BODY WEIGHT, FLOCK UNIFORMITY AND EGG QUALITY OF FLOCKS REARED IN TWO DIFFERENT REARING SHEDS

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Summary

Birds from two flocks of commercial caged hens, of the same age but reared in different sheds, were weighed at the ages of 6, 15, 19, 26, 37, 50 and 60 weeks. Body weight increased with increasing hen age for both groups. Eggs were collected from the flocks at the ages of 19, 26, 37, 50 and 60 weeks. Cuticle cover was measured using MST cuticle stain and a hand-held Konica Minolta spectrophotometer. Cuticle cover increased as hens aged and was higher for rearing shed A. There were significant effects of hen age and shed for ΔE^*_{ab} which was higher for shed A than shed B indicating better cuticle cover for birds originating from shed A. Traditional egg quality measurements were determined using specialized equipment supplied by TSS UK. A significant effect was recorded for flock age for all egg quality measurements. With advancing hen age, egg weight, shell weight, yolk colour and shell thickness increased, whereas shell breaking strength, shell deformation decreased. Albumen height, Haugh Units and percentage shell decreased then increased at late lay. Egg shell quality and egg internal quality were better, overall, for birds reared in shed A than for birds reared in shed B, an indication that initial rearing conditions may have a persistent effect on bird performance.

I. INTRODUCTION

Deteriorating shell quality is still a big concern in commercial egg production. There are many factors that affect the overall quality of the egg. The age of hens is reported to influence egg weight and eggshell quality (Silversides and Scott, 2001; Van den Brand et al., 2004). Body weight uniformity is another factor that can influence overall egg quality. Parkinson et al. (2007) studied the influence of flock uniformity in several commercial layer farms and found that flocks studied had an average body weight 100-300 grams above the breed standard, which indicated obesity. These obese birds produced excessively large eggs which resulted in lower egg shell quality (Parkinson et al., 2007). The goal for flock uniformity is to have 80 per cent of the pullets within plus or minus 10 per cent of the average flock body weight. Flocks with high uniformity have been reported to reach peak egg production earlier and have higher peak production than flocks of low uniformity (Hudson et al., 2001; Kosbah et al., 2009). On the other hand, poor uniformity is associated with variation in the degree of sexual maturity of hens, where underweight pullets have delayed onset of egg production (Yuan et al., 1994). Productive and profitable layers begin with good quality pullets. Having the correct body weight at the start of egg production will enable pullets to achieve their genetic potential. Problems that develop during the growing period cannot be corrected after egg production begins.

II. MATERIALS AND METHODS

A total of 100 birds were weighed from each flock at different ages: 6, 9, 12, 15, 19, 26, 36, 50 and 60 weeks of age. Body weight uniformity was calculated.

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A total of 90 eggs were collected directly from the cage fronts of each flock at 26, 35, 50 and 60 weeks of age. Thirty eggs were processed for the amount of cuticle with MST cuticle blue stain. A hand-held Konica Minolta spectrophotometer (CM-2600d) was used to measure the cuticle colour. The colour of the eggshell cuticle, stained with MST cuticle blue dye was measured using the L*a*b colour space. L* has a maximum of 100 (white) and a minimum of 0 (black). Green is indicated by –a* and red by +a*. Blue is indicated by –b* and yellow by +b*. ΔE^*_{ab} was calculated as described by Leleu et al. (2011). Sixty eggs were used for determination of traditional egg shell quality measurements: shell reflectivity, egg weight, eggshell breaking strength, shell deformation, shell weight and shell thickness, using specialized equipment (Technical Services and Supply, TSS, UK). Egg internal was also measured in the form of albumen height, Haugh Units and yolk colour.

Data were analyzed using Statview Software (SAS Institute Inc., Version 5.0.1.0). A two way analysis of variance was conducted taking flock age and shed/flock as the independent variables and body weight, egg quality measurements, SCI a* after staining and single score (ΔE^*_{ab}) as dependent variables. Level of significance was indicated by probability of less than 5%. The Fishers PLSD test was used to differentiate between mean values

III. RESULTS

Between the flocks/sheds, body weight was not significantly different for all ages combined although body weight was lower for shed A until 26 weeks of age. However, body weight was significantly affected (P<0.0001) by hen age and there was a significant interaction between hen age and shed. Body weight increased with hen age. Body weight uniformity ranged from 70% to 87 % for shed A, and from 71% to 89% for shed B (Table 1).

Table 1 - Body weight and flocks uniformity

Flock Age	Body Weight (kg)		Flock Uniformity (%)	
(weeks)	Shed A	Shed B	Shed A	Shed B
6	$^{f}0.55 \pm 0.004$	$^{g}0.57 \pm 0.005$	75	76
15	$^{e}1.31 \pm 0.009$	$^{f}1.37 \pm 0.010$	87	84
19	$^{d}1.69 \pm 0.014$	$^{e}1.78 \pm 0.011$	80	89
26	$^{c}1.92 \pm 0.014$	$^{d}1.91 \pm 0.014$	82	86
37	$^{b}2.09 \pm 0.017$	$^{c}1.99 \pm 0.016$	78	78
50	$^{b}2.07 \pm 0.023$	$^{b}2.04 \pm 0.019$	70	79
60	$^{a}2.12 \pm 0.019$	$^{a}2.11 \pm 0.021$	72	71
PValue				
Age (A)	<0.0001		<0.0001	
Shed (S)	NS		NS	
A*S	<0.0001		<0.0001	

a,b,c,d,e,f,g Across a column, values with different superscripts are significantly different from each other. Values are Mean ± SE

There was a significant effect of hen age for L* which fluctuated with hen age. There was also a significant difference among age categories for a* after staining. Means values for a* increased, with the most negative values for shed A at 50 weeks and 37 weeks for shed B. A similar pattern was recorded for the ΔE^*_{ab} value (Table 2).

There was a significant main effect (P<0.0001) of hen age for all eggshell quality measurements. As hen age increased, shell reflectivity increased (varied between the sheds), egg weight increased, shell breaking strength and shell deformation decreased, shell weight increased, percentage shell decreased, shell thickness fluctuated, albumen height slightly decreased, Haugh Units fluctuated and yolk colour increased (Table 3).

Table 2 - Spectrophotometric measurements of stained cuticle

Measurement		19 wk	26 wk	37 wk	50 wk	60 wk	P Value
L	Shed A	$^{a}54.9 \pm 0.8$	$^{c}51.0 \pm 0.6$	$^{bc}52.8 \pm 0.5$	$^{a}54.8 \pm 0.8$	$^{ab}54.6 \pm 0.7$	0.0002
	Shed B	$^{b}52.9 \pm 1.0$	$^{b}55.0 \pm 0.6$	$^{b}52.96 \pm 0.8$	$^{a}57.7 \pm 1.1$	$^{b}54.2 \pm 0.8$	0.001
a	Shed A	$^{a}4.4 \pm 1.2$	$^{b}-0.8 \pm 0.9$	$^{bc}-1.3 \pm 0.9$	$^{c}-3.8 \pm 1.1$	$^{bc}-1.9 \pm 0.9$	<0.0001
	Shed B	$^{a}3.3 \pm 1.1$	$^{ab}1.4 \pm 1.0$	$^{c}-1.6 \pm 0.8$	$^{bc}-0.8 \pm 1.1$	$^{bc}-0.3 \pm 0.8$	0.003
ΔE^*_{ab}	Shed A	$^{b}16.9 \pm 1.2$	$^{a}21.6 \pm 1.0$	$^{a}21.5 \pm 1.0$	$^{a}22.6 \pm 1.2$	$^{a}21.0 \pm 1.0$	0.003
	Shed B	$^{b}17.6 \pm 1.2$	$^{b}17.8 \pm 1.0$	$^{a}21.9 \pm 1.0$	$^{b}18.5 \pm 1.3$	$^{ab}19.8 \pm 0.9$	0.038

^{a,b,c} Across a row, values with different superscripts are significantly different from each other. Values are Mean ± SE

Table 3 - Traditional measures of eggshell quality

Measurement		19 wk	26 wk	37 wk	50 wk	60 wk	P Value Age	P Value Shed	P Value A*S
Translucency score	A	2.6 ±0.12	2.6 ± 0.08	2.7 ± 0.09	2.1 ± 0.11	2.7 ± 0.11	<.0001	NS	NS
	B	2.7 ± 0.11	2.7 ± 0.08	2.9 ± 0.10	2.1 ± 0.09	2.8 ± 0.13			
Reflect (%)	A	29.1 ± 0.5	26.5 ± 0.3	27.1 ± 0.4	29.0 ±0.5	27.9 ± 0.4	<.0001	.0025	<.0001
	B	27.7 ± 0.4	27.3 ± 0.4	30.8 ± 0.6	29.7 ± 0.5	28.6 ± 0.5			
Egg wt (g)	A	49.5 ±0.5	59.5 ± 0.4	62.9 ±0.5	63.4 ±0.4	65.9 ±0.5	<.0001	.0001	<.0001
	B	51.4 ±0.5	57.8 ±0.5	59.4 ± 0.5	62.7 ± 0.5	63.8 ± 0.7			
BSN (N)	A	45.5 ± 0.9	43.7 ± 0.7	41.7 ±0.8	40.8 ±0.9	41.6 ±1.0	<.0001	NS	NS
	B	45.6 ±0.7	44.1 ±0.7	40.0 ± 0.9	39.7 ± 0.8	40.7 ± 1.0			
Def (µm)	A	311.2±2.97	280.8±3.5	287.3±4.7	259.3±4.2	258.0±4.0	<.0001	NS	NS
	B	311.2±2.97	288.7±3.4	280.5±4.6	248.5±4.3	255.3±4.3			
Shell wt (g)	A	4.94±0.05	5.78±0.04	6.07±0.06	6.09±0.06	6.17±0.08	<.0001	<.0001	.0050
	B	4.97±0.06	5.60±0.06	5.64±0.06	6.01±0.06	5.99±0.07			
Percentage shell (%)	A	10.0±0.10	9.7±0.07	9.6±0.06	9.6±0.08	9.4±0.09	<.0001	NS (.0668)	NS
	B	9.7±0.08	9.7±0.07	9.5±0.08	9.6±0.07	9.4±0.10			
Shell thick (µm)	A	398.2±3.1	413.0±2.6	398.2±2.8	409.9±3.7	409.2±3.6	<.0001	.0010	NS
	B	392.8±3.0	406.2±2.9	381.3±3.2	409.1±2.9	404.9±4.5			
Albumen Ht (mm)	A	10.9±0.1	9.6±0.1	9.2±0.2	9.2±0.2	9.4±0.2	<.0001	.0001	NS
	B	10.8±0.1	9.2±0.1	8.8±0.2	8.8±0.1	9.1± 0.1			
Haugh Unit	A	105.2±0.4	97.5±0.6	94.3±0.8	95.0±0.9	95.4±0.8	<.0001	.0059	NS
	B	104.1±0.5	96.1±0.5	93.4±0.9	93.0±0.7	94.6±0.7			
Yolk colour	A	10.5±0.13	11.2±0.08	11.4±0.08	11.7±0.10	11.7±0.10	<.0001	.0033	NS
	B	10.2±0.10	11.0±0.07	11.2±0.11	11.6±0.06	11.6±0.10			

There was a significant difference between the two shed groups for a number of egg quality measurements with birds reared in shed A having higher shell reflectivity, egg weight, shell weight, shell thickness and a tendency to higher percentage shell than birds reared in shed B. In addition, egg internal quality measures (albumen height, Haugh Units and yolk colour) were significantly higher for birds reared in shed A than for those reared in shed B.

IV. DISCUSSION

Body weight of all hens was close to the target body weight for HyLine Brown laying hens reared in an intensive production system. The highest uniformity was recorded at 15 week of age for shed A (87%) and at 19 week of age for shed B, (89%). The quality of a flock is judged by its uniformity. Haider and Chowdhury (2010) reported that the uniformity of commercial brown layer chicks (Shaver 579) at 8-17 weeks of age achieved an average of 84% which was higher than minimum standards (80%) provided by the Shaver 570 Management guide. Having the correct body weight at the start of egg production will enable pullets to achieve their genetic potential. Uniform flocks with the correct body weight give several benefits: birds are managed in a large group and management changes (lighting, feeding and housing) can be more easily instituted (Kosbah et al., 2009).

For the cuticle colour, the L* value increased with the age of flock indicating a lightening of shell colour with age. However, it decreased slightly when hens reached 60 week of age for reasons that are not clear. For the a* value, the more negative value at 37 and 50 weeks of age for shed B and shed A, respectively, was due to a greener colour which indicated more cuticle on the shell. There was a similar pattern for the ΔE^*_{ab} value which has been shown to be a reliable indicator of the extent of staining of the cuticle (Leleu et al., 2011). The cuticle is in direct contact with the outside environment, therefore represents the first line of defense against a harsh environment, including bacteria.

Age has an important effect on egg shell and internal quality. With increasing hen age, egg weight, shell weight and yolk colour increased. On the other hand, shell breaking strength, shell deformation, percentage shell and albumen height decreased, which is in agreement with previous studies (Robert and Chousalkar, 2012; Van Den Brand et al., 2004). A particularly interesting finding of the present study was that shell quality and egg internal quality of birds reared in shed A was consistently higher by most indicators than for birds reared in shed B. The notable exceptions were shell breaking strength and shell deformation, which were not different between birds from the two rearing sheds.

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REFERENCES

Haider S & Chowdhury SD (2010) *Bangladesh Journal of Animal Science* **39:** 170-175.

Hudson BP, Lien RJ & Hess JB (2001) *Journal of Applied Poultry Research* **10:** 24-32.

Kosba MA, Zeweil HS, Ahmed MH, Shabara SM & Debes AA (2009) *Egyptian Poultry Science* **29:** 1157-1171.

Leleu A, Messens W, De Reu K, De Preter S, Herman L, Heyndrickx M, De Baerdemaeker J, Michiels CW & Bain M (2011) *Journal of Food Protection* **74:** 1649-1654.

Parkinson G, Cransberg P & Fadavi-Firooz R (2007) *An EPRID report for the Australian Egg Corporation Limited.*

Robert JR & Chousalkar KK (2012) *Australian Poultry Science Symposium* **23:** 241-244.

van den Brand H, Parmentier HK & Kemp B (2004) *British Poultry Science* **45:** 745-752.

Yuan T, Lien RJ & Daniel GRMC (1994) *Poultry Science* **73:** 792-800.