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REGULAR ARTICLE

THE INFLUENCE OF BEE POLLEN ON THE MEAT CHEMICAL COMPOSITION FOR BROILER´S ROSS 308 MUSCLES

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ABSTRACT

The objective of the present study was to evaluate the meat chemical composition of breast and thigh muscles for boiler Ross 308 after addition the bee pollen as nutritional supplement to feed mixture in a dose (500 $mg.kg^{-1}$ and 1500 $mg.kg^{-1}$) to experimental groups (E1, E2) respectively. The fattening duration was 42 days. At the end of the experiment, the results show that the water content in experimental groups (E1, E2) was higher than control and there were no significant differences ($P \leq 0.05$) among the groups, the protein content was higher in the control group than experimental groups (E1, E2) and there were no significant differences ($P \leq 0.05$) among the groups. The breast and thigh fat contents in control (2.04%, 13.20%) was higher than (E1) group (1.61%, 12.91%) and (E2) group (1.94%, 12.25%) and there were significant differences ($P \geq 0.05$) between control group and experimental (E1, E2) groups and there were no significant differences ($P \leq 0.05$) in thigh samples. The energy value was higher in the control group than experimental (E1, E2) and there were significant differences ($P \geq 0.05$) between control and experimental group (E1) in breast sample.

Hence, it was concluded that the bee pollen has a positive effect of meat chemical composition of broiler, which led to increased water slightly which leading to improve the tenderness of the meat, and reduce the fat content useful for human health and has a negative effect on protein content which are decreased.

Keywords: Bee pollen, Ross 308, breast and thigh muscles, fat, protein

INTRODUCTION

The poultry industry has become an important economic activity in many countries. Poultry meat is in the human nutrition an important source of high quality proteins, minerals a vitamin. The quality of meat in general and hence the poultry meat is an extremely complex notion that can be assessed from different points of view, from the standpoint of consumer interests and the slaughter industry, broilers should have not only high slaughter yields and desirable carcass conformation scores but also good aesthetic, sensory and nutritional characteristics. Nutritionally speaking, poultry meat is a valuable source of proteins, vitamins and minerals, and has a relatively low fat content **(Bogosavljević *et al.*, 2010)**.

In that respect, the chemical composition of muscle tissue of major primal cuts is an important element of broiler meat quality **(Demby and Cunningham, 1980; Ristić, 1999; Grashorn and Closterman, 2002; Bogosavljević-Bošković, 2003)**. Diet composition and feed consumption can affect the chemical composition of muscle tissue to a greater or lesser extent. Particular importance has been attached to a broiler rearing system in the last years **(Ristić, 2003; Holcman *et al.*, 2003; Bogosavljević *et al.*, 2006, 2011)**.

Foods derived from muscle of farm animals, poultry, contribute significantly to the intake of energy and essential nutrients (protein, long chain [LC] n^{-3} polyunsaturated fatty acids [PUFA], several trace elements, and most B vitamins) in most societies and households **(De Smet, 2012)**.

There are very large differences between societies in the level of consumption of animal-derived foods and in the types and characteristics of the prevailing animal production systems. Consequently, the impact of the production and consumption of animal-derived foods on human health and well-being is diverse **(FAO, 2009)**.

A much smaller increase is projected for the developed countries. On the other hand, the current high levels of consumption of meat in developed countries have been criticized for contributing to the burden of chronic diseases **(World Cancer Research Fund, 2007)** and to climate change and other environmental problems **(FAO, 2009)**. For these reasons, reducing the intake of meat in developed countries is now advocated, which may pose nutritional challenges for some key nutrients in specific population groups **(Millward and Garnett, 2010)**.

The growth promoters and feed additives in chicken diets have been used for many years **(USDA, 2008)**. Growth promoters are chemical and biological substances which are added to livestock food with the aim to improve the growth of chickens in fattening improve the utilization of food and in this way realize better production and financial results. Their mechanism of action varies. The positive effect can be expressed through better appetite, improved feed conversion, stimulation of the immune system and increased vitality **(Perić, 2009),** such as bee pollen.

The bee pollen is created in the male sexual organ of the flower - anthers with the purpose of fertilizing the stigma. It is the main source of proteins for bees **(Brožek, 2012)**. Pollen grains, a fine powder-like material, are the male seeds of a flower blossom which has been gathered by the bees and to which special elements from the bees has been added. Honeybee collects pollen and mixes it with its own digestive enzymes. Bee pollen is a rich source of protein (25%); essential amino acids; oil (6%), containing more than 51% PUFA of which 39% linolenic, 20% palmitic and 13% linoleic acids; more than 12 vitamins; 28 minerals; 11 enzymes or co-enzymes; 11 carbohydrates (35–61%) which are mainly glucose, fructose and sucrose; flavonoids and carotenoids; phytosterols **(Crane, 1990; Abreu, 1992; Xu *et al.*, 2009)**.

The present study aimed to the effect of bee pollen on broiler´s Ross 308 breast and thigh chemical composition.

MATERIAL AND METHODS

The experiment was implemented in the test Poultry Station of Slovak University of Agriculture in Nitra. The tested chickens were Ross 308. The experiment included 90 one day-old chicks, which were divided into 3 groups: control (C) and experimental (E1, E2) groups, each group has 30 pieces of chicken, the fattening duration was 42 days.

The chickens were breeding in a cage conditions. Each cage was equipped with feed dispenser and water intake was ensured *ad libitum* through a self feed-pump. The temperature was controlled during the fattening period and it was 33 °C at the first day and every week was reduced about 2 °C. The lighting during the feeding period was continuous. Each group was fed by same starter complete feed mixture (CFM) HYD-01 (loose structure) from 1st day to 21st day of their age, and from the 22nd to 42nd day of their age, chickens were fed by a complete feed mixture (CFM) HYD-02 (loose structure), in all investigated groups of experiments (Table 1).

However, they were added natural bee pollen in the amount (500 $mg.kg^{-1}$ and 1500 $mg.kg^{-1}$) to experimental groups (E1, E2) in their feed mixture. The complete feed mixture HYD-01 and HYD-02 had been produced without antibiotic preparations and coccidiostatics. The bee pollen which was used in the experiment was natural.

At the end of the fattening period (day 42) from each experimental group were selected 30 pieces of chickens for slaughter analysis (15 ♀ pieces and 15 pieces ♂), to evaluate the meat chemical composition of breast muscles (*musculus pectoralis major*) and skinless thigh muscles (*musculus biceps femoris*), skin and subcutaneous fat of each group experiment. Chemical composition of meat was determined device INFRATEC 1265 (NSR), where we measured water content, fat content and protein g. 100 g^{-1}. Energy value in kJ.100 g^{-1}, we investigated the calculated through conversion factors for fat and protein **(Strmiska *et al.*, 1988)**.

The experimental analyses were evaluated at Experimental Centre for Livestock in Slovak University of Agriculture in Nitra. The results of meat performance (arithmetic mean, standard deviation, coefficient of variation) were statistically analyzed by the statistic program Statgraphics 5.0. For the determination of significant differences among the tested groups was used F-test and followed by t-test.

Table 1 Ingredients and nutritional composition of experimental feed mixture per kg

Ingredient (%)	Starter HYD-01 (1 to 21 days of age)	Grower HYD-02 (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
Premix Euromix BR 0.5 %	0.50	0.50
Nutrient composition ($g.kg^{-1}$)		
Crude protein	210.76	190.42
Fiber	30.19	29.93
Ash	24.24	19.94
Ca	8.16	7.28
P	6.76	5.71
Mg	1.41	1.36
Linoleic acid	13.51	14.19
ME_N ($MJ.kg^{-1}$), calculated	12.02	12.03

Euromix BR – premixprovider per kg ofdiet: vitamin A – 2 500 000 IU,vitamin E – 50 000 mg; vitamin D3 – 800 000 IU; vitamin K3 – 800 mg; vitamin B1 – 600 mg; vitamin B2 – 1 800 mg; vitamin B6 – 1 200 mg; vitamin B12 – 10.0 mg; vitamin C –50 000 mg; nicotinacid – 12 000 mg; calciumpantothenate – 3 000 mg; folicacid – 400 mg; biotin 40 – 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

Table 2 shows the meat chemical composition (water, protein, fat ($g.100\ g^{-1}$)) and energy value ($kJ.100\ g^{-1}$) of breast and thigh muscles for chickens Ross 308. However the water content in control group (73.82%, 66.69%) were lower than (E1) (74.57%, 67.05%) and (E2) (74.45%, 67.08%) and there were no significant differences ($P \geq 0.05$) among the groups.

The protein content in the control group (23.09%, 19.22%) was higher than (E1) group (22.72%, 19.20%) and (E2) group (22.58%, 19.72%) except thigh in group (E2) was higher than the control group, there were no significant differences (P ≥ 0.05) among the groups. On the other hand the fat content in the control group (2.04%, 13.20%) was higher than (E1) group (1.61%, 12.91 %) and (E2) group (1.94%, 12.25%), there were significant differences (P ≤ 0.05) between control group and (E1, E2) and there were insignificant differences (P ≥ 0.05) between experimental groups (E1, E2).

The energy value ($kJ.100\ g^{-1}$) of breast and thigh muscles in control (462.6 kJ, 819.10 kJ) were higher than (E1) group (441.11 kJ, 807.94 kJ) and (E2) group (451.31 kJ, 791.94 kJ) and there were significant differences (P ≤ 0.05) between control group and (E1) and there were insignificant differences (P ≥ 0.05) between the control group and also between experimental (E1, E2). However in thigh samples there was no significant difference (P ≥ 0.05) among the experimental groups.

The present results confirmed **Haščík *et al.* (2012)** results, who they were tested meat chemical composition of breast and thigh muscular parts ($g.100\ g^{-1}$) of chickens Ross 308 to verify the differences due to use of bee pollen extract in feed mixture at a dose of 400 $mg.kg^{-1}$ and 800 $mg.kg^{-1}$ they were found that the water content (73.97%, 68.49% C; 74.32%, 69.79% E1 and 74.01%, 70.12% E2) and protein content (23.96%, 18.98% C; 23.28%, 18.82% E1 and 23.65%, 18.92% E2) similar of our results, but the fat content (1.07%, 11.53% C; 1.40%, 10.39% E1 and 1.34%, 9.96% E2) and energy value (441.65 kJ, 752.36 kJ C; 442.70 kJ, 717.60 kJ E1 and 446.64 kJ, 692.20 kJ E2) were contrary with our results, it were lower in control group than experimental groups. The current study confirmed with **Haščík *et al.* (2011)** they were studying the effect of probiotic preparation for meat chemical composition of cocks different combinations of hybrid chicks.

Our study upheld on protein and fat contents with **Suchý (2002)** who tested the chemical composition for muscles of hybrid broiler chickens during prolonged feeding. The present study confirmed on the protein and water contents except fat content it was a small amount (0.68 - 0.37 %) with **Wattanachant *et al.* (2004)** who was studying composition, color, and texture of the Thai Indigenous and broiler chicken muscles. Our study also had similar results on water, protein and fat content with **Wattanachant (2008)** who they studied the factors affecting the quality characteristics of Thai Indigenous chicken meat.

Table 2 Chemical composition of breast and thigh muscles for chickens Ross 308

Indicator	Groups	Breast Mean±S.D	Thigh Mean±S.D
Water content ($g.100\ g^{-1}$)	**C**	73.81 ± 0.56	66.69 ± 2.65
	E1	74.57 ± 0.59	67.05 ± 2.54
	E2	74.45 ± 0.58	67.08 ± 1.37
Protein content ($g.100\ g^{-1}$)	**C**	23.09 ± 0.46	19.22 ± 0.65
	E1	22.72 ± 0.52	19.20 ± 0.49
	E2	22.58 ± 0.56	19.72 ± 1.01
Fat content ($g.100\ g^{-1}$)	**C**	2.04a ± 0.47	13.20 ± 3.06
	E1	1.61b ± 0.60	12.91 ± 2.67
	E2	1.94b ± 0.62	12.25 ± 1.81
Energy value ($kJ.100\ g^{-1}$)	**C**	462.6a ± 17.82	819.10 ± 108.73
	E1	441.11b ± 20.52	807.94 ± 98.80
	E2	451.307 ± 2035	791.94 ± 58.63

*C: control group, *E1, E2,: experimental groups, *mean: average, *S. D: standard deviation, Mean values in the same columns with different superscripts (a, b) are significant ($P \leq 0.05$) levels

CONCLUSION

From the present results, it was concluded that the use of bee pollen as a dietary supplement in the feed mixture of broiler Ross 308 in the amount (500 mg. kg^{-1} and 1500 mg. kg^{-1}) to experimental (E1, E2) respectively led to an increase the water content in experimental groups, but it had decreased the protein, fat, contents and energy value, these results have positive effects to the human body, because high amounts of fat content is insalubrious.

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REFERENCES

ABREU, M. 1992. Food use of pollen in relation to human nutrition. In *Alimentaria,* vol. 235, 1992, p. 45-46.

BOGOSAVLJEVIC, BOSKOVIC, S. – AJIC, Z. – MITROVIC, S. – JOKOVIC, R. 2003. Meat Quality Parameters Selected in Yield of Carcasses and Parts of Broilers From Two Non-industrial Rearing Systems. In 49thInternational Congress of Meat Science and Technology, Brazil, Proceedings. p. 41-42.

BOGOSAVLJEVIC, BOSKOVIC, S. – KURCUBIC, V. – PETROVIC, D. M − RADOVIC, V. 2006. The Effect of Sex and Rearing System on Carcass Composition and Cut Yields of Broiler Chickens. In *Czech Journal of Animal Sciences*, vol. 51, 2006, 31-38.

BOGOSAVLJEVIĆ, BOŠKOVIĆ, S. – PAVLOVSKI, Z. – PETROVIĆ, D. M. – DOSKOVIĆ, V. – RAKONJAC, S. 2010. Broiler meat quality: Proteins and lipids of muscle tissue. In *African Journal of Biotechnology* ,vol. 9, 2010, p. 9177-9182.

BOGOSAVLJEVIC, BOSKOVIC, S. – PAVLOVSKI, Z. – PETROVIC, D. M. – DOSKOVIC, V. – RAKONJAC, S. 2011. The Effect of Rearing System and Length of Fattening Period on Selected Parameters of Broiler Meat Quality. In *Archiv für Geflügelkunde,* vol. 75, 2011.

BROŽEK, J. 2012. Včelí produkty, Praha, Český svaz včelařů: 1986 [online] [cit. 2012-10-05]. In Available on the internet: <http: //www.agroporadenstvo.sk/zv/vcely/vcely_03.htm?start>

CRANE, E. 1990. Bees and Beekeeping. Science, Practice and World Resources. Comstock Pub, Ithaca: NY, USA, 1990, p. 593-594.

DE SMET, S. 2012**.** Meat, poultry, and fish composition: Strategies for optimizing human intake of essential nutrients. In *Animal Frontiers***.** vol. 2, 2012 , p. 10-16.

DEMBY, J. H. – CUNNINGHAM, F. E. 1980. Factors affecting the composition of chicken meat-literature review. In *World's Poultry. Sci. J.*, vol. 36, 1980, p. 25-37.

FAO. 2009. The State of Food and Agriculture. Livestock in balance. FAO, Rome, Italy.

HAŠČÍK, P. – KAČÁNIOVÁ, M. − BOBKO, M. − POCHOP, J. − MIHOK, M. − ARPÁŠOVÁ. H. 2011. Effect of probiotic preparation for chemical composition of meat cocks different combinations of hybrid chicks. In *Acta universitatis agriculturae et silviculturae mendelianae brunensis* , vol. LIX, 2011, p. 83-93.

HAŠČÍK, P. – ELIMAM, I. O. E. − GARLÍK, J. − KAČÁNIOVÁ, M. − BOBKO, M. − KŇAZOVICKÁ, V. − VAVRIŠINOVÁ, K. − ARPÁŠOVÁ, H. – BUČKO, O. 2012. Chemical composition of muscle after pollen application in nutrition of broiler chickens. In *Potravinárstvo*, vol. 6, 2012, p. 26-32.

HOLCMAN, A. – VADNJAL, R. – ŽLEDNER, B.– STIBILJ, V. 2003.Chemical composition of chicken meat from free range and extensive indoor rearing. In *Arch. Geflügelk.*, vol. 67, 2003, p. 120-124.

MILLWARD, D. J. – GARNETT, T. 2010. Nutritional dilemmas of greenhouse gas emission reductions through reduced intakes of meat and dairy foods. In *Proceedings of the Nutrition* Society, vol. 69, 2010, p.103-118.

PERIĆ, L. – ŽIKIĆ, D.− LUKIĆ, M. 2009. Application of alternative growth promoters in broiler production. In *Biotechnology in Animal Husbandry.* vol. 25, 2009, p. 387-397.

RISTIC, M. 1999. Sensory and chemical criteria for broiler meat of different breeds from alternative livestock keeping. Proceedings of XIV European Symposium on the Quality of Poultry Meat. 19-23 September, Bologna, Italy, 1999, p. 291-294.

RISTIC, M. 2003. Fleishqualität von broilerr aus der ökologischer produktion. In *Biotechnology of Animal Husbandry*, vol.19, 2003, p. 335-343.

SUCHÝ, P. − JELÍNEK, P. − STRAKOVÁ, E. − HUCL, J. 2002. Chemical composition of muscles of hybrid broiler chickens during prolonged feeding. In *Czech Journal of Animal Sciences*, vol, 47, 2002, p. 511-518.

USDA. 2008. Additives in meat and poultry products. In [Showed. 2012-15-10], availableat<http://www.fsis.usda.gov/factsheets/ Additives in Meat & Poultry _Products/index.asp.

WATTANACHANT, S. 2008. Factors affecting the quality characteristics of Thai indigenous chicken meat. In *Journal Sciences Technology*, vol. 15, 2008, p.317-322.

WATTANACHANT, S. – BENJAKUL, S. – LEDWARD, D. A. 2004. Composition, Color, and Texture of Thai Indigenous and Broiler Chicken Muscles. In *Poultry Science*, vol. 83, 2004, p. 123-128.

WEI, L. – LIU, S. G. – SHI. X. W. 2008. Genetic diversity of Xue-feng black bone chicken based on microsatellite markers. In *Biodiversity Science*, vol. 16, 2008, p. 503-508.

WORLD CANCER RESEARCH FUND/AMERICAN INSTITUTE FOR CANCER RESEARCH. 2007. Food, Nutrition, Physical Activity, and the Prevention of Cancer: A Global Perspective. *American Institute for Cancer Research, Washington D.C.* 2007, p. 517.

XU, X. – SUN, L. – DONG, J. − ZHANG, H. 2009. Breaking the cells of rape bee pollen and consecutive extraction of functional oil with supercritical carbon oxide. In *Innovative Food Science and Emerging Technologies*, vol. 10, 2009, p. 42-46.