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OXIDATIVE STABILITY OF CHICKEN MEAT AFTER PROPOLIS EXTRACT APPLICATION IN THEIR DIETS

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ABSTRACT

In the experiment, the effect of the addition of propolis extract in a feed mixture for chicken broilers Hubbard JV on oxidative stability of breast and thigh muscles during refrigerated storage was investigated. In the experiment were included 90 pieces of one day-old chicks, which were divided into 3 groups (control, E1 and E2). Chickens were fed by *ad libitum* system until the age of 42 days. These feed mixtures were made without antibiotics preparation and coccidiostats. Propolis extract in an amount of 150 mg.kg^{-1} (E1) and 450 mg.kg^{-1} (E2) was added into feed mixtures for experimental groups. During whole period of refrigerated storage were higher values of MDA determined in control group compare to experimental groups. The higher average MDA value determined in breast muscels of broiler chicken hybrid combination Hubbard JV was in samples of control group (0.157 mg.kg^{-1}) compared to experimental groups E1 (0.140 mg.kg^{-1}) and E2 (0.130 mg.kg^{-1}) after 6-month of refrigerated storage. Significantly higher values of MDA were determined in control group compare to second experimental group from fourth month to the end of storage. The significantly lower value of MDA was determinated in first experimental group compare to control only at 6 month of storage. Trend of thigh muscle oxidation stability of chicken hybrid combination Hubbard JV was during 6 months of refrigerated storage similar than in breast muscle. The higher average MDA value determined in thigh muscels was in samples of control group (0.170 mg.kg^{-1}) compared to experimental groups E1 (0.150 mg.kg^{-1}) and E2 (0.139 mg.kg^{-1}) after 6-month of refrigerated storage. Significantly higher values of MDA were determined in control group compare to second experimental group from fourth month to the end of storage. Higher amount of MDA in thigh muscle compare to breast muscle is due to by higher amount of fat occurred in thigh muscle.

Keywords: oxidative stability; meat; broiler chicken; propolis.

INTRODUCTION

Lipids play important role in technological, nutritional and sensory function of food. However they are liable to undergo autooxidation that leads to the formation of a number of undesirable compounds. In an effort to retard this process, various antioxidants are employed. The application of synthetic antioxidants has recently been restricted because there is suspiction that they are carcinogenic. For this reason a growing interest has been paid to the research of natural antioxidants, among which spices occupy an important position **(Pokorny et al., 2001)**.

Lipid oxidation is a major cause of meat quality deterioration. Lipid oxidation is an important determinant of shelf life of meat and meat products. Antioxidants are natural or synthetics substances used to prevent lipid oxidation. Meat protection, primarily against lipid components, is possible by addition of antioxidants to feed mixes. This is the way to ensure oxidative stability of meat fats during the postslaughter proccessing of carcasses and storage of meat **(Marcinčák et al., 2005)**. Many researchers have indicated that lipid oxidation in meat and meat products can by controlled or minimized, by the addition of commercial synthetic or natural antioxidants **(Gray et al., 1996; Kazimierczak et al., 2008; Haščík et al., 2012; Elimam et al., 2013; Kročko et al., 2014)**.

The *post mortem* oxidation of lipids decreases the nutritional value and the sensory quality of meat. It has been shown, in chickens, that dietary fat sources have major impact on the composition and the melting point of fat in tissues **(Hrdinka et al., 1996)**.

Propolis is a resinous, rubbery and balsamic substance collected by honey bees from the buds of flowers, trees and other plant sources. Propolis contains resins, aromatic and ethereal oils, flavonoid pigment, vanillin, isovanilin, caffeic, benzoic and ascorbic acids as well as benzyl alcohol and cinnamic acid **(Harman 1983; Greenaway et al., 1990; Said et al., 2006)**. These components possess antimicrobial, antifungal and antioxidant properties **(Ashour, 1989; Hegazi, El-Hady, 2002; Lu et al., 2005; Trusheva et al., 2005)**. The composition of propolis depends on the vegetation at the site of collection; more than 180 compounds, mainly polyphenols, have been identified as constituens of propolis; the major polyphenols are flavonoids, accompanied by phenolic acid

and esters, phenolic aldehydes, ketones and others **(Castaldo and Capasso, 2002)**.

Certainly, it is possible to state, that plant extract, propolis and the other natural supplements are considered as an alternative to the antibiotic and they have wide range of possible uses; consequently, influence of these products on human and animal health is curently evaluted and determined with regard to growth of organic farming **(Tekeli et al., 2011)**. For this reason, the present study was aimed to investigate the effect of propolis extract Slovak multifloral addition to feed mixtures for oxidative stability of meat in the process of installation of Hubbard JV chickens.

MATERIAL AND METHODOLOGY

The experiment was realized at the test station of poultry (Slovak Agricultural University in Nitra). The experiment enrolled 90 one day old chicks of hybrid combination Hubbard JV and was formed into 3 groups: control group (C) and two experimental groups (E1, E2) of 30 pcs chickens in each group. Custom feeding insisted 42 days. Chickens were fed to 21th day of age an *ad libitum* with the same starter feed mixture HYD-01 (powdery form) and from 22nd to 42th day of age fed with the growth feed mixture HYD-02 (powdery form). The feed mixture HYD-01 and HYD-02 have been produced without antibiotic preparations and coccidiostats. Nutritional value of feed mixtures (Table 1) given during the experiment was the same in each group, but to the experimental groups were added propolis extracts at a dose of 150 (E1) and 450 mg.kg^{-1} (E2). Propolis extract was prepared from minced propolis **(Krell, 1996)**. Weighed 150 g propolis was the volume of 80% ethanol, 500 cm^3.

Extraction was carried out in a water bath at 80 °C under reflux for 60 minutes. After cooling was extract centrifuged. The supernatant was evaporated on a rotary vacuum evaporator at a water bath at temperature of 40 – 50 °C and then weighed. Residue in an amount of 15 and 45 g was dissolved in 1000 cm^3 of ethanol concentration of 80% and applied to 100 kg of the feed mixture.

At the end of feeding (day 42th) from each group were selected 10 pieces of chicken for slaughter analysis. To determine changes in lipid degradation (determination of thiobarbiturates numbers, TBA) the samples of chickens were boned and thigh and breast muscle packed into polyethylene bags and stored for 6 months at -18 °C.

Table 1 Composition of the diets.

Ingredients (%)	Starter (1 to 21 days of age)	Grower (22 to 42 days of age)
Wheat	34.00	37.00
Maize	33.94	37.57
Soybean meal	23.00	18.00
Fish meal (71% N)	5.00	3.00
Dried blood	–	1.00
Ground limestone	1.00	0.95
Monocalcium phosphate	0.80	0.70
Fodder salt	0.10	0.10
Sodium bicarbonate	0.15	0.20
Lysin	0.13	0.08
Methionin	0.18	0.20
Palm kernel oil Bergafat	1.20	0.70
Premix Euromix BR 0.5%[1]	0.50	0.50
Analysed composition (g.kg^{-1})		
Crude protein	212.40	191.61
Fibre	30.51	29.68
Ash	27.01	20.91
Ca	8.23	7.18
P	6.56	5.87
Mg	1.41	1.36
Linoleic acid	13.53	14.06
ME$_N$ (MJ.kg^{-1})	12.07	12.16

[1]active substances per kilogram of premix: vitamin A 2 500 000 IU; vitamin E 50 000 mg; vitamin D3 800 000 IU; niacin 12 000 mg; d-pantothenic acid 3 000 mg; riboflavin 1 800 mg; pyridoxine 1 200 mg; thiamine 600 mg; menadione 800 mg; ascorbic acid 50 000 mg; folic acid 400 mg; biotin 40 mg; vitamin B12 10.0 mg; choline 100 000 mg; betaine 50 000 mg; Mn 20 000 mg; Zn 16 000 mg; Fe 14 000 mg; Cu 2 400 mg; Co 80 mg; I 200 mg; Se 50 mg

TBA value expressed in number of malondialdehyde were measured in the process of first storage day of 1st, 2nd, 3rd, 4th, 5th and 6th months. TBA number was determined by **Marcinčák et al. (2004)**. Absorbance of samples was measured on UV-VIS spectrophotometer T80 (PG Limeted Instruments, UK) at a wavelength of 532 nm, the translation results on the amount of malondialdehyde (MDA) in 1 kg samples.

Results of the experiment was evaluated with statistical program Statgraphics Plus version 5.1 (AV Trading Umex, Dresden, Germany), were calculated variation-statistical values (mean, standard deviation) and to determine the significant difference between groups was used variance analyze with subsequent Scheffe test.

RESULTS AND DISCUSSION

The results of the oxidation stability determined in breast and thigh muscle of chickens Hubbard JV during 6 months storage at -18 °C are shown in Table 2. Our results are in accordance with **Marcinčák et al. (2010)** who, after slaughtering and processing of poultry samples also recorded low values of MDA. During refrigerated storage of the breast and thigh muscles (6 months) were detected increased content of MDA in comparison to the first day of storage. During whole period of refrigerated storage were higher values of MDA determined in control group compare to experimental groups. The higher average MDA value determined in breast muscels of broiler chicken hybrid combination Hubbard JV was in samples of control group (0.157 $mg.kg^{-1}$) compared to experimental groups E1 (0.140 $mg.kg^{-1}$) and E2 (0.130 $mg.kg^{-1}$) after 6-month of refrigerated storage. Significantly higher values of MDA were determined in control group compare to second experimental group from fourth month to the end of storage. The significantly lower value of MDA was determinated in first experimental group compare to control only at 6 month of storage.

Trend of thigh muscle oxidation stability of chicken hybrid combination Hubbard JV was during 6 months of refrigerated storage similar than in breast muscle. The higher average MDA value determined in thigh muscels was in samples of control group (0.170 $mg.kg^{-1}$) compared to experimental groups E1 (0.150 $mg.kg^{-1}$) and E2 (0.139 $mg.kg^{-1}$) after 6-month of refrigerated storage. Significantly higher values of MDA were determined in control group compare to second experimental group from fourth month to the end of storage. Higher amount of MDA in thigh muscle compare to breast muscle is due to by higher amount of fat occurred in thigh muscle **Botsoglou et al. (2002)**.

Reached results of oxidation stability determined in chicken meat of hybrid combination Hubbard JV after propolis extract addition in their diet are in accordance with **Young et al. (2003), Onibi and Osho (2007), Imik et al. (2010)** and **Rahimi et al. (2011)**. The possibilities of using alternative feed supplements containing various antioxidant active substances for poultry which increase the oxidation stability of the meat during its period of freeze storage are showen in works of **Alcicek et al. (2003), Šperňáková et al. (2007), Mikulski et al. (2009), Ahadi et al. (2010), Marcinčák et al. (2010), Skřivan et al. (2010), Karaalp and Genc (2013)**.

Also **Samouru et al. (2007)** and **Ramos Avila et al. (2013)** state that the degradation pathways of fatty substances play one of the main causes of foods deterioration and unpleasant odors. This factor is also

Table 2 Effect of storage in freeze (-18 ºC) on the concentration of malondialdehyde ($mg.kg^{-1}$) in breast and thigh muscle (mean ±SD).

Time of storage	Group		
	Control	E1	E2
	Breast muscle		
Day - 1	0.106 ±0.014^{a}	0.096 ±0.011^{a}	0.099 ±0.014^{a}
Month - 1	0.123 ±0.012^{a}	0.117 ±0.013^{a}	0.111 ±0.005^{a}
Month - 2	0.130 ±0.013^{a}	0.120 ±0.017^{a}	0.111 ±0.014^{a}
Month - 3	0.139 ±0.020^{a}	0.126 ±0.015^{a}	0.121 ±0.016^{a}
Month - 4	0.145 ±0.007^{a}	0.130 ±0.020^{ab}	0.119 ±0.010^{b}
Month - 5	0.150 ±0.007^{a}	0.133 ±0.016^{ab}	0.126 ±0.015^{b}
Month - 6	0.157 ±0.004^{a}	0.140 ±0.011^{b}	0.130 ±0.015^{b}
	Thigh muscle		
Day - 1	0.128 ±0.015^{a}	0.112 ±0.018^{a}	0.109 ±0.015^{a}
Month - 1	0.136 ±0.070^{a}	0.125 ±0.018^{a}	0.120 ±0.013^{a}
Month - 2	0.144 ±0.015^{a}	0.135 ±0.006^{a}	0.127 ±0.016^{a}
Month - 3	0.150 ±0.011^{a}	0.139 ±0.023^{a}	0.128 ±0.015^{a}
Month - 4	0.157 ±0.008^{a}	0.142 ±0.014^{ab}	0.134 ±0.011^{b}
Month - 5	0.163 ±0.011^{a}	0.146 ±0.010^{ab}	0.135 ±0.014^{b}
Month - 6	0.170 ±0.018^{a}	0.150 ±0.014^{ab}	0.139 ±0.013^{b}

responsible for the loss of flavor, texture, appearance, nutritional value of food, increases the drop losses, pigment, polyunsaturated fatty acids, fat-soluble vitamins, reduces the quality of meat intended for human consumption and ultimately reduces its stability, shelf life and safety.

Botsoglou et al. (2007) reported that a higher concentration of antioxidants in poultry meat has the effect of reducing lipid oxidation, ie. there is a reduction in MDA values during chilling and refrigeration storage, which was confirmed by our findings.

CONCLUSION

Results achieved in the experiment show that the addition of propolis extract in feed mixture for broiler chickens had a significantly ($p \leq 0.05$) positive impact on the reduction of oxidative processes in the breast and thigh muscles during refrigerated storage.

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