J. Agric. Sci. Mansoura Univ., 32 (12): 10167 - 10182, 2007

TREACLE AND SIDIR HONEY AS ANTIOXIDANT AGENT AGAINST LIPID OXIDATION IN CHICKEN BREAST MEAT MINCE

El-Sayed, Samiha M.
Food Science and Technology Dept.,Fac. of Home Economics, AL-Azher Univ.Egypt

ABSTRACT

Lipid oxidation is a major deterioration factor in meats. Sources of natural antioxidants, such as honey, are as effective as synthetic commercially available ones. In this study minced chicken breast meat (with and without skin) with added natural materials known as effective antioxidants namely treacle (black honey) and sidir honey mixed with different levels (1, 5 and 10% w/w) were stored up to 3 days at 4^0C to evaluate their stability during refrigerated storage. The effect of adding treacle and sidir honey to chicken breast meat on oxidative stability was measured using thiobarbituric acid values (TBA values) (as mg malonaldehyde /kg) and inhibition %. The TBA value decreased at 5% added of treacle. The percentage inhibition of oxidation had the highest value when treacle added at the same level. Honey appears to be a good source of natural antioxidants in addition to its properties, it has been found to be more effective in our study than either natural or synthetic commercial antioxidants such as α-tocopherol, propyl gallate (PG), respectively.

Keywords: Chicken breast meat, natural antioxidants, treacle, sidir honey, thiobarbituric acid values, Inhibition %, propyl gallate and α-tocopherol.

INTRODUCTION

The principal contribution of honey to the human diet is as a source of easily digestible sugars. However, due to its complex chemistry, honey may make other contributions to nutrition. One largely unexplored attribute of honey of potential dietary significance is its antioxidant content. Honey has been reported to contain alpha-tocopherol, ascorbic acid and beta carotene (Crane, 1975, Honeydew, 2007and Honeys Nutrition & Health Facts, 2007), all of which function under certain circum-stances as antioxidants (Larson, 1988). Pro-oxidant chemicals in the diet or in the environment can generate toxic oxygen radicals that cause DNA damage (Holmes *et.al*.1992; Ames *et.al*., 1993) such damage can lead to a wide variety of aged related pathologies including arthritis, strokes and some cancers (Temple& Basu, 1998).

Honey is a remarkably complex natural liquid that is reported to contain at least 181 substances (White, 1975). The composition of honey is rather variable and primarily depends on the floral source; however, certain external factors also play a role such as seasonal and environmental factors and processing. Honey is a supersaturated solution of sugars of which fructose (38%) and glucose (31%) are the main contributors. A wide range of minor constituents is also present in honey, many of which are known to have antioxidant properties. These include phenolic acids and flavonoids (Ferreres *et.al*., 1993; Andrade *et.al.,* 1997), certain enzymes (glucose oxidase, catalase), ascorbic acide (White, 1975), carotenoid like substances (Tan *et.al*., 1988), organic acids (Cherchi *et.al*., 1994), maillard reaction products (White,1975) and amino acids and proteins (White &Rudyj,1978). The antiox-

idant activity of phenolic compounds might significantly contribute to the human health benefits of plant foods (Hertog *et.al*., 1993) and beverages such as red wine and tea (Bravo, 1998).

Low levels (Less than 5 mg/100g) of ascorbic acid, a water soluble antioxidant, have been reported in honey (White, 1975). Maillard reaction and decomposition of fructose in the acid medium of honey (Villamiel *et.al*, 2001). These reactions might result in the formation of hydroxymethyl furaldehyde, other furfural Compounds and Maillard reaction products. Many of these compounds act as antioxidants (Namiki, 1998).

Honey colour has been correlated with potential alkalinity and ash content and water content has been correlated with rate of granulation and likelihood of fermentation (Crane, 1975). Both of these attributes may also be correlated with antioxidant content, honey colour reflects in part the content of pigments many of which (Such as carotenoids and flavonoids) have antioxidant properties and water content may affect the degree to which water soluble antioxidant constituents can accumulate.

Lipid oxidation is a major deteriorative factor in meat systems during storage. Liqid hydroperoxides and their breakdown products have been implicated in a number of deterious effects, including off-flavor and off-color development (Pearson *et.al*., 1983), possible reaction with certain food components such as amino acids and proteins with concomitant losses of nutritional value and functionality (Matsushita, 1975) and a variety of health related problems such as heart disease and cancer (Yagi, 1988 and Addis, 1986).

The addition of antioxidants has been used as an effective method for prevention of oxidation in meat systems. There are many synthetic antioxidants that can be used in processed meat products. However, with today's consumer trends away from the addition of synthetic chemicals to foods, there is an interest in the development of natural antioxidants. One solution is the supplementation of the diet of food producing animals with α-tocopherol "a naturally occurring antioxidant". (McKibben &Engeseth, 2002). Numerous studies have documented the effectiveness of tocopherol supplementation in the feed of food producing animals for the prevention of lipid oxidation in meats (Engeseth *et.al*., 1993; Morrissey *et.al.,* 1994; Gaber *et.al*., 1996).

Several studies had indicated that honey which was usually used as a tradional sweeting agent possessed antioxidative properties and might work as a protective agent against lipid oxidation in muscle foods (Frankel *et.al*., 1998 and Mathew *et.al*., 1998).

The antioxidant effect of dark honey had been the subject of many scientists (McKibben &Engeseth, 1998); their studies showed that, some honeys possessed surprising quantities of antioxidants. It was also mentioned that when honey is cooked, it acquire additional functionally important antioxidants (Frankel *et.al*., 1998). It was also reported by (Mathew *et.al.* 1998) that the incorporation of honey into the batter that binds small pieces of turkey to from a restructed turkey roll has reduced effectively the rate of oxidation during refrigeration. The incorporation of honey in both ground turkey and poultry inhibited oxidation by70% when using darker honey (McKibben &Engeseth, 1998). Previous studies had shown that the nectar tended to con-

tain quantities of flavonoids which probably might be the principal contributors for honey`s antioxidant activity (Frankel *et.al.,* 1998).

An antioxidative effect was found by adding dry honey to turkey breast rolls (Antony *et.al.* 2002) and by the addition of honey maillard reaction products to a turkey breast model (Antony *et.al*. 2000a, b). Johnston *et al*.,**(**2005**)**reported that clover and wildflower honeys could delay lipid oxidation in cooked and reheated ground beef patties contained 18% fat stored at 4°C and −18°C. Honey may be a natural alternative to phosphates to delay lipid oxidation (Johnston *et. al*., 2005and Nagai *et.al.*, 2006**)**. Honey contains a variety of phytochemicals (as well as other substances such as organic acids, vitamins and enzymes) that may serve as sources of dietary antioxidant (Gheldof &Engeseth, 2002; Gheldof *et.al*, 2002) .The amount and type of these antioxidant compounds depends largely upon the floral source / variety of the honey (Gheldof *et.al*.,2002). In general, durker honey has been shown to be higher in antioxidant content than lighter honey (Gheldof *et.al,* 2002).

The major objective of this research was to evaluate the effectiveness of treacle or black honey as so called in Egypt and sidir honey as an inhibitor of lipid oxidation in cooked chicken breast meat (with and without skin) and to compare its effectiveness to that of some commonly used antioxidants (e.g. propyl gallate and α-tocopherol) .

MATERIALS AND METHODS

Materials:

Fresh chicken breast meat was purchased from a local super market in Jeddah city, K.S.A in Marsh (2005) (which produced by EL-Watania company) on day zero of each analysis. The age, diet history and rearing history practices of chickens were unknown. The chicken breasts were divided into two groups, the first group have skin (with skin) and the second group was removed their skin (without skin).

Honey from different type's sidir "*Ziziphus Spina- chrisy*" and treacle (black honey made in Egypt) were obtained from EL-Sembola Company in Jeddah city, K.S.A.

Ground chicken meat was immediately prepared into patties of uniform size and weight (140 g, control and honeys, sidir and treacle were tested at three levels (1,5 and 10% of the weight of the meat) or other antioxidant, added by drizzling over the meat,mixing by hand and cooked in an electric oven to endpoint temperature of 170 ^{0}C for 25min. Finally, the effectiveness of honey as a source of antioxidants was also compared to that propyl gallate (PG) and α-tocopherol (at 0.02% of total fat). Control without honey or any source of antioxidant was also performed.

Eeach treatment was packed in teflon plates and covered with heavy duty domestic plastic wrap. All samples were then stored in a refrigerator at 4˚C for TBA values analysis after storage for 0, 1 and 3 days.

METHODS

Analytical methods

Moisture and ash content were determined according to AOAC (2000). Nitrogen was determined by a semi micro-kjeldahl method

AOA.C(2000) and was further converted into crude protein using a conversion factor of 6.25. Total lipids were determined by the method of Folsch *et.al*., (1957). All experiments were carried out in triplicates

Antioxidant quantitation

Sidir and treacle honey were evaluated for antioxidant content by using a spectrophotometric assay (Glavind, 1963). For each honey, 0.75 ml of honey was dissolved in warm water and mixed with 1.5 ml of 0.09 mmol solution of 1;1-diphenylpicrylhydrazyl (DPPH) (Sigma chemical comp. Louis,Mo.WA) in methanol. The mixture allows to incubate for 5 min at room temperature and then 2 ml of xylene was added. This solution was shaken vigorously and allows to separate. The xylene layer was then removed by centrifuged at 3000 rpm for 2-3 min. The absorbance of the xylene layer was measured by spectropholometer (JENWAY) at 517 nm against a xylene blank. Each sample was then completely reduced and the absorbance read at 517 nm. DPPH was compared against a standard curve ascorbic acid in water at a range from o to 0.044mg/ml and results are expressed as antioxidant microequivalents (µeq) based on the standard curve. One antioxidant microequivalent is the ability to reduce of micromole of a pro-oxidant because each molecule of ascorbic acid is able to reduce two molecules of pro-oxidant; one µmol of ascorbic acid has two antioxidant µeq. Two samples of each honey were tested and test antioxidant values averaged.

Anaylsis of Lipid oxidation

Cooked ground chicken breast was evaluated for extent of lipid oxidation by measuring thiobarbituric acid values (TBA values) following a modified procedure of Tarladgis *et.al*., (1960). The reaction was applied to a distillate produced under standardized conditions from an acidified macerate. The results were expressed as.

TBA number (mg malonaldehyde per kg sample) = 7.8×O.D whereas O.D = absorbance at 538 nm.

The percent inhibition of oxidation was calculated as described by (Antony *et.al*. 2002).

% inhibition = 1- (TBA value of treated sample / TBA value of control) ×100

Statistical analysis

Data were statistically analyzed using analysis of variance (ANOVA) and the differences among the means were determined for significance $p \leq 0.01$ using Duncan's test and SAS computer program (SAS, 1995).

RESULTS AND DISCUSSION

Gross chemical composition of chicken breast meat

The results of the proximate composition of chicken breast meat is presented in Table (1), where the moisture content of chicken breast meat mince sample was 68.33 %. The breeding, the feeding and the system of slaughtering could influence to some extent the moisture content of different kinds of meat (Paleari *et.al*., 1998) and Abd EL-Qader (2004) reported the value of 71.10 % as the moisture percentage of fresh chicken meat.

The crude protein (N×6.25) of chicken breast mince as shown in Table (1) was 21.31%. The total lipid of chicken breast mince as indicated in Table (1) was 8.85 %(on wet weight basis).
Kolsarici &Candogan (1995) reported that breast muscles contained 1.12-5.06% fat.

Table 1: Proximate composition of chicken breast meat mince:

Components	**Mean ± SD (%)**	
	with skin	without skin
Moisture	68.33 ± 0.11	ND˚
Crude protein	21.31 ± 0.01	ND
Total lipids	8.85 ± 0.06	3.26 ± 0.01
Ash	0.97 ± 0.02	ND
Carbohydrates	0.54 ± 0.02	ND

All values are means±SD of triplicate determination. ND˚ =not detect.

Some chemical composition and antioxidant content of treacle and Sidir honey

Some chemical Table composition and antioxidant content of treacle and sidir honeys are presented in Table (2). The moisture content, pH and total soluble solids (TSS) were 24.97, 15.34%, 5.61, 4.71% and 75.03%, 83.26% for treacle and sidir honey, respectively. Moisture content varied due to the type of honey (Al-Khalifa and Al-Arify, 1999).Also they reported that average moisture of honey ranged from 14 to16.90%. The pH of clover honey was 3.6 (Hashim *et.al*., 1999). Most honeys are acidic having a pH in the range 3.5-5(Al-Khalifa&Al-Arify,1999).The moisture content of the treacle samples ranged from 22.46 to 25.77 %, which was somewhat less than that of authentic samples (mean 26.46 %). Correspondingly, the total soluble solids of the authentic samples mean 73.55 % was lower than that of the treacle samples ranging between 74.23 and 77.54 % (Amin *et.al*., 1999).

The antioxidant content of treacle and sidir honey are presented in Table (2). The antioxidant content reported is based on water soluble components. From the tabulated data, it could be noticed that treacle had higher significant antioxidant content (79.63×10^{-4} µequiv) than that, sidir honey (6.86×10^{-4} µequiv). Our sample antioxidant values followed trends similar to those presented by Frankel *et.al*., (1998) who found antioxidant content correlate with the color of since the darkest colors have the highest antioxidant values. Honey reduced oxidative breakdown of lipids and the resulting development of off-flavors in processed turkey meats during storage (Dawson *et.al*., 1994).

The correlation between water content and antioxidant content is consistent with the chemistry of many antioxidants reported to occur in honey. Ascorbic acid as well as many antioxidant alkaloids are water soluble, so higher percentage of water content could conceivably allow for greater amounts of dissolved antioxidants for a given amount of honey. The association between colour and antioxidant content observed here may provide a rapid means of determining in an approximate fashion, the antioxidant content of various honeys (Frankel *et.al*., 1998). Given the fact that nectars, from

which honeys derive are relatively high in water content (ranging from 30% to 90%) the probability is high that the majority of antioxidant honey constituents are water soluble. It is also important to note that under the conditions of this assay certain water soluble antioxidants may be degraded antioxidant enzymes for example while water soluble are not heat stable (Frankel *et.al*., 1998).

Several components of honey have the potential to serve as antioxidants, including phenolics, peptides, organic acids, enzymes, vitamins and maillard reaction products (Gheldof *et.al*, 2002). Some nonphenolic components that contribute to the overall antioxidant capacities of honey were also quantified including proteins, gluconic acid, ascorbic acid, peroxide and hydroxymethyl furaldehyde (White& Rudyj,1978). Rajalakshmi & Narasimhan(1996) reported that organic acids such as gluconic, citric and malic acids, might also contribute to the observed antioxidant capacity of honey. Organic acids chelate metals and hence can synergistically enhance the action of other antioxidants such as phenolics. Gluconic acid the pred/ ominant honey organic acid, present at 50 fold higher levels than other acids (Cherchi *et.al*., 1994). Gluconic acid was thus selected as an indicator of the organic acid concentration in the honey.A high total acidity may mean that the honey had fermented at some time and that the resulting alcohol was converted into organic acid (Rodgers, 1979).

Table 2: Some chemical composition and antioxidant content of treacle and sidir honeys.

Components	**Treacle** (%)Mean±SD	**Sidir** Mean±SD (%)	**t-test**
Moisture	24.97±0.03	15.34±0.10	161.05** (<0.001)
PH	5.61±0.03	4.71±0.08	19.486** (<0.001)
Total soluble solids	75.01±0.01	83.26±0.03	451.871** (<0.001)
Antioxidant content (µequiv. $\times 10^{-4}$)	79.63±0.03	6.86±0.04	2520.827** (<0.001)

**** Significant at p ≤ 0.01** **All values are means±SD of triplicate determination.**

Comparison of the antioxidant effectiveness of sidir and treacle honey with that of other antioxidants during storage

The concentration of treacle and sidir honey at 5% (w/w) was most effective at reducing lipid oxidantion (measured by TBA values) at 0,1 and 3 days of storage at 4˚C for chicken breast meat "with skin" (Table 3). The 5% addition had lower TBA values in sidir and treacle honey.

From the tabulated data, it could be notied that any of the three concentrations of two different honey tested would be beneficial at reducing lipid oxidation in such samples over a 3 day period. The control samples exhibited the highest significant (P≤0.1) increase in TBA values compared to all other treatments. Both of 5% honey containing minced chicken breast meat exhibited the lowest TBA values during the course of storage at 4˚C. Antioxidant effect of treacle had been the subject of many scientists (Mckibben &Engeseth, 2002), who showed that some honeys possessed surprising quantities of antioxidants. It was also mentioned that when honey is cooked, it acquire additional functionally important antioxidants (Frankel *et.al*., 1998). It was also reported by Mathew *et.al*., (1998) that the incorporation of honey

into the batter that binds small pieces of turkey to form a destructed turkey roll, has reduced effectively the rate of oxidation during refrigeration. The incorporation of honey in both ground turkey and poultry inhibited oxidation by 70% when using darker honey (Mckibben &Engeseth, 2002).

Previous studies had shown that the honey tended to contain large quantities of flavonoids which probably might be the principal contributors for honey's antioxidant activity (Frankel *et.al*., 1998). Skin contained high amounts of fat (Scott, 1956).

The effectiveness of the various honeys at reducing lipid oxidation in cooked ground chicken breast (without skin) is demonstrated after 1 and 3 days of storage at 4˚C (Table, 4). The capacity of the various honeys to reduce TBA value development in chicken breast samples increased with increasing water soluble antioxidant capacity of the honey. Treacle had the highest antioxidant content and also was most effective in preventing lipid oxidation (in both with or without skin) comparing to control (no honey) or other used antioxidants (synthetic or natural such as PG and α-tocopherol).

Treacle and sidir honey (5% w/w) were much more effective at reduction of TBA values over the 3 days storage at 4˚C than those either PG or α-tocopherol (Table, 4). The antioxidant content of two honey tested was first calculated on the basis of the number of microequivalents of ascorbic acid (as determined by the spectrophotometric antioxidant assay as described above).

However,total phenolics levels was used to estimate the amount of antioxidant added from the 5% treacle to be comparable to the allowable limit of antioxidant addition (0.02% of the weight of the lipid).At an estimated comparable antioxidant level the treacle was more protective than either PG or α-tocopherol which used. The reason for the differences in antioxidant protection is not known. One reason might be that the phenolic antioxidant PG and α-tocopherol function in radical scavenging. Honey is a complex system of more than one phenolic component (Mckibben &Engeseth, 2002). The same authors showed that honey thus may provide radical scavenging activities but may also contribute metal chelation activities, leading it to perform differently from PG and α-tocopherol.

Related research by Dawson *et.al*., (1997)demonstrated the protective effect of honey against lipid oxidation in a turkey roll product due to the effect of maillard browning reaction products on lipid oxidation. Maillard reaction products are known for their potential antioxidant activity (Bersuder *et.al.,* 1998). The maillard reaction is facilitated by the addition of honey to the turkey before heating as the principal reactants are reducing sugars(from the honey) and free amino groups (from the proteins in meat) (Bailey and Um,1992). These researchers also isolated/ purified maillard reaction products and added them to turkey rolls. They found the turkey was protected against lipid oxidation by the isolated maillard products as demonstrated in other meat systems (Bedinghous &Ockerman, 1995; Smith &Alfawaz, 1995).

Inhibition of oxidation was greater with honey than with the isolated maillard reaction products (Antony *et.al*, 2000).

3

4

Moreover, Antony *et.al*., (2002) reported the effect of dry honey on oxidation in turkey breast, and they showed that an addition up to 15% of dry honey inhibited the development of oxidative compounds in cooked turkey meat. They suggest that honey can act, as a natural antioxidant, which is important with the recent emphasis on decreasing the use of artificial preservation in food and the perception of honey as a healthy sweetener.

Inhibition of oxidation by different antioxidants

The percent inhibition of oxidation based on TBA values is shown in Tables (5, 6) for chicken breast meat with and without skin which stored for 3 days at 4˚C. There was relationship between inhibition % and percentage of addition and type of meat for the honey added samples. From the tabulated data in Table (5), it could be noticed that at 5% treacle was the highest inhibition % (97.511) comparing with another percentage of addition of honey followed by sidir honey at 5% (which was 97.299) and treacle at level 1% (97.246) (in chicken breast meat with skin). The percent inhibition decreased with increasing the storage period of chicken breast meat with skin. These results agree with that obtained by Mckibben &Engeseth (2002) who reported that honey appears to be a good source of natural antioxidants in addition to its properties of contributing various flavor notes to meat. It has been found to be more effective in our system. Than either α-tocopherol or BHT.

Antony *et.al.,* (2002) reported that there was an interaction between percentage of addition and type of meat for the honey added samples. They indicated that at 15% honey there was no significant difference in TBA values between the cooked and 48hours stored samples. Also, they showed that the percent inhibition was 85% for the direct honey treatment and 75% for the 15% maillard reaction products (MRPs) for the cooked samples, however for samples stored at 4˚C, the 15% honey treated samples showed 88% inhibition as compared to 56% for the 15% MRPs, this indicated a lower rate of oxidation in the honey added sample after storage.

Data in Table (6) indicate that the percentage inhibition of oxidation generally was higher in chicken breast meat with skin than without shin. From the tabulated data, it could be noticed that the percent inhibition increased as a result of treacle 5% added followed by addition treacle at 10% level and sidir honey at level 5%, in contrast with aforementioned data, the percent inhibition was decreased with increased storage period at 4˚C .

From the aforesaid data, it could be said that commonly used antioxidants such as α-tocopherol and propyl galate (PG) was much lower effective as an inhibitor of lipid oxidation in meat system comparing with sidir or treacle, wherease PG and α-tocopherol had the lowest percent inhibition.

Mckibben & Engeseth (2002) reported that the reason for the differences in antioxidant protection is not known, one reason might be that the phenolic antioxidants α-tocopherol and BHT function in radical scavenging. Honey is a complex system of more than one phenolic component; honey thus may provide radical scavenging activities but may also contribute metal chelating activities, leading it to perform differently from α-tocopherol and BHT.

REFERENCES

Abd El-Qader,Maroa(2004).Quality improvement of chicken frozen burger formulated with some spices or their volatile oils.M.SC.Thesis,Food Sci.and. Tech.Dept.Fac.Agric.,CairoUniv.

Addis, P.B.(1986). Occurrence of lipid oxidation products in foods. Food Chem. Tox., 24:1021-1030.

Al-Khalifa,A.S. and Al-Arify,I.A.(1999). Physicochemical characteristics and pollen spectrum of some Saudi honeys. Food Chemistry.67:21-25.

Ames,B.M., Shigena, M.K.and Hagen, T.M.(1993). Oxidants, antioxidants, and the degenerative diseases of ageing. Proceedings of the Nation. of Academy Science USA.90:7915-7922.

Amin A. Wafaa, Safwat M. and El-Iraki M. Samir.(1999). Quality criteria of treacle (black honey) Food chemistry .67, 17-20.

Andrade,p.; Ferreres, F. and Amaral, M.T.(1997). Analysis of honey phenolic acids by HPLC, its application to honey botanical characterization. J.Liq. Chromatogr. Relat . Technol., 20:2281-2288.

Antony,S.;Han,I.Y.;Rieck,J.R.and Dawson,P.L.(2000a). Antioxidative effect of maillard reaction products formed from honey using different reaction times. J.Agric. Food Chem., 48:3985-3989.

Antony,S.;Rieck, J.R.and Dawson,P.L.(2000b). Effect of dry honey on oxidation in a turkey meat system. Poultry Sci., 79:1846-1850.

Antony,S.M.;Han, I.Y.;Rieck,J.R.and Dawson,P.L.(2002). Antioxidative effect of Maillard reaction products added to turkey meat during heating by addition of honey. J.Food Sci., 67(5):1719-1724.

AOAC.(2000). Official Methods of Analysis' 17th ed. Association of Official Analytical Chemists Published by the Association of Official Analysis Chemists, Inc, USA.

Bailey, M. E.and Um, K. W. (1992). Maillard reaction products and lipid oxidation. ACS Symp. Ser., No. 500. 122-139.

Bedinghaus, A. J.and Ockerman, H. W. (1995). Antioxidative maillard reaction products from reducing sugars and free amino acids in cooked ground pork patties. J. Food Sci., 60, 992-995.

Bersuder, P.; Hote and Smith, G. (1998). Antioxidants from a heated histidine-glucose model system. I. Investigation of the antioxidant role of histidine and isolation of antioxidants by high-performance liquid chromatography. J.Am. Oil Chem. Soc., 75(2), 181-187.

Bravo,L. (1998). Polyphenols:chemistry,dietary sources, metabolism,and nutritional significance. Nutr. 56:317-333.

Cherchi, A.;Spanedda, L.and Tuberas, P.(1994). Solid phase extraction of high performance liquid chromatographic determination of organic acids in honey. J.Chromatogr., 669,59-64.

Crane,E.(1975). Honey a comprehensive survey, Crane Russak and Co., New York..

Dawson, P.L., Han,I.Y. and Mathew,S.(1997). Effect of dry honey on turkey rolls on the flavor, color, microbial and oxidative stability. Poultry Sci. 76(Suppl. I):49.

Dawson, P.L., Acton, J.C., and Han, I.Y. (1994). Honey as an ingredient in sliced turkey meat. Poultry Sci. 73, SPSS Abstracts Supplement I.P.133.

Engeseth, N. J.; Garay, J.I.and Booren, A.(1993).Improved oxidative stability of veal lipids and cholesterol through dietary vitamin E supplementation. Meat Sci., 35, 1-15.

Ferreres,F.,Garcia-Viguera,c.,Tomas-Lorente,F.,Tomas-Barberan, F.A. and Hesperetin, A.(1993).Amarker of the floral origin of citrus honey. J.Sci. Food Agric., 61:121-123.

Folsch, J., Lees. M., and Saloamestanley. G. H. (1957). A simple method for the isolation and purification of total lipids from animal tissues. J. Biol. Chem. 226:497-509.

Frankel, S.; Robinson, G. E.and Berenbaum, M. R. (1998) .Antioxidant content and correlated characteristics of 14 monofloral honeys. J. Apic. Res., 37, 27-31.

Frankel,S.,Robinson,G.E.and Berenbaum,M.R.(1998).Antioxidant content and correlated characteristics of 14 monofloral haneys. J.Apic.Res. 37:27-31.

Gaber,M.J.,Reeder,R.A.,Davidson,p.M.,Pumfrey,W.M.and Schelling,G.T. (1996).Dose. Response effects of vitamin Esupplementation on growth performance and meat characteris in beef and dairy steers. Can. J.Anim. Sci., 79(1)63-72.

Gheldof, N. and Engeseth, N.J. (2002). Antioxidant capacity of honeys from various floral sources based on the determination of oxygen radical absorbance capacity and inhibition of vitro lipoprotein oxidation in human serum samples. J.Agric. Food Chem., 50:3050-3055.

Gheldof, N.;Wang, X.H. and Engeseth, N.J.(2002). Identification and quantification of antioxidant components of honeys from various floral sources. J.Agric. Food Chem., 50:5870-5877.

Glavind, J. (1963). Antioxidants in animal tissue.Acta Chem. Scand., 17:1635-1640.

Hashim, I.B.; Mcwatters, K.H. and Hung, Y.C.(1999). Marination method and honey level affect physical and sensory characteristics of roasted chicken. J.Food Sci., 64(1):163-166.

Hertog,m.g., Feskens,E.J., Hollman,P.C., KATAN,m.b,and kromhout,D.(1993).Dietary antioxidant flavonoids and risk of coronary heart disease: the Zutphen Elderly Study.Lancer.342:1007-1111.

Hgbh, Holmes ,G.E.,Bernstein,C& Bernstein,H.(1992)Oxidative and other DNA damages as the basis of ageing. Mutation Research.275:305-315.

Honeydew, (2007). (http: //www. airborne.co. nz/hnydew.htm), Airborne Honey,March 16 .

Honeyʻs, Nutrition and Health Facts, (2007). (http://www.foodreference. com/html/art-honey-health.html). Retrieved on June 3.

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, Issue 4, August, Pp 627-631.

Kolsarici,N. and candogan,K. (1995). The effects of potassium sorbate and lactic acid on the shelf life of vacuum packed chicken meats. Poultry Sci., 74:1884-1893.

Larson,R.A.(1988). The antioxidants of higher plants.Phytochemistry.27:969-978.

Mathew, S.; Dawson, P. and Han, I. (1998). Antioxidative maillard reaction products formed using honey in a turkey meat model system. Institute of Food Technologists Annual Meeting Book of Abstracts; Chicago, IL, Abstract 46C-9, p 108.

Matsushita, S. (1975).Specifc interactions of linoleic acid hydroper-oxides and their secondary degraded products with enzyme proteins. J. Agric. Food Chem., 23, 150-154.

Mckibben,J. and Engeseth, N.J.(2002). Honey as a protective agent against lipid oxidation in ground turkey. J.Agric. Food Chem., 50:592-595.

Morrissey, P.A.; Buckley, D.J.;Sheehy, P.J.A.. and Monahan, F. J.(1994) .Vitamin E and meat quality. Nure. Soc., 53(2). 289-295.

Nagai,T., Inoue,R., Kanamori, N.,Suzuki,N., and Nagashima T. (2006). Characterization of honey from different floral sources. Its functional properties and effects of honey species on storage of meat. Food Chemistry.97:256-262.

Namiki, M. (1998). Chemistry of Maillard reactions: recent studies on the browning reaction products formed using honey in a turhey meat model system. J.Api. Res., 37:221-225.

Paleari,M.A.,Camisasca,S.,Beretta,G.,Renon,P.,Corsico,P.,Bertolo,G.,and Crivelli,G.(1998).Ostrich meat: physicochemical characteristics and comparison with turkey and bovine meat. Meat Sci.48:205-210.

Pearson, A.M.; Gray. J.L; Wolzak, A.M. and Horenstein, N.A.(1983). Safety impolication of oxidized lipids in muscle foods. Food Technol., 27(7), 121-129.

Rajalakshmi, D.and Narasimhan, S.(1996). Food antioxidants: sources and methods of evaluation. In: food Antioxidants: Technological, Toxicological and Health perspectives: Modhavi, D.L.,Deshpande, S.S., Salunkhe, D.K.,Eds.; Marcel Dekker: New York, pp. 65-158.

Rodgers, P.E.W. (1979). Honey quality control. In E. Crance(ED.), Honey: Acomprehensive survey (pp.314-325).London: Heinemann.

SAS Institute Inc. (1995). Statistical Analysis system. User's Guide Version 6. SAS Institute Inc., Carry, NC.

Scott,M.L. (1956).Composition of turkey meat. J.Am. Dietet. Assoc., 32:941-944.

Smith, J. S and Alfawaz, M. (1995). Antioxidative activity of maillard reaction products in cooked ground beef, sensory and TBA values. J. Food Sci., 60(2), 234-236.

Tan. S.Y., Holland. P.T., Wilkins. A.L. and Molan. P.C. (1988). Extractives from New Zealand Honeys. I. White Clover. Manuka and Kanuka. Unifloral – Honeys. J. Agric. Food Chem., 36. 453-460.

Tarladgis, B.G.; WATTS, b.m. and Younathan, M.T.(1960). A distillation method for the quantitative determination of malonaldehyde in rancid foods. J.Am. Oil Chem. Soc., 37:44-48.

Temple, NJ.and Basu,T.K.(1988).Does beta-carotene protect cancer critical appraisal.Nutritional Research.8:685-701.
Villamiel, M.;Dolores del Castillo, M.;Corzo, N. and Olano, A.(2001). Presence of furosine in honeys. J.Sc. Food Agric., 81:790-793.
White, J.W. (1975). Composition of honey. In Honey, Acomprehensive survey. Crane, E.,Ed., Crane, Russak & company : New York, pp 157-206.
White, J.W.and Rudyj, O.N. (1978). The protein content of honey. J.Apic. Res., 17:234-238.
Yagi, K.(1988). Lipid peroxides as agents involved in atherogenesis. In Lipid Peroxidation in Biological Systems; sevanian, A., Ed; AOCS: Champaign, IL, Chapter 16.
Yen, G. and Hsieh,P.P.(1995). Antioxidant activity and scavenging effects on active oxygen of xylose-lysine Maillard reaction products. J.Sci.Food Agric., 67:415-420.

العسل الأسود وعسل السيدر كمضادات أكسدة طبيعية ضد أكسدة الدهون فى مفروم لحم صدور الدجاج

سميحة محمد السيد
قسم علوم وتكنولوجيا الأغذية- كلية الأقتصاد المنزلى- جامعة الأزهر

تعتبر أكسدة المواد الدهنية من أهم العوامل التى تؤثر على اللحوم وهناك مصادر طبيعية لمضادات الأكسدة مثل العسل: ففى هذه الدراسة تم اضافة العسل الأسود(المعروف فى مصر) وعسل السيدر كمواد مضادة للأكسدة الطبيعية على مفروم لحم صدور الدجاج (بالجلد وبدون جلد) بمستويات مختلفة (١ ، ٥ ، ١٠ % بالوزن) وتم تخزينها لمدة ٣ أيام على ٤°م وتم تقييم درجة الثبات خلال فترة التخزين المبرد. ومن خلال الدراسة تم قياس الثبات التأكسدى لمفروم لحم صدور الدجاج المضاف اليها العسل الأسود وعسل السيدر وذلك بواسطة أختبار حمص الثيوباربتيوريك (مجم مالونالدهيد/كجم)، االنسبه المئويه للتثبيط .

أظهرت النتائج أن أضافة العسل الاسود بنسبة ٥% أدى الى خفض قيمة حمض الثيوباربتنيوريك وسجل أعلى قيمة فى النسبة المئوية للتثبيط على نفس مستوى الأضافة وكذلك أوضحت الدراسة أن العسل مصدر جيد لمضادات الأكسدة الطبيعية ويرجع ذلك لخصائصه. أيضاً وجد أن العسل كمادة مضادة للأكسدة أكثر تأثير وكفاءة مقارنة بالبروبايل جاليت والألفا توكوفيرول.

Table 3: Thiobarbituric acid values (TBA) of cooked chicken breast meat (with skin) after 0, 1 and 3 days at storage at 4°c.

Sample	Day (0) Mean±SD	Day (1) Mean±SD	Day (3) Mean±SD	°F (p)	Significant
Treacle(% w/w)					
1	0.405±0.000	0.608±0.000	0.733±0.000	1025154.0** (<0.001)	D(0) vs°° D(1) & D(3) , D(1) vs D(3)
5	0.367±0.001	0.491±0.000	0.616±0.000	112140.3** (<0.001)	D(0) vs D(1) & D(3) , D(1) vs D(3)
10	0.491±0.000	0.632±0.000	0.764±0.000	1198966.5** (<0.001)	D(0) vs D(1) & D(3) , D(1) vs D(3)
F (p)	32125.8** (<0.001)	137364.7** (<0.001)	457821.00** (<0.001)		
Significant between groups	(1%) vs (5%) & (10%) (5%) vs (10%)	(1%) vs (5%) & (10%) (5%) vs (10%)	(1%) vs (5%) & (10%) (5%) vs (10%)		
Sidir (% w/w)					
1	0.663±0.004	0.725±0.000	0.819±0.000	2784.0 ** (<0.001)	D(0) vs D(1) & D(3) , D(1) vs D(3)
5	0.398±0.000	0.569±0.000	0.741±0.000	946496.6** (<0.001)	D(0) vs D(1) & D(3) , D(1) vs D(3)
10	0.555±0.005	0.679±0.000	1.131±0.000	33123.5** (<0.001)	D(0) vs D(1) & D(3) , D(1) vs D(3)
F (p)	3602.8** (<0.001)	221832.0** (<0.001)	696894.6** (<0.001)		
Significant between groups	(1%) vs (5%) & (10%) (5%) vs (10%)	(1%) vs (5%) & (10%) (5%) vs (10%)	(1%) vs (5%) & (10%) (5%) vs (10%)		
Control (no honey)	14.725±0.002	15.959±0.000	17.948±0.012	155675.2** (<0.001)	D(0) vs D(1) & D(3) , D(1) vs D(3)
PG	1.989±0.000	3.393±0.002	4.430±0.000	3194272.6** (<0.001)	D(0) vs D(1) & D(3) , D(1) vs D(3)
α-tocopherol	1.570±0.004	1.903±0.003	2.254±0.005	25681.0** (<0.001)	D(0) vs D(1) & D(3) , D(1) vs D(3)
F (p)	14693160.0** (<0.001)	56615643.0** (<0.001)	4669292.0** (<0.001)		
Significant between groups	TR (10%), SI (1%), PG, α-tocopherol significant with each other	TR(10%), SI(1%), PG, α-tocopherol significant with each other	TR(10%), SI(1%), PG, α-tocopherol significant with each other		

**** Significant at p ≤ 0.01 TR= Treacle SI=sidir honey PG= propyl gallate**

° F (p) →F=ANOVA, P= Significant vs°° =versus All values are means±SD of triplicate determination.

Table 4: Thiobarbituric acid values (TBA) of cooked chicken breast meat (without skin) after 0, 1 and 3 days at storage at4°c.

Sample	Day (0) Mean±SD	Day (1) Mean±SD	Day (3) Mean±SD	°F (p)	Significant
Treacle (% w/w)					
1	1.217±0.000	0.514±0.000	0.764±0.000	6982564.0** (<0.001)	D(0) vs D(1) & D(3) , D(1) vs D(3)
5	0.273±0.001	0.320±0.000	0.421±0.000	122983.7** (<0.001)	D(0) vs°° D(1) & D(3) , D(1) vs D(3)
10	0.343±0.000	0.530±0.000	0.772±0.000	3784801.1** (<0.001)	D(0) vs D(1) & D(3) , D(1) vs D(3)
F (p)	6722175.2** (<0.001)	757009.6** (<0.001)	2259825.8** (<0.001)		
Significant between groups	(1%) vs (5%) & (10%) (5%) vs (10%)	(1%) vs (5%) & (10%) (5%) vs (10%)	(1%) vs (5%) & (10%) (5%) vs (10%)		
Sidir (% w/w)					
1	0.452±0.000	0.577±0.000	0.803±0.000	2374281.0** (<0.001)	D(0) vs D(1) & D(3) , D(1) vs D(3)
5	0.359±0.000	0.413±0.000	0.515±0.000	626652.0** (<0.001)	D(0) vs D(1) & D(3) , D(1) vs D(3)
10	0.523±0.000	0.647±0.000	0.944±0.000	2005981.7** (<0.001)	D(0) vs D(1) & D(3) , D(1) vs D(3)
F (p)	434136.9** (<0.001)	648858.6** (<0.001)	5382058.5** (<0.001)		
Significant between groups	(1%) vs (5%) & (10%) (5%) vs (10%)	(1%) vs (5%) & (10%) (5%) vs (10%)	(1%) vs (5%) & (10%) (5%) vs (10%)		
Control(no honey)	0.897±0.002	4.189±0.000	9.859±0.000	45002011.0** (<0.001)	D(0) vs D(1) & D(3) , D(1) vs D(3)
PG	0.819±0.001	0.936±0.001	1.895±0.002	597470.3** (<0.001)	D(0) vs D(1) & D(3) , D(1) vs D(3)
α-tocopherol	0.569±0.000	0.733±0.000	1.115±0.004	54055.3** (<0.001)	D(0) vs D(1) & D(3) , D(1) vs D(3)
F (p)	1564836.0** (<0.001)	49452191.0** (<0.001)	13379916.0** (<0.001)		
Significant between groups	TR(10%), SI(10%), control, PG, α-tocopherol significant with each other	TR(10%), SI(10%), control, PG,α- tocoph-erol significant with each other	TR(10%), SI(10%), control, PG,α- tocoph-erol significant with each other		

**** Significant at p ≤ 0.01 TR= Treacle SI=sidir honey PG= propyl gallate**

° F (p) →F=ANOVA, P= Significant vs°° =versus All values are means±SD of triplicate determination.

Table 5: The percent inhibition of thiobarbituric acid values (TBA) by different antioxidant in chicken breast meat with skin.

Sample	Day (0) Mean±SD	Day (1) Mean±SD	Day (3) Mean±SD	˚F(p)	Significant
(% w/w) Treacal					
1	97.246±0.352	96.188±0.001	95.915±0.003	35.977** (<0.001)	D(0) vs˚˚ D(1) & D(3)
5	97.511±0.366	96.921±0.002	96.567±0.002	15.314** (0.004)	D(0) vs D(1) & D(3) ,
10	96.663±0.501	96.041±0.001	95.741±0.002	7.930** (0.021)	D(0) vs D(1) & D(3) ,
F (p)	3.332 (0.106)	399989.40**(<0.001)	106655.25**(<0.001)		
significant	(5%) vs (10%)	(1%) vs (5%) & (10%) (5%) vs (10%)	(1%) vs (5%) & (10%) (5%) vs (10%)		
Sidir (% w/w)					
1	95.498±0.001	95.455±0.003	95.437±0.002	552.563** (<0.001)	D(0) vs D(1) & D(3) , D(1) vs D(3)
5	97.299±0.001	96.432±0.002	95.871±0.002	508003.38** (<0.001)	D(0) vs D(1) & D(3) , D(1) vs D(3)
10	96.292±0.002	95.748±0.002	93.698±0.002	1684090.8** (<0.001)	D(0) vs D(1) & D(3) , D(1) vs D(3)
F (p)	1022612.1**(<0.001)	1322401.0**(<0.001)	1322401.0**(<0.001)		
Significant between groups	(1%) vs (5%) & (10%) (5%) vs (10%)	(1%) vs (5%) & (10%) (5%) vs (10%)	(1%) vs (5%) & (10%) (5%) vs (10%)		
Control(no honey)	ND	ND	ND	ND	ND
PG	96.493±0.002	78.739±0.001	74.648±1.154	911.647** (<0.001)	D(0) vs D(1) & D(3) , D(1) vs D(3)
α-tocopherol	0.785±0.004	88.074±0.002	87.440±0.017	71814211.0** (<0.001)	D(0) vs D(1) & D(3) , D(1) vs D(3)
F (p)	19.402**(0.002)	1.14×10^{8}**(<0.001)	1049.280**(<0.001)		
Significant between groups	TR (5%), SI (5%), PG, α-tocopherol signifi-cant with each other except TR(5%) with SI(5%)	TR(5%), SI(5%),PG, α-tocopherol signifi-cant with each other	TR(5%), SI(5%), PG, α-tocopherol signifi-cant with each other except TR(5%) with SI(5%)		

**** Significant at p ≤ 0.01 TR= Treacle SI=sidir honey PG= propyl gallate ND=not detect**

˚ F (p) →F=ANOVA, P= Significant vs˚˚ =versus All values are means±SD of triplicate determination.

Table 6: The percent inhibition of thiobarbituric acid values (TBA) by different antioxidant in chicken breast meat without skin

Sample	Day (0)	Day (1)	Day (3)	°F(p)	significant
	Mean±SD	Mean±SD	Mean±SD		
(% w/w) Treacal					
1	54.743±0.002	87.710±0.010	92.247±0.002	35242394.0** (<0.001)	D(0) vs°° D(1) & D(3) , D(1) vs D(3)
5	69.565±0.001	92.365±0.001	95.728±0.002	3.65×10^{8}** (<0.001)	D(0) vs D(1) & D(3) , D(1) vs D(3)
10	61.739±0.001	87.337±0.002	92.168±0.001	5.59×10^{8}** (<0.001)	D(0) vs D(1) & D(3) , D(1) vs D(3)
F (p)	92779461.0**(<0.001)	679167.37**(<0.001)	5336557.1**(<0.001)		
significant	(1%) vs (5%) & (10%) (5%) vs (10%)	(1%) vs (5%) & (10%) (5%) vs (10%)	(1%) vs (5%) & (10%) (5%) vs (10%)		
Sidir (% w/w)					
1	49.565±0.004	86.220±0.085	91.851±0.002	648326.89** (<0.001)	D(0) vs D(1) & D(3) , D(1) vs D(3)
5	60.333±0.282	90.130±0.020	94.778±0.001	39281.256** (<0.001)	D(0) vs D(1) & D(3) , D(1) vs D(3)
10	211.739±0.000	84.544±0.004	90.427±0.003	2.01×10^{9}** (<0.001)	D(0) vs D(1) & D(3) , D(1) vs D(3)
F (p)	929198.26**(<0.001)	9584.073**(<0.001)	4312508.2**(<0.001)		
Significant between groups	(1%) vs (5%) & (10%) (5%) vs (10%)	(1%) vs (5%) & (10%) (5%) vs (10%)	(1%) vs (5%) & (10%) (5%) vs (10%)		
Control(no honey)	ND	ND	ND	ND	ND
PG	8.696±0.061	77.624±0.052	80.775±0.002	2315710.1** (<0.001)	D(0) vs D(1) & D(3) , D(1) vs D(3)
α-tocopherol	15.855±17.905	82.495±0.000	88.687±0.001	45.778** (<0.001)	D(0) vs D(1) & D(3) , D(1) vs D(3)
F (p)	35.461**(<0.001)	178862.88**(<0.001)	78384377.0**(<0.001)		
significant between groups	TR(5%), SI(5%), PG, α-tocopherol significant with each other except TR(5%) with SI(5%)	TR(5%), SI(5%), PG, α-tocopherol significant with each other	TR(5%), SI(5%), PG, α-tocopherol signifi-cant with each other		

**** Significant (sig.) at p ≤ 0.01 TR= Treacle SI=sidir honey PG= propyl gallate ND=not detect**
° F (p) →F=ANOVA, P= Significant vs°° =versus All values are means±SD of triplicate determination.