under refrigeration these results were in agreement with **Juntachote *et al.,* (2006) and de Oliveira *et al.*, (2013).**

Table (6): Mean values of free fatty acids (mg/100g) in examined samples of chilled chicken fillet stored at 4±1 ºC.

Samples	0 day	3rd days	6th days	9th days	12th days
Control	**0.30±0.017**	**1.1±0.08**	**2.7±0.3**	**S**	**S**
Honey (5%)	**0.28±0.015**	**0.98+0.04**	**2.5±0.2**	**S**	**S**
Honey (10%)	**0.25±0.016**	**0.89±0.04**	**2.3±0.1**	**3.1±0.11**	**S**
Rosemary (0.5%)	**0.26±0.017**	**0.92±0.03**	**2.3±0.1**	**3.2±0.2**	**S**
Rosemary (1.5%)	**0.23±0.008**	**0.77±0.03**	**2.1±0.3**	**2.7±0.4**	**3.11**
Cinnamon (0.5%)	**0.28±0.011**	**0.90±0.05**	**2.4±0.2**	**3.3±0.1**	**S**
Cinnamon (1.5%)	**0.25±0.015**	**0.82±0.03**	**2.18±0.14**	**2.9±0.1**	**3.40**
H (5%) +R (0.5%) +C (0.5%):	**0.20±0.008**	**0.71±0.026**	**1.72±0.1**	**2.4±0.11**	**2.9±0.1**

S=Spoiled samples, H=Honey, R= Rosemary, C= Cinnamon.

Concerning to the free fatty acids contents as illustrated in (Table 6) they were significantly increase at 3rd day of refrigeration in all samples.Thus, the important losses of total lipids contents in chicken samples have been considered to be related to the autoxidation of lipids. The results were agreed with those reported by **Igene *et al.*, (1979),** who showed that losses observed in total lipids during storage were primarily due to the changes in the triglycerides levels. Moreover, the data recorded in (Table 6) indicated that free fatty acids of the control fillet chicken samples stored at 4±1 ˚C at 0, 3, and 6, days were 0.30±0.017, 1.1±0.08, 2.7±0.3 respectively, and complete spoilage at 9th days. As recommended by **EOS, (2005)** free fatty acids value must not exceed 3 mg /100g of chicken meat. Also the results obtained in (Table 6) indicated that honey 10%, rosemary 1.5%, cinnamon 1.5% and mixed group with low concentration of honey, rosemary and cinnamon, were more effective and prolonged the shelf life of chicken fillet and the mean of free fatty acids at 9th days were 3.1±0.11, 2.7±0.4, 2.9±0.1, 2.4±0.11 respectively. Furthermore, the mean value of free fatty acids at 12th day in mixed group was 2.9±0.1, so in 9th day of storage it was observed how the used of low concentration of honey, rosemary and cinnamon caused a reduction of the oxidation products. These results were agreed with those reported by **Goodson *et al*., (2002), Johnston *et al*., (2005) and Abdel bar, (2016)** and indicating a close relationship between the lipid oxidation and the refrigeration and mentioned that natural antioxidant prolonged shelf life of chilled meat.

CONCLUSION AND RECOMMENDATIONS

The obtained results in the present study confirmed that, natural antioxidant as honey, rosemary and cinnamon when added to chicken fillet assist increasing the shelf life of chicken fillet after 6 days of refrigeration at 4 ºC. The using of natural antioxidants also improved the oxidative stability of lipids, reducing the degradation compared with the control samples, with a great acceptability till 9 days in samples which treated with low concentration of the three antioxidants ingredient. Legal regulation and specific chemical standards must be adapted by concerned authorities to ensure maximum safety to consumers.

REFERENCES

Abd El-Bar, Shimaa, Ibrahim (2016): Detection of *Staphylococcus aureus* classic enterotoxin genes in some meat products using multiplex PCR. Ph.D. Faculty of Veterinary Medicine Kafrelsheikh University, Cairo, Egypt.

Anshul, K.K.; Robinson, J.J.; Abraham, V.; Appa, R. and Narendra Babu, R. (2016): Utilization of carrageenan, citric acid and cinnamon oil as an edible coating of chicken fillets to prolong its shelf life under refrigeration conditions. Veterinary world, org. 9: 166 - 175.

Badi, H.N.; Yazdani, D.; Ali, S.M. and Nazari, F. (2004): Effect of Spacing and Harvesting Time on Herbage Yield and Quality/Quantity of Oil in Thyme, Thymus vulgaris L. Industrial Crops and Products, 19: 231 - 236.

Basaga, H.; Tekkaya, C. and Acitel,F.(1997): Antioxidative and free radical scavenging properties of rosemary extract. LWT, (1): 105 -108.

Botsoglou, N.A.; Grigoropoulou, S.H.; Botsoglou, E.; Govaris, A. and Papageorgiou, G. (2003): The Effects of Dietary Oregano Essential Oil and α-Tocopheryl Acetate on Lipid Oxidation in Raw and Cooked Turkey during Refrigerated storage. Meat Science, 65: 1193 -1200.

Bour, R.; Codony,R.;Tres, A.; Deckere, E.A. and Guardiola, F. (2009): Dietary strategies to improve nutritional value, oxidative stability, and sensory properties of poultry products. Critical Reviews in Food Science and Nutrition, 49: 800 - 822.

Bozin, B.; Mimica-Dukic, N.; Samojlik, I. and Jovin, E.A. (2007): Antimicrobial and Antioxidant Properties of Rosemary and Sage (Rosmarinus officinal L. and Salvia officinalis L., Lamiaceae) Essential Oils. Journal of Agriculture and Food Chemistry, 55: 7879 -7885.

Brake, N. C. and Fennema, O. R. (1999): Lipolysis and lipid oxidation in frozen minced mackerel as related to molecular diffusion and presence of gelatin. Biochem, 61: 125 - 132.

Burt, S. (2004): Essential oils:their antibacterial properties and potential applications in foods-A review. Int. Journal Food Microbial. 94 (3): 223-253.

Chen, H.; Muramoto, K.; Yamauchi, F. and Huang, C. (2006): Natural antioxidants from rosemary and sage. Journal Food Sci. 42 (4): 1102-1104.

Cuvelier, M.; Richard, H. and Berset, C. (1996): Antioxidative activity and phenolic composition of pilot-plant and commercial extracts of sage and rosemary. Journal Am. Oil Chemsoc, 73 (5): 645-652

De Oliveira,T.L.; Soares, R.A. and Piccoli, R.G.(2013): A Weibull model to describe antimicrobial kinetics of oregano and lemongrass essential oils against *Salmonella Enteritidis* in ground beef during refrigerated storage. Meat Sci., 93 (3): 645 - 651.

Dinesh, D. J. and Cheorun, J. (2013): Essential oils as potential antimicrobial agents in meat and meat products: A review. Trends in Food Science and Technology, 34:96 -108.

EOS (2005): Egyptian standar, Egyptian Organization for Standardization and Quality Control: chicken and turkey meat and their products. Lssue no.2910.

Faleriro, M.L. (2011): The mode of antibacterial action of essential oils. In science against microbial pathogens: communicating current research and technological advances; Mendez-Vilas, A., Ed.; Brown walker Press: Boca Raton, FL; USA, 2:1143 -1156.

Folch, J.; Lees, M. and Sloanes, G. (1957): Simple method for the isolation and purification of total lipids from animal tissues. Journal. Biol. Chem., 226: 497- 509.

FAO Food and Agriculture Organization (1980): Manual of Food Quality Control. FAO, United Nation, Rome, Italy.

Fung, D.Y., (2010): Microbial hazards in food: food-borne infections and intoxications. In: Toldra, F. (Ed.), Handbook of Meat Processing. Blackwell Publishing, USA, 481-500.

Gilbert, C. (1998): Le sens caché des risques collectifs. La Recherche, 307, 110 -113.

Goodson,K. J.; Morgan, W.W.; Reagan, J.O.; Gwartney, B. L.; Courington, S.M. and Wise, J.W. (2002): Beef Customer Satisfaction: Factors affecting consumer evaluation of clod streaks. Journal of Animal Science, 80 (2), 401- 408.

Gram, L.; Ravn, L.; Rasch, M.; Bruhn, J.B.; Christensen, A. and Givskov, M. (2002): Food spoilage interactions between food spoilage bacteria. International Journal of Food Microbiology, 78: 79 -97.

Guillen, S.R. and Chozas, M. (1998): The thiobarbiyuric Acid (TBA) Reaction in Foods: A Review. Critical Review in Food Science and Nutrition, 38: 315-330.

Igene, J.O.; Pearson, **A.M.; Merkel, R.A. and Coleman, T.H. (1979):** Effect of frozen storage time, cooking and holding temperation upon extractable lipids and TBA values of beef and chicken. Journal of Animal Science, 49 (3):701 -707.

ISO (1988): Sensory Analysis-General Guidance for the Design of Test Rooms. 8589: 1-9.

Johnston, J. E.; Sepe, H. A.; Miano, C.L.; Brannan, R. G. and Alderton, A.L. (2005): Honey inhibits lipid oxidation in ready - to-eat ground beef patties. Meat Science, 70 (4): 627- 631.

Juntachote, T.; Berghofer, E.; Siebenhandl, S. and Bauer, F. (2006): The Antioxidative properties of Holy basil and Galangal in cooked ground pork. Meat Science, 72(3): 446 - 456.

Ke, P. J. and Woyewoda, A. D. (1978): Tritimetric method for and determination of free fatty acids in tissues and lipids with ternary solvents *m*-cresol purple indicator. Anal. Chem. Acta., 99: 387-391.

Kingston, E. R.; Monahan, F. J.; Buckley, D. J. and Lynch, P. B. (2008): Lipid oxidation in cooked pork as affected by vitamin E, cooking and storage conditions. Journal of Food Science, 63(3): 386-389.

Marija, B.; Milan, B.Z.; Jelena, I.; Jelena, D.; Loncina Jasna, L.; Marija, D. and Radmila, M.(2013): Use of essential oils in order to prevent food borne illnesses caused by pathogens in meat. Tehnologija mesa, 54:14 -20.

Mariutti, L. R.B.; Nogueira, G.C. and Bragagnolo, N. (2011): Lipid and cholesterol oxidation in chicken meat are inhibited by sage but not by garlic. Journal of Food Science, 76 (6): C909 - C915.

Mckibben, J. and Engeseth, N.J. (2002): Honey as a protective agent againist lipid oxidation in ground turkey. Journal of Agricultural and Food Chemistry, 50 (3); 592 -595.

Mielnik, M.B.; Signe, S.; Bjorg, E. and Grete, S. (2008): By-Products from Herbs Essential Oil Production as Ingredient in Marinade for Turkey Thighs. LWT-Food Science and Technology, 41: 93 -100.

Mitsumoto, M.; Arnoid, R.N.; Schaefer, D.M. and Cassens, R.G. (1995): Dietary vitamin E supplementation shifted weight loss from drip to cooking loss in fresh beef longissimus during display. Journal of Animal Science, 73(8): 2289 - 22294.

Niño, D. (2009): Conversation with: Cristian Alfonso (Chemical engineering department, Universidad Nacional de Colombia, Bogotá, Colombia). Dic 10.

Pearson, D. (2006): Chemical Analysis of Foods. 11th Ed, Publishing Co., Churchill Livingstone, Edinburgh, London, United Kingdom.

Pessoa, L.M; Morais, S.; Bevilaqua, C. and Luciano, J. (2002): Anthelmintic activity of essential oil of *Ocimum gratissimum Linn*. and eugenol against *Haemonchus contortus*. Vet Parasitol. 11; 109 (1-2): 59 - 63.

Pikul, J.; Leszezynski, D.E. and Kummerow, F. (1989): Evaluation of three modified TBA methods for measuring lipid oxidation in chicken meat Journal Agri. Food Chem., 37:1309.

Sampaio, G. R.; Saldanha, T.; Soares. R. A. M. and Torres, E. A. F. S. (2012): Effect of natural antioxidants combinations on lipid oxidation in cooked chicken meat during refrigerated storage. Food Chemistry, 135: 1383 -1390.

Sasse, A.; Colindres, P.;and Brewer,M. S. (2009): Effect of natural and synthetic antioxidants on the oxidative stability of cooked, frozen pork patties. Journal of Food Science, 74 (1): S 30 -S 35 371-378.

Schiavone, A.; Marzoni, M.; Castillo, A.; Nery, J. and Romboli, I., (2010): Dietary lipid sources and vitamin E affect fatty acid composition or lipid stability of breast meat from Muscovy duck. Canadian Journal of Animal Science 90:152-160.

Stoick, S.; Gray, J.; Booren, A. and Buckley, D. (1991): Oxidative stability of restructured beef steaks processed with oleoresin rosemary, tertiary butyl hydroquinone and sodium tripolyphosphate. Journal Food Sci. 56 (3): 597- 600.

Tang, S.; Kerr, J.P.; Sheehan, D.; Buckley, D.J. and Morrissey, P.A. (2001): Antioxidative Effect of Added Tea Catechins on Susceptibility of Cooked Red Meat, Poultry and Fish Patties to Lipid Oxidation. Food Research International, 34: 651 - 657.

Tuley, S.K. (1996): A Manual on the Essential Oil Industry [CDROM]. Vienna, Austria: UNIDO.

World's Poultry Science Association, (1987): Working Group No. 5. Mead, G. C.: Recommendation for a standardized method of sensory analysis for broilers. World's Poult. Sci. Journal 68- 43:64.

Yanishlieva, N. V.; Marinova, E. and Pokorny, J. (2006): Natural antioxidants from herbs and spices. European Journal of Lipid Science and Technology, 108 (9), 776 -793.

تأثير مضادات الاكسدة الطبيعية على فترة صلاحية فيليه الدجاج مع الاشارة بوجه خاص الى جودتها الكيميا ئية

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الملخص العربى

لحم الدجاج الطازج له اهتمام دائم كأحد عناصر سلسلة الغداء. اجريت هده الدراسة بهدف معرفة مدى كفاءة بعض مضادات الاكسدة الطبيعية الصالحة للاكل (عسل النحل وزيت الروزمارى والقرفة) لتعزيز مدة صلاحية لحم الدجاج (الفيليه) من خلال تخزينه مبردا. قسمت عينات فيليه الدجاج الى 8 مجموعات متساوية. المجموعة الاولى كانت ضابط للتجربة والمجموعة الثانية والثالثة تم تغطيتها بعسل النحل عند تركيز (5%،10%) والمجموعة الرابعة والخامسة والسادسة والسابعة تم تغطيتهم بزيت الروزمارى والقرفة عند تركيز (.5%، 1.5%) بالترتيب وتم تغطية المجموعة الثامنة بكل من عسل النحل وزيت الروزمارى والقرفة بالتركيز الصغير (5%،5. 0%،5. 0%) بالترتيب.

. تم الفحص عند (صفر؛3 ؛6؛9؛12) يوم من خلال حفظها مبردة عند درجة (4)° درجة مئوية. جميع المجموعات خضعت للفحص الحسى؛والتحليل الكيميائى لقياس درجة الحموضة؛ النتروجين الاساسى المتطاير الكلى؛ وحمض الثيوباربيتيوريك والاحماض الدهنية الحرة.

أظهرت النتائج ان لحم الدجاج (الفيليه) المغطى بالتركيزات الصغيرة من كل من (عسل النحل وزيت الروز مارى والقرفة معا) أضعفت من عمليات الاكسدة فى لحم الدجاج (الفيليه) حتى اليوم التاسع للتخزين واستمرت مقبولة او مستساغة مقارنة بالكنترول عند نفس اليوم.

وجد أن التغطية بمضادات الاكسدة الطبيعية الصالحة للأكل بديل جيد لزيادة فترة صلاحية ومدى قبول أو استساغة لحم الدجاج المحفوظ مبرد