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REGULAR ARTICLE

TECHNOLOGICAL PROPERTIES OF CHICKENS MEAT AFTER APPLICATION OF PROPOLIS EXTRACT IN THEIR DIET

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ABSTRACT

In the experiment, we used propolis extract (200 mg.kg^{-1}) in feed mixture during 40 days of feeding (experimental group) of Ross 308 chickens. Then, we evaluated technological properties of poultry meat stored by freezing at -18 °C for 3 months. In the breast muscle, pH was 6.04 for control group and significantly lower (P≤0.01) 5.86 for experimental group but without negative influence on meat quality. In the thigh muscle, pH values between the groups (control – 6.12; experimental – 6.15) were not significant (P≥0.05). In the breast muscle, colour of meat was 26.17% R (control group) and 25.85% R (experimental group). Paler colour of meat was insignificantly recorded in control group. In thigh muscle, we found (P≥0.05) a higher value 18.78% R in experimental group compared with control group (18.57% R). In the breast muscle, shear force was slightly higher (P≥0.05) in experimental group (1.59 kg.cm^{-2}) compared with control group (1.58 kg.cm^{-2}). In the thigh muscle, higher value of shear force (P≥0.05) was recorded in control group (1.35 kg.cm^{-2}) compared with

experimental group (1.29 kg.cm^{-2}). Baking losses were higher by 1.19% (P≥0.05) in experimental group (30.59%) compared with control group (29.40%). Results of the experiment confirm that propolis extract (200 mg.kg^{-1}) can be applied in nutrition of Ross 308 chickens, because it has not negative effects and has not significant influence on selected technological indicators of poultry meat quality.

Key words: broiler chicken, meat, propolis extract, technological properties

INTRODUCTION

Antibiotics are microbial metabolites produced by microscopic filamentous fungi and algae; weight of antibiotic molecule is light and low concentration of antibiotic can inhibit the growth of the other microorganisms **(Nir and Ve-Senkoylu, 2000)**. Antibiotics were used for stimulation of growth in animal nutrition, but European Community has issued the ban of antibiotic using from 1st January 2006 due to requirements of medicine and consumers **(Anonymous, 2005)**.

Therefore, research of various alternative products has been initiated in animal nutrition and different natural products have started to use - such as plant extracts **(Wenk, 2000)**, probiotics, enzymatic preparations, and bee products **(Wang *et al.*, 2004; Haščík *et al.*, 2007; Shalmany and Shivazad, 2006; Seven *et al.*, 2008)**.

Propolis, natural product, is an important material for possible use in animal nutrition. It is resins collected by honeybees (*Apis mellifera L.)* from tree buds. The main constituents of propolis are beeswax, resin and volatiles. The honeybees secrete beeswax, while the latter two constituents are obtained from plants. Propolis is a protective material against microorganisms in hive; it serves as a protection of tree buds and has antimicrobial properties **(Banková *et al.*, 1992)**. Pure propolis is usually composed from 50% of resin-vegetal balsam, 30% of beeswax, 10% of essential-aromatic oils, 5% of pollen and 5% of other organic substances **(Kumova *et al.*, 2002; Dodologlu *et al.*, 2003)**.

The composition of propolis depends on the vegetation at the site of collection; more than 180 compounds, mainly polyphenols, have been identified as constituents of propolis; the major polyphenols are flavonoids, accompanied by phenolic acids and esters, phenolic aldehydes, ketones and others **(Castaldo and Capasso, 2002)**. It has been shown, that propolis has antibacterial, antiviral, antifungal, antioxidant, anti-inflammatory,

immunostimulating and cytostatic properties **(Dimov *et al.*, 1991; Frenkel *et al.*, 1993)**. Certainly, it is possible to state, that plant extracts, propolis and the other natural supplements are considered as an alternative to the antibiotics and they have wide range of possible uses; consequently, influence of these products on human and animal health is currently evaluated and determined with regard to growth of organic farming **(Tekeli *et al.*, 2011)**.

The inclusion of new ingredient in animal feed mixture has to maintain adequate technological, nutritional and sensory properties of meat, whereas various supplements can cause deterioration mainly in the sensory quality of meat **(Aleson-Carbonell *et al.*, 2004; Pérez-Alvarez, 2006).**

The aim of the study was to investigate the effect of 80% extract of Slovak propolis added to the feed of Ross 308 chickens on the technological properties of meat.

MATERIAL AND METHODS

The experiment was realized at the test station of Department of Poultry and Small Farm Animals' Husbandry (Faculty of Agrobiology and Food Resources, Slovak Agricultural University in Nitra). The experiment enrolled 180 pieces of one day old chickens of hybrid combination Ross 308 and was formed into 2 groups: control (C) and experimental (E) groups, each of 90 chickens. Custom feeding insisted 40 days. Chickens were fed by the *ad libitum* system to 21th day of age with the same starter feed mixture HYD-01 (powdery form) and from 22nd to 40th day of age fed with the growth feed mixture HYD-02 (powdery form) in the both monitored groups. The feed mixtures 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 in the experimental group, propolis extract at a dose of 200 mg. kg^{-1} was added to the feed mixtures HYD-01 and HYD-02. Propolis extract was prepared from minced propolis **(Krell, 1996)**. The portion of propolis was 150 g and the volume of 80% ethanol was 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 in a water bath at temperature of 40-50 °C and then weighed. Residue in an amount of 20 g was dissolved in 1000 cm^3 of 80% ethanol and applied to 100 kg of the feed mixture.

Table 1 Composition of the diets

Ingredients [%]	Starter (1^{st} to 21^{st} days of age)	Grower (22^{nd} to 40^{th} days of age)
Wheat	35.83	31.21
Maize	35.00	40.00
Soybean meal (48 % N)	20.00	21.00
Fish meal (71 % N)	4.00	-
Dried blood	1.60	2.10
Dried whey	-	2.20
Ground limestone	1.00	0.80
Monocalcium phosphate	1.00	0.90
Fodder salt	0.10	0.15
Sodium bicarbonate	0.20	0.20
Lysin	0.10	0.06
Methionin	0.17	0.23
Palm kernel oil Bergafat	0.50	0.65
Premix Euromix BR 0,5 %[1]	0.50	0.50
Analysed composition [$g.kg^{-1}$]		
Crude protein	210.39	191.47
Fibre	29.78	29.89
Ash	24.56	17.77
Ca	8.24	7.13
P	6.76	6.11
Mg	1.39	1.37
Linoleic acid	12.77	13.41
ME_N ($MJ.kg^{-1}$) by calculation	12.00	12.08

1 active substances per kilogram of premix: vitamin A 2 500 000 IU; vitamin E 20 000 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 20 000 mg; folic acid 400 mg; biotin 40 mg; kobalamin 8.0 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

At the end of feeding (40th day), 60 chickens were selected from each group for experiment slaughter analysis, which was carried out at Department of Animal Products Evaluation and Processing (Faculty of Biotechnology and Food Sciences, SUA in Nitra). We measured the pH values in breast and thigh meat by GRYF209L (CR) after 3 months of storage of chicken half-carcases by freezing at -18 °C. The colour of raw meat after defrosting was evaluated by spectrophotometer SPEKOL 11 (SRN). Heat treatment of samples were realised by hot air at 200 °C for 60 minutes and by followed baking for 10-15 minutes. Baking losses of broiler carcass were detected by analytical balance Kern EW 220-3NM (SRN) with accuracy of 0.01 g, defined as a difference of sample weights before and after baking. Then, we evaluated the shear force of baking meat by consistometer Warner-Bratzler of mark Chatillon (USA) by the method of **Goodson *et al*. (2002)**. In this method, shear force is defined as a force required to cutting the meat sample with the section of 1 cm^2 across the meat fibers.

Results of the experiment were processed by the statistical program Statgraphics Plus version 5.1 (AV Trading Umex, Dresden, Germany). Basic variation-statistical values as arithmetic mean and standard deviation were calculated. And we used F-test with followed t-test to determine the significance of differences between the groups.

RESULTS AND DISCUSSION

Results of pH, meat colour, shear force and baking losses of breast and thigh muscles of chickens Ross 308 after storage at -18 °C for 3 months are shown in Table 2.

In term of pH evaluating in breast muscle after defrosting, we found the value 6.04 in the control group and slightly lower ($P \leq 0.01$) in the experimental group (5.86) with the addition of propolis extract. In the thigh muscle after defrosting, we achieved approximately the same values of pH ($P \geq 0.05$) in the experimental groups (control group - 6.12; experimental group - 6.15).

Table 2 Technological properties of the meat of Ross 308 chickens (mean±SE)

Indicator		Group		S
		control	experimental	
pH after defrosting	breast muscle	6.04a±0.15	5.86b±0.13	**
	thigh muscle	6.12a±0.16	6.15a±0.07	NS
Colour after defrosting [% R]	breast muscle	26.17a±0.50	25.85a±0.83	NS
	thigh muscle	18.57a±1.22	18.78a±1.64	NS
Shear force [kg.cm^{-2}]	breast muscle	1.58a±0.35	1.59a±0.30	NS
	thigh muscle	1.35a±0.33	1.29a±0.48	NS
Baking losses [%]	broiler carcass	29.40a±2.32	30.59a±1.09	NS

a,b means with different superscripts differ significantly, determined by Scheffe's test; S = significance; **P ≤ 0.01; NS = not significant;

The pH values found in chicken meat are consistent with values observed by **Fletcher *et al.* (2000)** and **Šulcerová *et al.* (2011)**, who recorded the pH level from 5.76 to 6.22 and muscle (thigh, breast) from the experiment can be considered as good quality, since the pH values were not below 5.4 and above 7.0, when the autolysis of meat can occur (**Jedlička, 1988**). **Balsyte *et al.* (1998)** also noted that the pH value may also vary as a consequence of poultry stressing, which reduces muscle glycogen just prior to slaughter to the minimum level, or limits the *post mortem* glycolysis. In our experiment, it did not show and the meat defects of type PSE or DFD were not observed. Value of pH in *post mortem* has also an impact on the technological properties of meat that are prerequisites for the production security and standard quality of products **(Sellier and Monning, 1994)**. **Fletcher (1999b)** found a strong negative correlation between muscle pH and colour of chicken meat.

The average colour values of poultry meat of chickens Ross 308 in the breast muscle were 26.17% R (control group) and 25.85% R (experimental group). Paler meat colour was observed (P≥0.05) in the control group. In the thigh muscle, we found a higher value of 18.78% R in the experimental group than in control group (18.57% R), but also without significant differences (P≥0.05) between groups, what is confirmed by **Ingr *et al.* (1997)** statement that meat colour is a poly-factorial property and it is located in a very broad range of values and meat colour is often dependent on the composition and proportion of muscle fibers. For the consumer, the colour of chicken meat as an important quality attribute for the selection of fresh meat at retail level and in the final evaluation and one of the important

factors affecting the colour of meat can also be poultry nutrition **(Fletcher, 1999a; Wilkins *et al.*, 2000)**, what was not confirmed in our experiment.

Sensory evaluation of food properties, important for consumer, is tenderness of poultry meat, too **(Lepetit, 2007)**. Shear force of breast muscle from this experiment was only slightly higher ($P \geq 0.05$) in the experimental group (1.59 $kg.cm^{-2}$) than in the control group (1.58 $kg.cm^{-2}$) and in thigh muscle, we found a higher value ($P \geq 0.05$) in the control group (1.35 $kg.cm^{-2}$), that is by 0.06 $kg.cm^{-2}$ more than in the experimental group, where its value was of 1.29 $kg.cm^{-2}$. The shear force results for muscle of Ross 308 chickens are lower than found by **Costa *et al.* (2007)**, who recorded values below 4 $kg.cm^{-2}$ and the results were also lower compared with results published by **Grashorn and Serini (2006)** and **Bobko *et al.* (2009a)**, who recorded shear force in breast muscle from 1.86 to 2.37 $kg.cm^{-2}$ and in thigh muscle from 1.64 to 2.56 $kg.cm^{-2}$.

The value of baking losses is important for consumer. This value was only slightly higher by 1.19% ($P \geq 0.05$) in the experimental group (30.59%), it means after application of propolis extract in nutrition of Ross 308 chickens, compared to control group (29.40%). These baking losses are lower than the 32.65-35.17% detected by **Castellini *et al.* (2002)**, but higher than 17.03-26.30% **(Grashorn and Serini, 2006; Bobko *et al.*, 2009b)**.

CONCLUSION

In this experiment, we tested an influence of Slovak propolis applied in the feed mixtures for chickens of Ross 308 at amount of 200 $mg.kg^{-1}$ on the selected technological properties of breast and thigh muscle after 3 months storage by freezing at -18 °C. Significant differences ($P \leq 0.01$) were found in evaluation of pH values in breast muscle in experimental group (5.86) compared with control group (6.04). However, lower pH value in experimental group has not negative influence on the possible deterioration of meat quality caused by autolysis or spoilage. We did not record significant differences ($P \geq 0.05$) in the other indicators (colour of meat, shear force, baking losses) between the groups of this trial.

Results of the experiment confirm, that propolis extract in amount of 200 $mg.kg^{-1}$ in feed mixture can be applied in chicken nutrition of Ross 308, because it has not negative effects and has not significant influence on selected technological indicators of poultry meat quality.

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