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THE INFLUENCE OF REARING SYSTEM ON SKIN COLOUR IN BROILERS

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ABSTRACT

The aim of this study was to determine the effect of different rearing systems on the skin colour of commercial broilers. Research was carried out on 100 broilers of two different provenances (ross 208 and prelux-bro) up to 56 days of age. In the first half of the experiment the broilers were fed according to standard technology with bro starter which contained 23.44 % crude protein and 12.98 MJ/kg metabolizable energy. On the 28th day broilers were divided into two groups and fed with bro finisher which contained 70 % cereals, 14.0 % crude protein and 16.26 MJ/kg metabolizable energy. Half of the broilers were kept indoors without access to the grassland, while the other half had free access during the day (12 hours). Free range broilers showed a higher degree of pigmentation in skin colour than the broilers in confinement. The differences were statistically significant for the L* (lightness) and b* (yellowness) values.

Keywords: broilers, skin colour, free range, deep litter

INTRODUCTION

Colour is one of the first impressions we have of a meat product. In modern markets, consumers still tend to favour skin colours which are traditionally available and which are based on local feeding practices as well as genetic stock (Fletcher, 1999). Because of its market impact, much is known about the factors affecting skin pigmentation. Pigmentation, or the deposition of pigments in the skin of the bird, depends on the genetic capability of the bird, dietary pigments, health of the bird and processing (Fletcher, 1999). Many consumers belive that broilers which have access to fresh grass every day, and also receive antibiotic-free, non-commercial grain rations have better meat quality with better sensory properties than broilers raised in closed poultry houses. This study was conducted to evaluate the effect of the management system (total confinement versus free range) on broiler breast skin colour.

MATERIAL AND METHODS

The research was carried out with two provenances of broilers. 50 broilers (25 females and 25 males) were from commercial provenance ross 208 and 50 broilers (25 females and 25 males) were from commercial provenance prelux-bro. All broilers were raised in the fixed poultry house of deep litter type up to 4 weeks of age and were fed *ad libitum* with standard mixture of the same content and nutritional value. The levels of metabolizable energy and crude protein up to 4 weeks of age were 12.98 MJ/kg and 23.44 % CP, respectively.
At the age of 4 weeks the chickens were divided into two groups. The first group was composed of 15 ross females, 10 ross males, 12 prelux-bro females and 12 prelux-bro males. The second one was formed from 12 ross females, 13 ross males, 13 prelux-bro females and 13 prelux-bro males. Broilers from the first group had continuous daytime (12 hours) access to open-air run. The ground to which the broilers had access was mainly covered with vegetation. The stocking density on the grassland was one bird per two square meters. Broilers from the second group were raised in deep litter house where the floor area was covered with wood shavings. They did not have access to the outdoors. From 4 weeks of age ahead all b roilers were fed *ad libitum* with finisher contained 70 % cereals (barley and maize). Protein concentration in finisher was 14.0 %, metabolizable energy 16.26 MJ per kg. At the age of 8 weeks all broilers were slaughtered and processed at the same way.
The slaughtering scheme was as follows: stunning with electrical current, bleeding by cutting jugular vein, scalding and plucking by machine and eviscerating by hand. The skin colour measurments were taken on the breast surfaces 24 h *post mortem* using a porTable Minolta Chroma Meter CR 300. Colour values (L*-lightness, a*-redness and b*-

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yellowness) were recorded on three randomly chosen points of chilled breast surfaces in triplicate. The data were subjected to statistical analysis using the GLM procedure in the SAS statistical program (SAS/STAT, 1990). The model was as follows:

$Y_{ijkl} = \mu + P_i + R_j + S_k + e_{ijkl}$

Y_{ijkl} = measured value; μ = population mean
P_i = effect of provenance i
R_j = effect of keeping system j
S_k = effect of sex k
e_{ijkl} = random error

RESULTS AND DISCUSSION

Colour perception by humans can be defined by a minimum of three dimensions, consisting of a lightness attribute (luminosity, distinguishing light from dark colour) and two chromatic attributes called hue (or dominant wavelength, colour perception of the object as red, yellow, green…), and chroma (saturationor depth or purity of the colour, the difference between grey and pure colour). Standardisation of colour quantification has been performed by the CIE (Commission international de l'Eclairage, 1976). The CIE L*a*b* system, the scale of which correlates with the colour perception by humans defines a three-dimensional colour space with opponent colours scale, a* (red positive-green negative), b* (yellow-blue) and L* (lightness, black to white reflectance, 0-100). The major advantages of reflectance colorimetry are its objectivity, accuracy and reproducibility. Major disadvantage is the abstract nature of colour description systems. On the basis of many experiments (e.g. Twining et al., 1986) which provided evidence that the Minolta Chroma Meter may be used as a reliable instrument for measuring pigmentation in broilers we used it in our study for reading breast skin colour. In Table 1 are shown the average values for broiler breast skin colours and variability within the groups.

Table 1. Initial mean lightness (L^*), redness (a^*) and yellowness (b^*) values of broiler breast skins

Breast skin colour	Free range broilers				Broilers raised indoors			
	Ross 208		Prelux-bro		Ross 208		Prelux-bro	
	females	males	females	males	females	males	females	males
L^*	73.19 ± 1.8	71.39 ± 2.1	71.26 ± 2.2	72.04 ± 2.3	73.47 ± 2.2	74.32 ± 1.1	72.95 ± 1.8	73.14 ± 3.2
a^*	1.13 ± 1.1	2.75 ±1.5	1.46 ± 1.1	1.50 ±1.5	1.59 ± 1.0	1.69 ± 1.7	1.31 ± 1.0	2.28 ± 1.3
b^*	15.62 ± 3.3	14.84 ± 4.1	16.39 ± 2.5	14.08 ± 4.4	12.67 ± 3.1	11.59 ± 3.1	10.82 ± 2.7	10.50 ± 1.8

The results given above show the lighter skin colour in ross males from confinement and the darker skin colour in prelux-bro females from free range. The higher mean redness value was observed in ross males from free range whereas the lower mean redness value was detected in ross females from free range.
The mean yellowness value was the highest in prelux-bro females from free range and the lowest in prelux-bro males which were raised indoors. The data in Table 2 represent the effects of the provenance, sex and keeping system on the breast skin colour values.

Table 2. The effects of provenance, sex and keeping system on the breast skin colour values

	P- values		
Effect	L^* value (lightness)	a^* value (redness)	B^* value (yellowness)
Provenance	0.0741	0.6891	0.3848
Keeping system	0.0072	0.7082	0.0001
Sex	0.9403	0.0086	0.0730

$P \geq 0.05$= non significant ; $P \leq 0.05$ = statistically significant; $P \leq 0.01$ = statistically significant; $P \leq 0.001$ = highly statistically significant

Analysis of variance showed that the provenance of the trial animals had no significant effect on lightness, redness and yellowness of the skin (Table 2). The keeping system had effect on breast skin yellowness and lightness while it did not have any effect on skin redness (Table 2). On the contrary to keeping system the sex influenced the redness of the breast skin colour but it did not exhibit any influence on skin lightness and yellowness (Table 2). Skin colour differences and their statistical significance are summarized in Table 3.

Table 3. Differences in skin colour between sexes, provenances and keeping systems

			LSM	Estimated difference ± SEE	P-values
L* (lightness)	sex	Females	72.82	0.04 ± 0.49	0.9403
		Males	72.79		
	provenance	Ross	73.25	0.88 ± 0.49	0.0741
		prelux-bro	72.36		
	keeping system	free range	72.13	1.34 ± 0.49	0.0072
		Indoors	73.48		
a* (redness)	sex	Females	1.30	0.79 ± 0.29	0.0086
		Males	2.09		
	provenance	Ross	1.76	0.12 ± 0.29	0.6891
		prelux-bro	1.64		
	keeping system	free range	1.64	0.11 ± 0.29	0.7082
		Indoors	1.75		
b* (yellowness)	sex	Females	13.94	1.24 ± 0.68	0.0730
		Males	12.71		
	provenance	Ross	13.62	0.59 ± 0.68	0.3848
		prelux-bro	13.03		
	keeping system	free range	15.19	3.73 ± 0.68	0.0001
		Indoors	11.46		

$P \geq 0.05$= non significant; $P \leq 0.05$ = statistically significant ; $P \leq 0.01$ = statistically significant;$P \leq 0.001$ = highly statistically significant; LSM = least square mean; SEE = standard error of the estimation

The b* values (yellowness) were significantly higher in broilers from free range when compared with those from confinement (Table 3).

Broilers reared on the pasture also showed lower lightness (L*) and lower redness (a*), but only values for lightness were significantly different from those measured in broilers reared indoors. These data are in conflict with the findings of Garcia et al. (1995) in which lower lightness and redness values of chicken thigh surfaces were found in indoor raised label chickens.

Studies performed by Ricard et al. (1986) and Bastiaens et al. (1991) cited by Remignon and Culioli (1995) also reported that the chemical or sensory characteristics of the meat are not affected by the growing conditions.

The differences in redness values between two sexes were confirmed statistically. Males had significantly higher redness values than females. The opposite situation was observed for the L* and b* values although in this case the differences were not statistically different.

Regarding breast skin colour we determined a higher L*, a* and b* values in ross broilers in comparison with the prelux-bro broilers but the differences between two provenances were not statistically reliable.

CONCLUSIONS

A comparison of breast skin colour of broilers from two keeping systems (indoors vs free range) turned out that the pastured birds had significantly higher pigmentation degree in yellowness. This may be connected with the raising under grass pasture conditions. There was a tendency that broilers kept indoors shown greater breast skin brightness than broilers raised on the pasture. Results of our study do not agree with the ones published by Garcia et al. (1995), Ricard (1986) and Bastiaens et al. (1991) cited by Remignon and Culioli (1995).

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