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THE EFFECT OF BEE POLLEN ON BROILER BREAST AND THIGH MEAT COLOUR L* a* b*

Peter Haščík[1], Ibrahim Elimam[1], Juraj Čuboň[1], Lenka Trembecká[1], Jana Tkáčová[1], Miroslav Kročko[1], Miroslava Kačániová[2]*

Address(es):
[1]Slovak University of Agriculture, Faculty of Biotechnology and Food Sciences, Department of Animal Products Evaluation and Processing, Tr. A. Hlinku 2, 949 76 Nitra, Slovak Republic.
[2] Slovak University of Agriculture in Nitra, Faculty of Biotechnology and Food Sciences, Department of Microbiology, Tr. A. Hlinku 2, 949 76 Nitra, Slovak Republic.

*Corresponding author: ibrahimelimam18@gmail.com

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ABSTRACT

The present study was aimed to investigate the impact of the addition bee pollen as supplements diet into the broiler feed mixture on broiler breast and thigh meat colour such as L* (lightness), a* (redness), and b* (yellowness) values. A total of the 180 chickens in one day old chickens hybrid combination Ross 308 which were divided into 6 groups (n=30): control, (I, II, III, IV and V) experimental groups. The value of L* in the control group was higher compared to the experimental groups except (II, IV) groups. The a* value in the breast was tended slightly to green in control and (I, V) groups only in (II, III, IV) groups which the value of the a* was tended slightly to redness colour and there were found significant differences (P≤0.05) between control and (II, III, IV) groups in breast and thigh muscles. Further, in the breast and thigh they were found that the b* value was higher in the control group compared to the experimental groups (I, II, III, IV and V) and there were found significant differences (P≤0.05) between control group and (II, III) groups. However, they were conclude that the bee pollen has no effect on broiler breast and thigh meat colour L* (lightness), otherwise they were found that the bee pollen in the amount (1500, 2500 and 3500 mg.kg^{-1}) were tended the broiler breast muscles to redness coloour slightly compared to the experimental group.

Keywords: Broiler, bee pollen, meat colour, light, redness

INTRODUCTION

Poultry meat is suitable for the production of so-called functional foods for human consumption, which is currently at the heart of agricultural and food research (**Berri et al., 2001; FAO 2002; Strakova et al., 2003; Gueye, 2009**). Colour is an important quality attribute that influences consumer acceptance of many food products, including poultry meat (**Qiao et al., 2001**). Poultry meat colour is a critical food quality attribute. Colour is important for both the consumer's initial selectionof a raw meat product in the marketplace and for theconsumer's final evaluation and ultimate acceptance of the cooked product upon consumption (**Fletcher, 1999**). Bee pollen has been praised for its good nutrition and therapeutic values (**Yang et al., 2013**). **Feiner (2006)** explains that the L* value represents the difference between white and black; an L*value of zero is black whilst an L* value of 100 is white. A positive a* value, or a+ value ranging from 0 to +50, represents the red tone of the product. Higher a+ values indicate a darker-red colour. A negative a* value, or a–value ranging from 0 to -50, represents the green tone of a sample and -50 is the darkest green tone. A positive b* value, or b^{+} value ranging from 0 to +50, represents the yellow tone of a sample. A b^{+} value of +50 is the strongest yellow tone. A negative b* value, or b^{-} value ranging from 0 to -50, represents the blue tone of a sample and, here as well, -50 is the strongest blue tone. The colour of meat or of a meat product can be measured and represented using the L*–a*–b* system (Fig. 1). **Haščík et al. (2013)** mentioned that the 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 valuable nutrients such as free amino acids, minerals, polyfenolytic substances and oligo-elements (**Serra Bonvehi and Escola Jordi, 1997**; **Villanueva et al., 2002**; **Bastos et al., 2004**; **Almeida-Muradian et al., 2005**; **Cocan et al., 2005**; **Hamamoto et al., 2006**; **Yamaguchi et al., 2006**). Bee pollen is also rich by carotenoids, flavonoids, phytosterols and other healthy substances (**Serra Bonvehi et al., 2001**; **Baltrusaityte et al., 2007**; **Moreira et al., 2008**). The object of the recent study was investigate the effect of the bee pollen on the broiler meat colour.

The recent study was objecting to investigate the effect of the bee pollen on broiler breast and thigh meat colour.

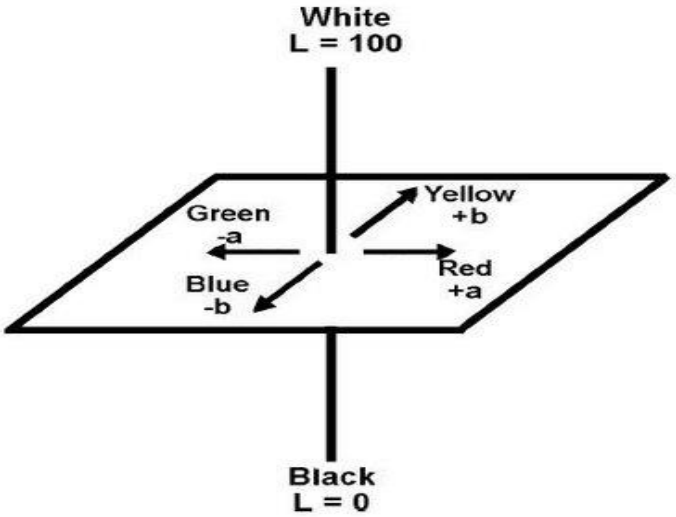

Figure 1 The three-dimensional structure of the L*–a*–b* system (Feiner, 2006)

MATERIAL AND METHODS

The experiment was realized at the test station of the Department of Poultry and Small Farm Animals' Husbandry (Faculty of Agrobiology and Food Resources, Slovak Agricultural University in Nitra). The experiment included 180 pieces in one day old chickens of hybrid combination Ross 308 which were divided into 6 groups (n=30): control, (I, II, III, IV, V experimental groups). Chickens were fed by the ad libitum system from 1th to 21th day of age with the same starter feed mixture (CFM) HYD-01 (loose structure) and from 22nd to 42nd day of age fed with the growth feed mixture (CFM) HYD-02 (loose structure) 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 and to the experimental groups were addition natural bee pollen in amount (I. 500 mg.kg^{-1}, II. 1500 mg.kg^{-1}, III. 2500 mg.kg^{-1}, IV. 3500 mg.kg^{-1}, V. 4500 mg.kg^{-1}). At the end of the feeding (42nd day), 20 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 colour of raw meat after defrosting was evaluated by spectrophotometer CM 2600d (Konica Minolta, Japan).

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 diets

Ingredients [%]	Starter (1st to 21st days of age)	Grower (22nd to 40th 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

Legend: [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

RESULTS AND DISCUSSION

Table (2) shows the results of the broiler´s breast meat colour L*–a*–b* after using bee pollen into their feed mixture. However the L* value after 45 minutes in the control group was (53.64±2.1) and L* values in the experimental groups were (I. 53.85±26.4; II. 53.96±3.3; III. 53.75±2.4; IV. 53.36±1.9; V. 52.31±2.1) and there were not significant differences (P≥0.05) among the groups. The a* value after 45 minutes in the control group was (9.52±0.87) and the a* values in the experimental groups were (I. -0.06±1.44; II. 2.05±1.9; III. 1.80±1.4; IV. 0.54±1.1; V. -0.46±0.4) and were significant differences (P≤0.05) between the control group and experimental (II, III) groups. The value b*after 45 minutes in the control group was (9.52±0.9) also the b* values after in the experimental groups were (I. 9.14±1.8; II.7.14±3.2; III. 7.81±2.2; IV. 9.16±1.4; V. 9.49±1.6) and were significant differences (P≤0.05) between the control group and experimental (II, III) groups.

Further, the table (3) summarize the effect of the bee pollen on broiler´s thigh meat colour L*–a*–b* after using bee pollen into their feed mixture. The value of the L*after 45 minutes was in control groups (53.64±2.09) and in the experimental groups were (I. 53.85±26.4; II. 53.96±3.3; III. 53.75±2.4; IV. 53.36±1.9; V. 52.31±2.1) and there were no significant differences (P≥0.05) among the groups. The a* value in the control group was (6.02±3.1) and the experimental groups (I. 6.40±4.2; II. 7.38±5.1; III. 6.91±3.8; IV. 5.98±3.3; V. 4.53±1.6) and there were no significant differences (P≥0.05) between the groups. The value of the b* after 45 minutes were in control groups (13.56±1.74) and the experimental groups (I. 11.92±4.8; II. 5.17±5.7; III. I 7.68±4.6; IV. 11.04±2.6; V. 13.28±1.3) and there were significant differences (P≤0.05) between the control group and experimental (II, III) groups.

Quality characteristics of the chicken breast and thigh muscles, include values of lightness (L*), redness*), and yellowness (b*) measurements are summarized in (Table 2 , 3) These include values of lightness (L*), redness*), and yellowness (b*). However, the average of L* values (lightness) after 45- minutes in the breast and thigh muscles, it was in control groups < 51.75 to >53.64 and in the experimental groups were ringing <49.38 to > 53.96 and where were no significant difference (P≥0.05) among the groups and our results is confirmed **Šulcerová et al. (2011**) who study the effect of addition of pollen and propolis to feeding mixtures during the production of broiler chickens Ross 308 to the colour of thigh and breast muscles and pH determination. Similarly, the present results in agreement with **Holownia et al. (2003**) who was made an evaluation of induced colour changes in chicken breast meat during simulation of pink colour defect. Also with **Petracci et al. (2004)** who found that broiler breast meat lightness (L*) values as being dark (L* < 50), normal (50 < or = L* < or = 56), or pale (L* > 56). Furthermore, the a* value in breast and muscles colour in control (< -0.98±0.4) group was tended to the green (-a) colour slightly compared to the experimental groups II (>2.05±1.9); III (<1.80±1.4); IV (<0.54±1.1) which were tended to the red colour slightly except experimental groups I (< -0.06±1.4) and V (< -0.46±0.4) and there were significant differences (P≤0.05) between control groups and experimental groups (II, III and IV) this result in agreement with **Foltyn et al. (2013)** who study the effect of corn DDGS on broiler performance and meat quality, also agree with **Qiao et al. (2001)** who study the effect of broiler breast meat colour on pH, moisture, water-holding capacity, and emulsification capacity. Otherwise, the value of a* in thigh muscles was tended to red colour in colour and experimental groups without significant differences (P≥0.05). On the hand, the b* value broiler thigh muscles colour in control and experimental groups were tended to yellow colour and there were significant differences (P≤0.05) in breast and thigh muscles between control group and (II, III) groups. Our results support **Bianchi and Fletcher (2002)** who study the effects of broiler breast meat thickness and background on colour measurements. However the present results confirmed **Haščík et al. (2013**) study who was made sensory evaluation of broiler meat after addition, Slovak bee pollen in their feed mixture. Similary suppored **Haščík et al. (2011)** who was made evaluated on the sensory quality of poultry meat after propolis application.

Table 2 The effect of bee pollen (mg.kg^{-1}) on broiler´s breast meat colour L*–a*–b* system (mean±SD)

Indicators	C	I (BP 500**)**	II (BP 1500)	III (BP 2500)	IV (BP 3500)	V (BP 4500)
	30	**30**	**30**	**30**	**30**	**30**
L*aft. 45 min	51.75±1.5^{a}	51.28±2.8^{ab}	52.50±2.4^{a}	49.38±2.9^{a}	52.19±2.9^{a}	49.62±2.9^{a}
a*aft. 45 min	-0.98±0.4^{ad}	-0.06±1.4^{ad}	2.05±1.9^{b}	1.80±1.4^{b}	0.54±1.1^{c}	-0.46±0.4^{d}
b*aft. 45 min	9.52±0.9^{a}	9.14±1.8^{a}	7.14±3.2^{b}	7.81±2.2^{b}	9.16±1.4^{a}	9.49±1.6^{a}

Legend: C - control group; (I, II, III, IV and V) - experimental groups**;** mean - average, SD - standard deviation; BP - bee pollen; ^{a,b} - means with different superscripts differ significantly; (P≤0.05) significant.

Table 3 The effect of bee pollen (mg.kg^{-1}) on broiler´s thigh meat colour L*–a*–b* system (mean±SD)

Indicators	C	I (BP 500**)**	II (BP 1500)	III (BP 2500)	IV (BP 3500)	V (BP 4500)
	30	**30**	**30**	**30**	**30**	**30**
L*aft. 45 min	53.64±2.1^{a}	53.85±26.4^{a}	53.96±3.3^{a}	53.75±2.4^{a}	53.36±1.9^{a}	52.31±2.1^{a}
a*aft. 45 min	6.02±3.1^{a}	6.40±4.2^{a}	7.38±5.1^{a}	6.91±3.8^{a}	5.98±3.3^{a}	4.53±1.6^{a}
b*aft. 45 min	13.56±1.7^{a}	11.92±4.8^{a}	5.17±5.7^{b}	7.68±4.6^{b}	11.04±2.6^{a}	13.28±1.3^{a}

Legend: C- control group; (I, II, III, IV and V)- experimental groups**;** mean -average, SD - standard deviation; BP- bee pollen; [a,b,c,d]-means with different superscripts differ significantly; (P ≤0.05) significant.

CONCLUSION

From the present study were concluded that there were not significant differences in broiler breast and thigh meat colour lightness (L*). Further, there were found that the bee pollen in the amount of (1500, 2500 and 3500 mg.kg^{-1} bee pollen) were tended broiler breast meat colour slightly to redness (a*) and there were found significant differences (P≤0.05) between control group and (II, III and IV) groups. Similarly, were found that the broiler breast and thigh meat colour yellowness (b*) and there were (P≤0.05) between control group and (II, III) groups.

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