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THE EFFECT OF BEE POLLEN AS SUPPLEMENT DIETARY FOR MEAT pH, COOLING AND FREEZING LOSES ON BROILER CHICKENS MEAT

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ABSTRACT

The present study was aimed to achieve the effect of bee pollen as a supplement dietary on broiler chickens for the meat pH value, cooling and freezing loss. A total 180 chicks in one day old which were divided into 6 groups (n = 30). To experimental groups were added bee pollen in different doses [(500 mg/kg (E1); 1500 mg/kg (E2); 2500 mg/kg (E3); 3500 mg/kg (E4) and 4500 mg/kg (E5)] into feed mixture. However the breast muscles pH value was greater in the experimental groups compared to the control groups except E1, E2 after 45 minutes and after 2 hours, and there were found significant differences (P≤0.05) between E1and E2 and between E2 with E4 after 2 hours. Also in thigh muscles the experimental groups were greater except E1, E2 and E3 after 45 minutes and after 2 hours and there found significant (P≤0.05) between E1and E4, and E4 an E5. Otherwise the cooling and freezingloss was higher in experimental groups except E5 in freezing loss and there were found significant differences (P≤0.05) between control group and E1, E2, E5 after 24 hours, also between control group with E2 and between E3 with E5 after 48 hours and there was significant (P≤0.05) between control and E5 groups with E2, E4 groups in freezing loss. The bee pollen has a positive effect on meat pH value but has a negative effect on cooling and freezing loss.

Keywords: bee pollen, broiler, pH meat value, cooling and freezing loss

INTRODUCTION

Broilers are chickens bred and raised specifically for meat production, and it's one of the most common and widespread domestic animals. In this regard, numerous references exist on increasing poultry meat yields and improving carcass quality. For this reason, many ingredients have been used in broiler diets, in recent years (**Karaoğlu *et al.,* 2005**). Complete feed mixtures for broiler chickens are often enriched with various additives as vegetable oils, probiotic, prebiotic and enzyme preparations (**Lee *et al.,* 2003, 2004; Shalmany and Shivazad, 2006)**. It is reported that additional benefits can be gained by supplementing broiler diets, particularly using of bee pollen as feed additives. Bee pollen has been used for many years in both traditional medicine and supplementary nutrition, as well as in alternative diets, mainly due to its nutritional properties and health benefits (**Serra *et al.,* 1997; Isla *et al.,* 2001; Almeida-Muradian *et al.,* 2005**). Pollen loads are formed from the pollen of one plant species, ie. monofloral pollen **(Carrión *et al.,* 2003)**, is shaped pollen grains from different plant species called multifloral pollen, respectively **(Stanley and Linskens, 1974; Barth *et al.,* 2009; Modro *et al.,* 2009)**. Pollen loads or bee pollen is the basic food for the colony as a source of protein for them **(Tüylü and Sorkun, 2004)**. The protein content of pollen is 25-30% carbohydrates, 30-55% fats, including fatty acids and sterols 1-20% and also contains significant amounts of vitamins and minerals. Composition of the pollen provides valuablenutrients such as free amino acids, minerals, polyfenolytic substances and oligo-elements **(Serra *et al.,* 1997; Villanueva *et al.,* 2002; Bastos et al., 2004; Almeida-Muradian *et al.,* 2005; Cocan *et al.,* 2005; Hamamoto *et al.,* 2006; Human and Nicolson, 2006; Yamaguchi *et al.,* 2006)** and therefore is also used in the human diet, which provides a sense of well-being, contributes to functional and well-balanced body has antioxidant properties **(Moreira *et al.,* 2008)** and prevents free radicals **(Hejinen *et al.,* 2002;Villanueva *et al.,* 2002; Bastos *et al.*, 2004; Almeida-Muradian *et al.,* 2005; Silva *et al*., 2006;**

Mărghitas *et al.,* 2009; Stanciu *et al*., 2009). Pollen is also rich in carotenoids, flavonoids, phytosterols and other healthy substances **(Serra *et al.,* 2001; Baltrusaityte *et al.,* 2007; Moreira *et al.,* 2008)**. There are implicit interrelationships between temperature and pH because glycolysis is exothermic, and the effects of pH are severe when a carcass is still near body temperature. The corollary of this tenet is that low glycogen levels at slaughter will prevent the normal *post-mortem* increase in meat reflectance, thus leaving muscles, as in the live animal. Three biophysical mechanisms have been proposed to explain how a low-pH causes increased reflectance (**Hamm, 1960; Bendall and Wismer-Pedersen, 1962; Swatland, 2004**): (1) denaturation of sarcoplasmic proteins, (2) increased surface reflectance from myo-fibrils, (3) increased refraction through myofibrils. Meat quality is influenced, to a large extent, by the rate of pH decline in the muscles after slaughter and by the ultimate pH (**Hambrecht *et al.,* 2004; Muchenje *et al.,* 2009**). The rate of pH decline is a good predictor of the colour and drip loss of meat (**Aberle *et al.,* 2001; Muchenje *et al.,* 2008**). The object of this work is to verify the influence of bee pollen on broiler´s chickens Ross 308 meat pH values, cooling and freezing loses.

MATERIAL AND METHODS

Animals and diets

The experiment was implemented in the test poultry station of Slovak University of Agriculture in Nitra. The experiment included 180 one day-old chicken hybrid combination Ross 308, which were divided into 6 groups (n=30): control (C) and experimental groups (E1, E2, E3, E4 and E5). Chickens experimental were fed from one day old to 42 days of age by *ad libitum system* with feed mixture HYD-01 (until the age of 21st days) and HYD-02 (from 22nd to 42nd days of age). Feed mixtures HYD-01 and HYD-02 were produced without any antibiotic preparations and coccidiostats. Their nutritional value (Table 1) was the same in each group during the whole experiment, but the experimental groups of broiler chickens were addition natural bee pollen to broiler feed mixture at doses of 500 mg/kg (E1); 1500 mg/kg (E2); 2500 mg/kg (E3); 3500 mg/kg (E4) and 4500 mg/kg (E5).

Sample analysis

At the end of the fattening (42 days) from each group were chosen 120 chickens for slaughter, and the technology quality of broiler chickens were determined pH measured in (45 minutes, 2 and 24 hours after slaughtering) the measurement of pH has been measured by a pH meter equipped with an electrode calibrated (Grif 209L apparatus) at pH 4.0 and 7.0 before measuring. The pH is easier measured by probe method by inserting a thin electrode directly into the muscle after incision of the muscle. The experimental analysis was evaluated at Department for evaluation and processing of animal products at Faculty of Biotechnology and Food Sciences Slovak university of agriculture in Nitra.

Statistical Analysis

The results of the experiment were evaluated with statistical program Statgraphics Plus Version 5.1 (AV Trading Umex, Dresden, Germany), were calculated variables-statistical values (arithmetic mean, standard deviation) and to determine the evidential difference between groups we used variance analyses with subsequent Scheffé's test.

Table 1. Composition of the broiler feed mixture

Ingredients (%)	Starter (1 to 21 days of age)	Grower (22 to 42 days of age)
Wheat	35.00	35.00
Maize	35.00	40.00
Soybean meal (48 % N)	21.30	18.70
Fish meal (71 % N)	3.80	2.00
Dried blood	1.25	1.25
Ground limestone	1.00	1.05
Monocalcium phosphate	1.00	0.70
Fodder salt	0.10	0.15
Sodium bicarbonate	0.15	0.20
Lysine	0.05	0.07
Methionine	0.15	0.22
Palm kernel oil Bergafat	0.70	0.16
[1]Premix Euromix BR 0,5 %1	0.50	0.50
Analyzed composition (g/kg)		
Crude protein	210.76	190.42
Fibre	30.19	29.93
Ash	24.24	19.94
Ca	8.16	7.28
P	6.76	5.71
Mg	1.41	1.36
ME_N ($MJ.kg^{-1}$) by calculation	12.02	12.03

[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

RESULTS AND DISCUSSION

The meat pH value of broiler breast muscles after application bee pollen as a supplemental dietary into the feed mixture, were shown in (Table 2). After 45 minutes the results were mentioned that the pH value in experimental groups were higher comparison to the control group except E2, E3 and there was significant differences (P≤0.05) between E1 with E2, E3, groups, also the value of pH after 2 hours was higher in experimental groups comparison to the control group except E2, E3 and there was significant differences (P≤0.05) between E2 with E4, on other hand the value of pH after 24 hours were higher in experimental groups than control group and there were no significant differences.

Table 3. summarize the meat pH value of thigh muscles, there were found the value of pH after 45 minutes in experimental groups were higher than control group, except E2, E3 and there was significant differences (P≤0.05) between E1 and E4, similar after 2 hours they found that the experimental groups were higher comparison to control except E1, E2, E3, also after 24 hours were found thatthe experimental groups were higher than control except E1, E2 E3 and there was no significant differences. Our results are confirm (**Šulcerova *et al.,* 2011**) who studied the effect of bee pollen and propolis on broiler (Ross 308) breast and thigh muscles. However the present study in agreement with (**Elimam *et al.,* 2012**) who studied the effect of bee on broiler´s Ross 308 pH value of the breast and thigh musclesthigh muscles, in the thigh findings but contrary in the breast muscles findings. Also the recent study are support (**Haščík *et al.,* 2010**) who tested probiotic on broiler. The

reason why the bee pollen improves the meat pH value, because bee pollen decrease the meat oxidative (**Haščík *et al.,* 2011**) and also bee pollen is antibacterial pathogens **(Basime *et al*., 2006; Kňazovická *et al*., 2009)** according to this reason, the pH meat value will be increased. Table 4. shows the results of cooling and freezing loss, however after 24 hours were found that the experimental groups were greater comparison to the control group and were found significant differences (P≤0.05) between control and E1, E2, E5 similar results were observed after 48 hours and they found that the experimental groups were higher in experimental than the control group and were found significant differences (P≤0.05) between control and E1, E5, also there was significant between E3 and E5.

Moreover the freezing loss was greater in experimental groups than control except E5 and there were significant differences (P≤0.05) between control and E3, E4, also were found significant between E5 with E3, E4. Our study support **(Ngapo *et al.,* 1999**) who studied the effects of freezing and thawing rate on drip loss from samples of pork. Why the bee pollen increases the cooling and freezing loss, because bee pollen increase meat water content (**Haščík *et al.,* 2012**), might that reason which has been explained why the bee pollen increase the cooling and freezing loss.

Table 2. pH of the breast muscles

Indicators	C	E1 (pollen 500 mg/kg)	E2 (pollen 1500 mg/kg)	E3(pollen 2500 mg/kg)	E4 (pollen 3500 mg/ kg)	E5(pollen 4500 mg/kg)
	30	30	30	30	30	30
45 minutes	6.16 ± 0.07^{abc}	6.20 ± 0.06^{a}	6.12 ± 0.08^{bc}	6.13 ± 0.04^{b}	6.20 ± 0.07^{ac}	6.17 ± 0.05^{abc}
2 hours	6.09 ± 0.03^{ab}	6.12 ± 0.08^{ab}	6.06 ± 0.06^{a}	6.07 ± 0.04^{ab}	6.10 ± 0.06^{b}	6.10 ± 0.06^{ab}
24 hours	6.00±0.03	6.03±0.13	6.00±0.06	6.01±0.09	6.04±0.09	6.03±0.06

*C: control group, *E1, E2, E3, E4, E5 experimental groups; $^{a, b, c}$:Values are expressed as means ± standard error (n = 30); (P ≤ 0. 05) Levels.

Table 3. pH of the thigh muscles

Indicators	C	E1 (pollen 500 mg/kg)	E2 (pollen 1500 mg/kg)	E3 (pollen 2500 mg/kg)	E4 (pollen 3500 mg/ kg)	E5(pollen 4500 mg/kg)
	30	30	30	30	30	30
45 minutes	6.52 ± 0.09^{ab}	6.49 ± 0.10^{a}	6.49 ± 0.07^{ab}	6.46 ± 0.08^{ab}	6.58 ± 0.06^{b}	6.52 ± 0.06^{a}
2 hours	6.46±0.09	6.40±0.09	6.40±0.08	6.40±0.09	6.47±0.11	6.48±0.04
24 hours	6.30±0.08	6.26±0.14	6.26±0.06	6.28±0.11	6.30±0.06	6.31±0.06

*C: control group, *E1, E2, E3, E4, E5 experimental groups; $^{a, b, c}$:Values are expressed as means ± standard error (n = 30); (P ≤ 0. 05) Levels

Table 4. cooling and freezing loss

Indicators	C	E1 (pollen 500 mg/kg)	E2 (pollen 1500 mg/kg)	E3 (pollen 2500mg/kg)	E4 (pollen 3500 mg/ kg)	E5 (pollen 4500 mg/kg)
	30	30	30	30	30	30
Cooling loss after 24 hours	3.48 ± 0.41^{a}	3.86 ± 1.31^{b}	4.46 ± 1.07^{b}	4.09 ± 0.51^{ab}	4.49 ± 0.38^{ab}	4.08 ± 0.61^{b}
Cooling loss after 48 hours	4.24 ± 0.51^{a}	4.47 ± 0.38^{abc}	5.17 ± 1.04^{bc}	4.76 ± 0.26^{ac}	5.28 ± 0.45^{abc}	5.31 ± 0.59^{b}
Freezingloss after 2 months	2.84 ± 1.40^{ac}	3.66 ± 0.39^{ab}	3.68 ± 1.23^{abc}	4.12 ± 0.64^{b}	4.07 ± 0.93^{b}	2.74 ± 0.20^{c}

*C: control group; *E1, E2, E3, E4, E5 experimental groups; $^{a, b, c}$:Values are expressed as means ± standard error (n = 30); (P ≤ 0. 05) Levels

CONCLUSION

From the recent study we conduct that the bee pollen has a positive effect on the meat pH value except doses of 1500 and 2500 mg/kg. But the bee pollen has a negative effect on cooling and freezing loss.

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