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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 MUSCLE AND PH DETERMINATION

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Abstract

ŠULCEROVÁ, H., MIHOK, M., JŮZL, M., HAŠČÍK, P.: *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 muscle and pH determination.* Acta univ. agric. et silvic. Mendel. Brun., 2011, LIX, No. 6, pp. 359–366

The aim of this study was to verify influence of pollen and propolis added to the feeding mixture in the diet of broiler chickens Ross 308 to colour breast and thigh muscles in relation to pH values. A total of 198 units 1 day-old Ross 308 hybrid combinations divided into 6 groups according to the feeding mixtures were investigated on meat quality characteristics changes. Muscle colour of breasts and thighs was measured and compared with pH in three times, pH_1, pH_2 and pH_{ult}. Feeding with various additions to feeding mixtures for chicken showed small impact of low content (200 or 300 $mg.kg^{-1}$) propolis to meat quality characteristics. Higher effect on breast quality was found in group with 400 $mg.kg^{-1}$ pollen addition to feed, there was faster and deeper postmortal process level found, although without negative impact on meat quality. Meat colour and muscle pH of chicken in this experiment was pale and had low ultimate pH. In these parameters were found correlation. Chicken meat of this experimental animals was paler and had the lowest ultimate pH, altough in group with higher addition it wasn't confirmed. Raw meat breast pH was significantly lower than thigh muscles in all measurement time. Various feeding especially pollen had significant impact on breast colour which was paler although without negative displays attended of pH decline. Significant relationships are between breast and thigh L*a*b* values and pH_1 respectively.

carcass, meat quality, lightness, postmortal changes, CIELAB

Chicken meat is more accepted than red meat because of comparably low levels of fat, cholesterol and high levels of iron (Jaturasitha *et al*., 2008). At present approximately 30% of the world's total meat consumption is poultry, only pork exceeding this share (FAO, 2006). High consumption of poultry meat leads to concern that the products marketed should be safe, have a low spoilage rate and show the right composition, packaging, colour, taste and appearance (Rio *et al*., 2007).

Composition of feed mixtures for chickens is important but also in terms of the required nutrients and energy and their ratio. With increasing energy and nutrients in chicken feed mixtures also are likely to increase their body weight without changing the quality of the carcases of chickens (Donaldson *et al*., 1957; Combs and Nicholson, 1964; Saleh *et al*., 2004; Haščík *et al*., 2010). Further opportunities to influence the yield, health, and the final quality of poultry meat, is the addition of various additives to feeding mixtures. Animal infectious diseases, especially the viral diseases, are worldwide concerned as they usually cause a great loss in domestic animal and poultry industry (Kong *et al*., 2004; Fan *et al*., 2011). Because virus has unique biological characteristics and pathogenesis,

there are no effective treatment methods for viral diseases. Vaccination is the most common preventive method, but some infectious diseases are still difficult to control (Kong, 2003; Kang *et al.*, 2009). Propolis supplementation is used in poultry diets (Shalmany and Shivazad, 2006). Recently, it has been reported to possess various biological activities, such as antibacterial, antiviral, anti-inflammatory, anticancer, antifungal, and antitumoral properties (Burdock, 1998; Banskota *et al.*, 2001; Ahn *et al.*, 2007). Propolis is an adhesive, dark yellow to brown coloured balsam that smells like resin. It is collected from buds, leaves and similar parts of trees and plants by bees and mixed with wax, sugar and plant exudates collected by bees from certain plant sources. More than 300 constituents have been identified in different propolis samples (Valle, 2000; Banskota *et al.*, 2001; Shalmany and Shivazad, 2006). Propolis usually contains variety of chemical compounds, such as polyphenols (flavonoids, phenolic acids and their esters), terpenoids, steroids, and amino acids. The composition of propolis depends on the vegetation at the site of collection (Kumazawa *et al.*, 2003). Propolis has many positive effects like increase in feed intake, body weight increase, flavonoid content, taste improvement, antioxidant and antimicrobial properties have been reported. Antioxidative, cytostatic, anti-mutagenic and immunomodulatory properties of propolis are based on its rich, flavonoid, phenolic acid and terpenoid contents (Kimoto *et al.*, 1999; Prytzyk *et al.*, 2003; Wang *et al.*, 2004). Second of the preparates which has positive effect on poultry gastrointestinal tract is pollen. Pollen is the male reproductive spore of plants. Flowers produce pollen to fertilize other flowers. It has a considerable potential for being used in increasing quantities as food and feed. Pollen contains proteins, carbohydrates, lipids, vitamins and minerals, moreover it is a rich source of free amino acids and, therefore, is appreciated even in human nutrition. In some countries the bee pollen has been recognized as a medicine, e.g. by the German Federal Board of Health pollen as food and medicine is traditionally used in Far East region – especially in China (Brindza *et al.*, 2010). Bee Pollen contains at least 22 amino acids, 18 vitamins, 25 minerals, 59 trace elements, 11 enzymes or co-enzymes, 14 fatty acids, 11 carbohydrates and approximately 25% protein. Bee pollen is extremely rich in carotenes, which are metabolic precursors of vitamin A. It is also high In B complex and vitamins C, D, E and lecithin. Bee pollen contains over 50% more protein than beef, yet its fat content is very low. Khojasteh and Shivazad (2006) and Wang *et al.* (2007) reported that bee pollen contains digestive enzymes from the bees.

Meat quality is influenced, to a large extent, by the rate of pH decline in the muscles after slaughter and by the ultimate pH (Sales and Mellett, 1996; Hambrecht *et al.*, 2004; Muchenje *et al.*, 2009a). 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 aim of this work is to verify influence of pollen and propolis added to the feeding mixture in the diet of broiler chickens Ross 308 to breast and thigh muscles colour in relation to pH values.

MATERIALS AND METHODS

The experiment was carried out in test poultry station Slovak Agricultural University in Nitra. In the experiment was included 198 units day-old Ross 308 hybrid combinations divided into 6 groups according to the added preparation with various amount of pollen and propolis and begin with start of feeding of HYD-01 and continue with HYD-02 (Table I).

I: *The amount of propolis and pollen added to the compound in experimental groups of broiler chickens Ross 308*

Experimental groups	Propolis	Pollen
	mg.kg^{-1}	
P1	200	x
P2	300	x
P3	400	x
P4	x	400
P5	x	800
P6 (control group)	x	x

Chickens have been bred in cage technology from the company MBD (CZ), each cage was equipped with feed disperser and water feed was ensured an *ad libitum* through a self fount. Heating was secured by central heating. The air temperature was at the first day 33 °C, and every week has been lowered by 2 °C. Light regime during the fattening period was continuous.

Custom fattening of chickens abided 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 42nd day of age fed with the growth feed mixture HYD-02 (powdery form) in the monitored groups. The fed feed mixture HYD-01 and HYD-02 have been produced without antibiotic preparations and coccidiostats. The average composition and nutritional value of feeding mixtures is shown in Table II.

Colour determination

The colour measurement of raw poultry was determined after using the CIE L*a*b* system with spectrophotometer Konica Minolta CM-3500d (Konica Minolta, Tokio, Japan). Samples were prepared for measurement and surface of raw meat was measured with SCE (Specular Component Excluded). The spectrophotometer was standardised using white and black standard tools. The illumination D65 with 8° viewing angle and a 8 mm slot were used. D65 was the chosen

II: *Composition and nutrient composition of diets (%)*

Ingredient	Starter diets	Grower diets
	(%)	
Wheat	35.00	35.00
Corn	35.00	40.00
Soybean extracted (48 % NL)	21.30	18.70
Fish meal (71 % NL[1])	3.80	2.00
Dried blood	1.25	1.25
Ground limestone	1.00	1.05
MCP[2] 22, 7 P[3], 16 Ca[4]	1.00	0.70
Fodder salt	0.10	0.15
Sodium hydrogen carbonate	0.15	0.20
Lysine HCl	0.05	0.07
Methionine 100 %	0.15	0.22
Fat - Bergafat	0.70	0.16
Euromix BR (0,5 %)[5]	0.50	0.50
Nutrient composition		
ME_N (MJ.kg^{-1})[6]	12.015	12.030
Nitrogenous proteins (g.kg^{-1})	210.760	190.420
Linoleic acid (g.kg^{-1})	13.512	14.191
Pulp (g.kg^{-1})	30.186	29.934
Methionine (g.kg^{-1})	4.960	5.218
Lysine (g.kg^{-1})	11.301	9.894
Calcium (g.kg^{-1})	8.155	7.275
Phosphorus total (g.kg^{-1})	6.755	5.708
Methionine + cysteine (g.kg^{-1})	7.845	7.900
Threonine (g.kg^{-1})	7.572	6.723
Vitamin A (lu)	12.632	12.600
Vitamin D (lu)	4.000	4.000
Vitamin E (mg.kg^{-1})	260.792	261.130
Vitamin K (mg.kg^{-1})	4.000	4.000
Vitamin B1 (mg.kg^{-1})	6.884	6.922
Vitamin B2 (mg.kg^{-1})	10.739	10.646
Vitamin B6 (mg.kg^{-1})	10.421	10.279
Vitamin B12 (mg.kg^{-1})	53.076	46.882
Pantothenic acid (mg.kg^{-1})	24.211	23.894
Folic acid (mg.kg^{-1})	2.374	2.364
Choline (mg.kg^{-1})	1645.430	1547.230
Betaine (mg.kg^{-1})	250.000	250.000
Niacin (mg.kg^{-1})	92.178	91.300
Biotin (mg.kg^{-1})	0.515	0.534
Vitamin C (mg.kg^{-1})	250.000	250.000
Ash (g.kg^{-1})	24.242	19.938
Sodium (g.kg^{-1})	1.703	1.777
Magnesium (g.kg^{-1})	1.407	1.356
Iron (mg.kg^{-1})	143.645	138.288
Copper (mg.kg^{-1})	17.423	17.074
Manganese (mg.kg^{-1})	123.597	122.838
Zinc (mg.kg^{-1})	110.424	108.406
Selenium (mg.kg^{-1})	0.401	0.355
Iodine (mg.kg^{-1})	1.135	1.098
Cobalt (mg.kg^{-1})	0.470	0.460

[1]nitrogenous proteins, [2]mineral feed additive, [3]phosphorus, [4]calcium, [5]premix - Euromix BR – premix provided per kg of diet: vitamin A – 2 500 000 lu, vitamin D3 – 800 000 lu, vitamin E – 20 000 mg, vitamin K3 – 800 mg, vitamin B1 – 600 mg, vitamin B2 – 1 800 mg, vitamin B6 – 1 200 mg, vitamin B12 – 8 mg, vitamin C – 20 000 mg, biotin – 40 mg, folic acid – 400 mg, calcium pantothenate – 3 000 mg, nicotinic acid – 12 000 mg, choline – 100 000 mg, betaine – 50 000 mg, Mn – 20 000 mg, Fe – 14 000 mg, Cu – 2 400 mg, Zn – 16 000 mg, Co – 80 mg, I – 200 mg, Se – 50 mg, anioxidant Endox – 5 000 mg, [6]metabolizable energy corrected for nitrogen balance

illumination as it approximates to daylight (Saláková *et al.*, 2009). Three measurements from each sample were done and the mean was calculated. L* (lightness), a* (redness/greenness position data), b* (yellowness/blueness position data), C* (chroma data) and h^0 (hue angle data) values were recorded. The colour difference ΔE_{ab} were used for simple display of different colour from the control group (P6) without amount of pollen and propolis. Even if the ΔE_{94}, CMC 1:c or ΔE_{2000} are later modified differences, ΔE_{ab} is easier and full competent for food materials application. ΔE_{ab} more than 2,3 is the smallest colour difference the human eye can see (Sharma *et al.*, 2005).

Statistical data analysis were performed using the analysis of variance procedure, correlation analysis procedure of UNISTAT 5.1 software (Unistat Ltd., London, Great Britain), using ANOVA to ascertain differences among means. Means were compared using Tukey's multiple range test method. The significance level was designed as $P < 0,05$, 0,01 or 0,001. The correlative relationships between colour (L*, a*, b*, C*, h^0) and meat quality (representing pH_1, pH_2, pH_{ult}) were performed with the correlation analysis procedure (Spearman's test).

pH value

Meat pH value was measured 45 min (pH_1), 2 (pH_2) and 12 hours (pH_{ult}) *post mortem* in laboratory after transport from slaughterhouse and storage in icebox and refrigerator with close fridge conditions (4–8 °C) using pH meter Portamess 911 Ph (Knick, Berlin, Germany). From each sample, three values were measured and the mean was calculated (Ambrosiadis *et al.*, 2004; Del Nobile *et al.*, 2009; Šulcerová and Burdychová, 2009).

RESULT AND DISCUSSION

As shown in Table III, there were significant differences ($P < 0,05$) in the breast muscles colour measurements, particularly in the L*, a* and h^0 among the feeding groups.

The biggest values L* (palest meat) significantly ($P < 0.05$) exposed group P5 and the lowest (darker meat) groups P6 (control diet without addition). Comparing the groups, P5 showed the smallest values of a*, while significantly ($P < 0.05$) opposite were recorded in group P4. Examine of various model (L*C*h) it is apparent that hue angle (h) of breast muscles was significantly ($P < 0.05$) in the group P4 and the highest in the groups P2 and

III: *Effect of various feeding on the meat quality of broilers*

	Feeding Group					
Parameter	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
Meat colour						
Breast L*	51.16 ± 0.60^{abcd}	50.53 ± 0.49^{bc}	51.50 ± 0.53^{ab}	52.50 ± 0.75^{ab}	53.42 ± 0.37^{a}	49.02 ± 0.90^{cd}
Thigh L*	54.23 ± 1.05	54.51 ± 1.05	54.96 ± 0.85	55.51 ± 0.79	57.73 ± 0.64	56.05 ± 1.16
Breast a*	–1.50 ± 0.17^{ab}	–1.85 ± 0.11^{ab}	–1.67 ± 0.10^{ab}	–1.30 ± 0.28^{a}	–2,17 ± 0.08^{b}	–1.51 ± 0.20^{ab}
Thigh a*	0.14 ± 0.16	–0.39 ± 0.30	0.59 ± 0.52	–0.33 ± 0.28	–0.43 ± 0.23	–0.14 ± 0.23
Breast b*	7.41 ± 0.42	6.57 ± 0.43	6.87 ± 0.20	8.01 ± 0.30	7.04 ± 0.29	7.30 ± 0.60
Thigh b*	8.98 ± 0.52	7.58 ± 0.56	6.38 ± 0.87	7.10 ± 0.56	7.47 ± 0.69	7.82 ± 0.98
Breast C*	7.63 ± 0.40	6.89 ± 0.40	7.09 ± 0.20	8.24 ± 0.30	7.40 ± 0.27	7.59 ± 0.56
Thigh C*	9.00 ± 0.51	7.67 ± 0.56	6.63 ± 0.90	7.19 ± 0.56	7.53 ± 0.68	7.87 ± 0.98
Breast h^0	102.60 ± 1.51^{ab}	107.72 ± 1.70^{a}	103.91 ± 0.82^{ab}	100.28 ± 1.83^{b}	107.84 ± 1.03^{a}	104.79 ± 2.43^{ab}
Thigh h^0	88.74 ± 1.09	93.53 ± 2.28	85.19 ± 4.29	92.94 ± 2.46	93.53 ± 2.02	90.72 ± 2.53
BreastΔE*ab	2.15	1.72	2.52	3.56	4.46	-
ThighΔE*ab	1.47	1.25	1.40	0.96	1.32	-
Meat pH						
Breast pH_1	6.14 ± 0.03^{a}	6.09 ± 0.01^{a}	6.14 ± 0.02^{a}	5.99 ± 0.02^{b}	6.12 ± 0.03^{a}	6.09 ± 0.03^{a}
Thigh pH_1	6.34 ± 0.04	6.30 ± 0.03^{b}	6.35 ± 0.04	6.28 ± 0.01^{b}	6.44 ± 0.02^{a}	6.29 ± 0.02^{b}
Breast pH_2	5.88 ± 0.01^{a}	5.83 ± 0.02	5.86 ± 0.01	5.77 ± 0.01^{b}	5.90 ± 0.04^{a}	5.91 ± 0.01^{a}
Thigh pH_2	6.16 ± 0.02	6.07 ± 0.04	6.19 ± 0.03	6.10 ± 0.01	6.20 ± 0.01	6.09 ± 0.04
Breast pH_{ult}	5.81 ± 0.01^{bc}	5.79 ± 0.01^{bc}	5.80 ± 0.01^{bc}	5.76 ± 0.01^{c}	5.88 ± 0.02^{a}	5.85 ± 0.02^{ab}
Thigh pH_{ult}	6.01 ± 0.03	5.99 ± 0.03	6.05 ± 0.02	6.05 ± 0.02	6.04 ± 0.04	5.97 ± 0.02

Values are mean ± S.D. (n = 5 each)
^{a,b,c,d,e,f} – Means within the same row with different superscripts differ significantly (P < 0.05)

IV: *Multivariate correlation coeficcients between colour and pH of breast and thigh muscles*

	thigh L*	**thigh a***	**thigh b***	**thigh C***	**thigh h^0**	**thigh pH_1**	**thigh pH_2**	**thigh pH_{ult}**
breast L*	0.39*	–0.35*	0.12	0.15	0.41*	0.25	0.36*	0.04
breast a*	–0.05	0.44**	0.20	0.23	–0.43**	–0.35*	–0.33*	–0.09
breast b*	0.24	0.05	0.44**	0.44**	0.03	–0.07	–0.21	0.01
breast C*	0.25	0.05	0.46**	0.46**	0.03	–0.09	–0.23	–0.01
breast h^0	–0.07	–0.33*	–0.28	–0.30	0.28	0.10	0.16	–0.02
breast pH_1	0.13	0.13	–0.28	–0.26	–0.20	0.42**	0.42*	–0.08
breast pH_2	0.25	0.13	0.15	0.17	–0.14	0.17	0.23	–0.13
breast pH_{ult}	0.26	0.10	0.03	0.06	–0.10	0.34*	0.22	–0.17

*P < 0.05, **P < 0.01, ****P < 0.001

P5, altough in chroma (C*) were no diferences. If was the control diet standard group, we could compare with other groups counting ΔE_{ab} (colour difference) The most different feeding group is the one with different breast colour just P5 and P4 group (ΔE_{ab}= 4.46 and 3.56), which can be already observed. In contrast thigh muscles show smaller difference, there was only higher P1 group (ΔE_{ab} = 1.47) in comparison of control diet group without feed addition. It is obvious, that various feeding had significant impact on breast colour, especially pollen. All means and values were in range for normal meat (Le Bihan-Duval *et al.*, 1999; Corzo *et al.*, 2009), there was no presence of meat quality differences like PSE or DFD (Barbut, 1993). Raw meat breast pH was significantly lower than thigh muscles in all measurement time. Breast pH of P4 group was significantly lower than other groups, simultaneously with the thigh muscle pH_1.

According to various authors of papers (Barbut 1993; Le Bihan-Duval Elisabeth *et al.*, 2008; Saláková *et al.*, 2009), meat colour and muscle pH are highly correlated. In Table IV, V and VI are correlations between meat colour characteristics and postmortal pH values, respectively either and both of breast and thigh. Significant relationships are between breast and thigh L*a*b* values (Table IV) and pH_1, respectively.

In Table V and VI are shown significant relationships between breast or thigh pH_1 (Fig. 1, 2), related to pH_2 and pH_{ult} with correlation coefficients 0.42 and 0.45, or 0.70 and 0.31.

V: *Multivariate correlation coeficcients between colour and pH of breast muscles*

	breast L*	breast a*	breast b*	breast C*	breast h^0	breast pH_1	breast pH_2	breast pH_{ult}
breast L*	-	0.29	0.35*	0.36*	0.14	–0.14	–0.05	–0.03
breast a*	0.29	-	0.50**	0.48**	–0.82***	–0.12	–0.14	–0.15
breast b*	0.35*	0.50**	-	0.99***	–0.84***	–0.33*	–0.14	–0.14
breast C*	0.36*	0.48**	0.99***	-	–0.82***	–0.37*	–0.15	–0.16
breast h^0	0.14	–0.82***	–0.84***	–0.82***	-	0.22	0.23	0.20
breast pH_1	–0.14	–0.12	–0.33*	–0.37*	0.22	-	0.42*	0.45*
breast pH_2	–0.05	–0.14	–0.14	–0.15	0.23	0.42*	-	0.79***
breast pH_{ult}	–0.03	–0.15	–0.14	–0.16	0.20	0.45*	0.79***	-

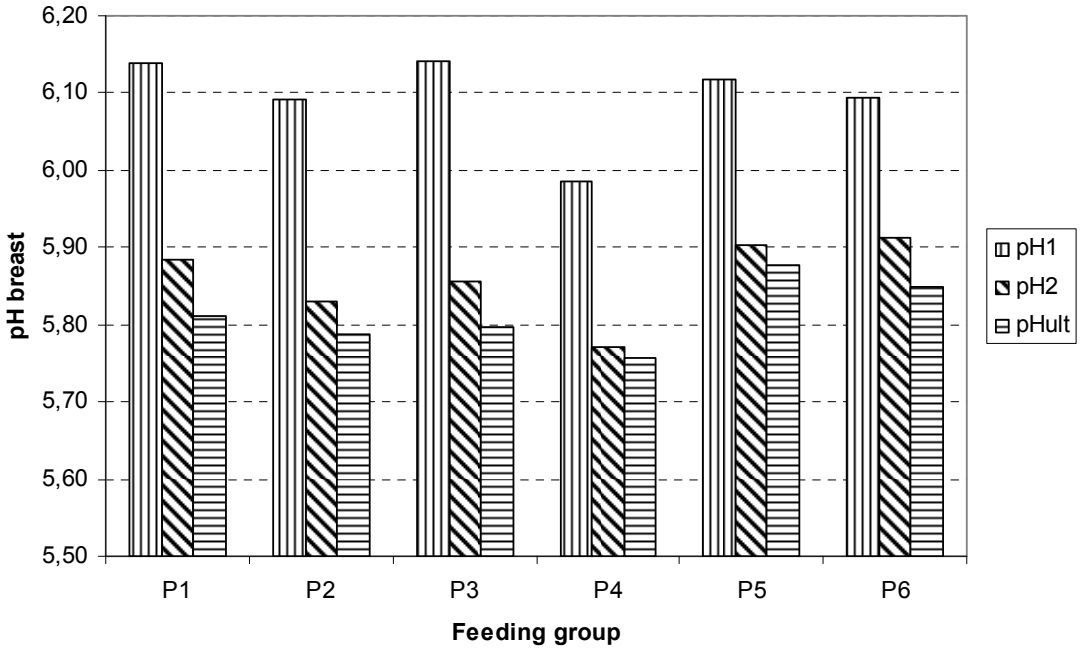
*P < 0.05, **P < 0.01, ****P < 0.001

VI: *Multivariate correlation coeficcients between colour and pH of thigh muscles*

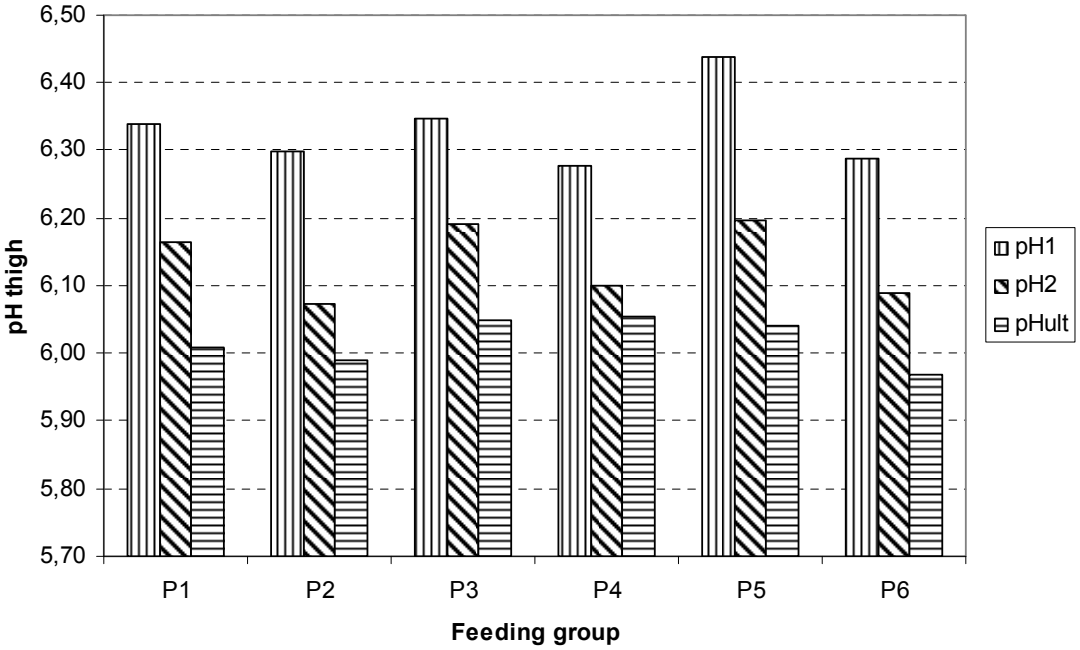
	thigh L*	thigh a*	thigh b*	thigh C*	thigh h^0	thigh pH_1	thigh pH_2	thigh pH_{ult}
thigh L*	-	–0.14	0.32*	0.36*	0.16	0.05	0.12	0.02
thigh a*	–0.14	-	0.21	0.23	–0.94***	–0.05	0.18	0.19
thigh b*	0.32*	0.21	-	0.99***	–0.11	0.3	–0.12	0.32*
thigh C*	0.36*	0.23	0.99***	-	0.14	–0.29	–0.1	–0.31*
thigh h^0	0.16	–0.94***	–0.11	0.14	-	0.01	0.2	–0.22
thigh pH_1	0.05	–0.05	0.3	–0.29	0.01	-	0.70***	0.31*
thigh pH_2	0.12	0.18	–0.12	–0.1	0.2	0.70***	-	0.29
thigh pH_{ult}	0.02	0.19	0.32*	–0.31*	–0.22	0.31*	0.29	-

*P < 0.05, **P < 0.01, ****P < 0.001

Amount of yellow intensity (b*) is bound to chroma, it is essential finding in the chicken meat evaluation, although the colour characteristic a* maybe very useful in colour difference assessing between groups. Interesting finding is low relationship between pH and lightness (L*). It can be caused by dissimilar condition of muscles postmortal process. The pH fall is due to the fact that the slaughtered animal glycogen is broken down into glucose. Glucose undergoes glycolysis but in the absence of oxygen, lactic acid is formed which causes pH in muscles to decrease (Muchenje *et al.*, 2009b). Such a pH decline helps in the conversion of muscle to meat. The ultimate pH influences the



1: *Effect of addition of propolis and pollen to feed on the pH breast muscles of broilers*



2: *Effect of addition of propolis and pollen to feed on the pH thigh muscles of broilers*

structure of myofibrils and, consequently, the water holding capacity and colour of meat (Castellini *et al.*, 2002; Dyubele *et al.*, 2010).

CONCLUSIONS

Feeding with various additions pollen and propolis to feeding mixtures for chicken showed small impact to meat quality characteristics. Higher effect was found in group with 400 mg.kg^{-1} pollen addition to feed, there was deeper pH and faster postmortal process level found, although without negative impact on meat quality. Meat colour and muscle pH are highly correlated. Raw meat breast pH was significantly lower than thigh muscles in all measurement time. Pollen addition of 400 and 800 mg.kg^{-1} to feed had significant impact on breast colour.

SUMMARY

The aim of this work is to verify influence of pollen and propolis added to the feeding mixture in the diet of broiler chickens Ross 308 to breast and thigh muscles colour in relation to pH values. Meat quality is influenced, to a large extent, by the rate of pH decline in the muscles after slaughter and by the ultimate pH The rate of pH decline is a good predictor of the colour and drip loss of meat. To the experiment was included 198 units day-old Ross 308 hybrid combinations divided into 6 groups according to the added preparation. Custom fattening of chickens abided 42 days *ad libitum*. Chickens were fed to 21th day of age an *ad libitum* with the same starter feed mixture HYD-01 and from 22nd to 42nd day of age fed with the growth feed mixture HYD-02 in the monitored groups. The colour measurement of raw poultry was determined after using the CIE L*a*b* system with spectrophotometer Konica Minolta CM-3500d (Konica Minolta, Tokio, Japan). Samples were prepared for measurement and surface of raw meat was measured with SCE (Specular Component Excluded). Statistical data analysis were performed using the analysis of variance procedure, correlation analysis procedure of UNISTAT 5.1 software, using ANOVA to ascertain differences among means. Means were compared using Tukey's multiple range test method. The significance level was designed as $P < 0.05$, 0.01 or 0.001. The correlative relationships between colour and meat quality were performed with the correlation analysis procedure (Spearman's test). Meat pH value was measured 45 min (pH_1), 2 (pH_2) and 12 hours (pH_{ult}) *post mortem*. Meat colour and muscle pH are highly correlated. Higher effect was found in group with 400 mg.kg^{-1} pollen addition to feed, there was deeper pH decline and faster postmortal process level found, although without negative impact on sensory quality. Significant relationships are between breast and thigh CIEL*a*b* values and pH1 respectively. Various feeding especially pollen had significant impact on breast colour which was paler although without negative displays attended of pH decline. Raw meat breast pH was significantly lower than thigh muscles in all measurement time.

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