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COMPARATIVE PERFORMANCE AND EGG QUALITY OF LAYING HENS IN ENRICHED CAGES AND FREE-RANGE SYSTEMS

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Abstract

Enriched battery cages and free-range as an alternative raising systems are intended to improve welfare of hens. Comparison of the productivity performance and egg quality of laying hens housed in two different systems regarding the welfare of laying hens was the objective of the study. A totally, eight hundred 19-wk-old Lohmann Brown hens were housed in enriched cages (n=400; 16 cages; 25 hens per cage) and in free-range system (n=400) to 50 wk of age. Hen-day egg production, feed intake, feed efficiency were measured at 30, 40 and 50 wk. In both rearing systems, eggs were recorded for 2-wk intervals between 30 and 50 wk of age to measure egg quality parameters. Hen-egg production was significantly higher in enriched cages than free range system throughout the experiment (P<0.05). Hens raised in free-range system had greater egg weight, egg shell thickness and dirty eggs than in enriched cages (P<0.05). In addition, the feed intake and feed efficiency were higher in the free-range raising system than in the enriched cages at 30 wk. However, the heights and width of egg albumen and yolk were not affected by the raising systems (P>0.05). Based on the results the interior egg quality parameters appear to have similar for hens kept in both rearing systems. However, the higher proportion of dirty eggs for hens raised in free-range system was the greatest problem and still needs to be considered.

Key words*: enriched cages, free-range, egg quality, performance, laying hens.*

INTRODUCTION

After the ban decision on conventional cages in the European Union by 2012 (CEC, 1999) various alternative housing systems such as aviaries, floor husbandry, free-range and enriched (furnished) cages have been approved. Egg production system is probably one of the most important challenges for the egg producing industry in the last decade.

There are various factors including diseases, behavior, nutritional value, genetics and air conditions in house affecting the level of welfare laying hens. Traditional (conventional) battery cages are not sufficiently for allowing hens behaviour, new rearing systems including free cage rearing offer hens a significantly improved level of animal welfare than do conventional battery cage systems (Duncan, 1998; Duncan, 2004).

The use of enriched cages and free-range housing systems have received a considerable attention raises on hens well-being among the other alternative systems.

Battery cages have many disadvantages for welfare including behaviour, but also some benefits such as resulting in a low level aggression and cannibalism (Appleby, 1998) and maintaining a small group size, hygiene and animal health conditions (Rodenburg et al., 2005)

Differences between the alternative raising systems may affect the welfare, health and hygiene and resulting in the performance and egg quality parameters.

The aim of the present study was to evaluate the differences in laying hens performance and internal and external egg quality for laying hens kept in enriched cages and free-range systems.

MATERIALS AND METHODS

A totally eight hundred 19-wk-old Lohmann Brown hens were housed in enriched cages (n=400; 16 cages; 25 hens per cage) and in free-range system (n=400) to 50 wk of age. The enriched cages (120 x 55 x 45; length × width × height) had wire floors and solid metal walls. In fee-range system, hens were housed in a stocking density with six hens per m^2 door and 0.2 hens per m^2 of range area.

Both groups of hens were fed a commercial feed containing 17.5 % CP, 2750 kcal ME/kg, 3.5 % Ca and 0.85% available P. Thought the experiment lights were on a 16L:8D schedule, from 07:00 to 2300 h. Feed intake, feed efficiency were measured at 30, 40 and 50 wk. In both rearing systems, eggs were recorded for 2-wk intervals between 30 and 50 wk of age to measure egg quality parameters. Body weight and feed intake and feed efficiency were determined each week during the all period of experiment. Egg production per group, per-cage-hen-day production and quality parameters were 30, 40 and 50 weeks of age on the random sample of 30 eggs per treatment.

Statistical analysis was performed using the mixed model and *t*-test procedure of SPSS 15.0. Tukey's test was used to separate group means. A significant difference was at $P < 0.05$.

RESULTS AND DISCUSSIONS

Housing system has an important influence on the performance (Anderson and Adams, 1994; Moorthy et al., 2000), welfare (Stojcic et al., 2012) and for the productive performance of laying hens (Mugnai et al. 2009).

Egg production, feed intake and feed efficiency results were presented in Table 1. Feed efficiency was lower in the hens kept in the enriched cages compared with those reared in the free-range system at 30 wk of age ($P<0.05$). Previous studies showed that housing system of hens had significant effect on hen egg production (Flock et al., 2002; Stojcic et al., 2012). In present study, hen-egg production was significantly higher in enriched cages than free range system throughout the experiment ($P<0.05$).On the other hand, Roll et al. (2009) showed no difference in egg production between laying hens kept in conventional cages and in floor pens. Rearing system did not affect the feed consumption of laying hens at 30 and 40 wk of age ($P>0.05$). However, hens in enriched cage system consumed significantly lower feed than hens in free-range system at 50 wk of age ($P<0.05$)

Hens raised in free-range system had greater egg weight than in enriched cages ($P<0.05$) (Table 2) in the third period (30, 40 and 50 wk of age). Besides, egg weight increased over time at 30, 40 and 50 wk of age in both rearing systems. Similarly, Singh et al (2009) also found greater egg weights in floor pens than in conventional cages. In contrast to our findings, Yakabu et al. (2007) reported that eggs from floor pens were lighter than those from conventional cages.

Significant influence of rearing system was obtained on egg shape index at 30 wk of age, on egg shell thickness throughout the experiment ($P<0.05$). However, the shape index did not differ between two rearing systems at 40 and 50 wk of age ($P>0.05$). The thickest egg shell was recorded in eggs from hens reared in free-range at 40 and 50 wk of age ($P<0.05$).

Mortality is a main indicator of poor welfare, management and other housing conditions. Tauson and Abrahamsson (1999) reported that a greater mortality of hens kept floor pens than cages. Contrary, in our study mortality during the rearing period in enriched cages was higher than free-range housing system (7.8 % for enriched cages and 5.4 % for free range).

Egg quality is important for the economic success of a producer and also consumer appeal (Singh et al. 2009). Egg quality may be influenced by several factors including housing regimen and nutritional values. The overall egg internal quality parameters (albumen height, width and yolk height, width) were not significantly ($P>0.05$) different between the 2 rearing systems (Table 3).

Table 1. Effect of rearing (enriched cage and free-range) systems on egg production and performance of laying hens

Period	Hen-egg production (%)		Feed consumption (g/hen per d)		Feed efficiency (g of feed/g of egg)	
	Enriched	Free-range	Enriched	Free-range	Enriched	Free-range
Wk 30	91.6^{a}±1.12	87.4^{b}±1.22	103.7±0.47	107.6±0.44	2.15^{b}±0.06	2.20^{a}±0.09
Wk 40	94.0^{a}±1.36	90.3^{b}±1.10	115.2±0.38	118.4±0.46	2.08±0.03	2.10±0.06
Wk 50	91.1^{a}±1.22	88.6^{b}±1.31	118.6^{b}±0.40	124.7^{a}±0.39	2.12±0.04	2.14±0.05

^{a,b}Means± SE within each period with different superscript letters are significantly different ($P < 0.05$).

Table 2. Weight, shape index, shell weight and shell thickness of eggs of laying hens in enriched cages and free-range systems

Period	Egg weight (g)		Shape index		Shell weight (g)		Shell thickness (mm)	
	Enriched	Free-range	Enriched	Free-range	Enriched	Free-range	Enriched	Free-range
Wk 30	56.2^{b}±0.31	59.8^{a}±0.23	76.0^{b}±1.11	77.5^{a}±0.22	6.3±0.09	7.5a±0.09	0.30±0.005	0.33±0.004
Wk 40	60.1^{b}±0.47	62.8^{a}±1.03	77.3±0.24	76.9±0.35	6.7±0.09	7.0±0.09	0.27^{b}±0.004	0.31^{a}±0.003
Wk 50	62.1^{b}±0.32	64.0^{a}±0.47	77.2±0.27	76.7±0.38	7.1±0.08	7.4±0.11	0.26^{b}±0.003	0.29^{a}±0.004

^{a,b}Means± SE within each period with different superscript letters are significantly different ($P < 0.05$).

Table 3. Albumen height and width, yolk height and width of eggs of laying hens in enriched cages and free-range systems

Period	Albumen height (mm)		Albumen width (cm)		Yolk height (mm)		Yolk width (mm)	
	Enriched	Free-range	Enriched	Free-range	Enriched	Free-range	Enriched	Free-range
Wk 30	8.2±0.14	8.0±0.16	7.6±0.13	7.4±0.12	18.4±0.09	18.4±0.12	41.0±0.24	42.2±0.22
Wk 40	8.0±0.18	8.2±0.14	7.6±0.22	7.4±0.19	18.6±0.11	18.5±0.09	42.1±0.13	41.3±0.15
Wk 50	8.4±0.22	8.5±0.18	7.3±0.08	7.2±0.09	18.6±0.10	18.7±0.10	40.9±0.22	40.3±0.23

^{a,b}Means± SE within each period with different superscript letters are significantly different ($P < 0.05$).

The influence of rearing systems differed dirty eggs and cracked eggs (Table 4).

Table 4. Cracked and dirty eggs of laying hens in enriched cages and free-range systems

Period	Cracked eggs (%)		Dirty eggs (%)	
	Enriched	Free-range	Enriched	Free-range
Wk 30	0.35±0.02	0.40±0.03	2.59^{b}±0.11	5.33^{a}±0.18
Wk 40	0.54^{a}±0.04	0.78^{a}±0.06	2.04^{b}±0.13	6.72^{a}±0.17
Wk 50	1.12^{a}±0.09	0.86^{b}±0.06	1.88^{b}±0.09	8.41^{a}±0.22

In our study proportions of dirty eggs were significantly higher in the free-range system than enriched cage system (P<0.05). However, no significant differences were found in interior egg quality traits between keeping systems (P>0.05). A similar housing effect was found by Abrahamsson and Tauson, (2005). Besides, the percentage of cracked eggs was influenced by rearing system and increased with age (P<0.05). The highest percentage of cracked eggs was observed in free-range systems (P<0.05).

CONCLUSIONS

Based on the results the interior egg quality parameters appear to have similar for hens kept in both rearing systems. However, the higher proportion of dirty eggs for hens raised in free-range system was the greatest problem and still needs to be considered.

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REFERENCES

Abrahamsson P., Tauson, R., 1995. Aviary systems and conventional cages for laying hens: Effects on production, egg quality, health and bird location in three hybrids. Acta Agriculturae Scandinavica A-Animal Sciences, 45(3): 191-203.

Anderson K.E., Adams A.W., 1994. Effects of floor versus cage rearing and feeder space on growth, long bone development, and duration of tonic immobility in single comb White Leghorn pullets. Poultry Science 73:958-964.

Appleby M.C., 1998. Modification of laying hen cages to improve behaviour.Poultry Science, 77(12): 1828-1832.

Duncan I.J., 1998. Thirty years of progress in animal welfare science. Journal of Applied Animal Welfare Science. 1: 151-154.

Duncan I.J., 2004. Welfare problems of poultry. The well-being of farm animals: Challenges and solutions, 307-323.

Flock D.K., Heil G., 2002. A long-term analysis of time trends in the performance profile of white-egg and brown-egg hybrid laying strains based on results of official German random sample tests from 1974/75 to 1997/99.Archiv fur Geflugelkunde, 66(1):1-20.

Moorthy M., Sundaresan K., Viswanathan K., 2000. Effect of feed and system of management on egg quality parameters of commercial white leghorn layers. Indian Veterinary Journal 77:233-236.

Mugnai C., Dal Bosco A., Castellini C., 2009. Effect of rearing system and season on the performance and egg characteristics of Ancona laying hens. Italian Journal of Animal Science, 8(2):175-188.

Rodenburg T.B., Tuyttens F.A., Sonck B., De Reu K., Herman L., Zoons J., 2005. Welfare, health, and hygiene of laying hens housed in furnished cages and in alternative housing systems. Journal of Applied Animal Welfare Science, 8(3):11-226.

Roll V.F.B., Briz R.C., Levrino G.A.M., 2009. Floor versus cage rearing: effects on production, egg quality and physical condition of laying hens housed in furnished cages. Ciência Rural, 39(5): 1527-1532.

Singh R., Cheng K.M., Silversides F.G., 2009. Production performance and egg quality of four strains of laying hens kept in conventional cages and floor pens. Poultry Science, 88(2): 256-264.

Stojčić M.D., Perić L., Milošević N., Rodić V., Glamočić D., Škrbić Z., Lukić M., 2012. Effect of genotype and housing system on egg production, egg quality and welfare of laying hens. Journal of Food, Agriculture & Environment, 10(2):556-559.

Tauson R.A.W., P. Abrahamsson, 1999. Effect of two floorhousing systems and cages on health, production, and fear response in layers. Journal of Applied Poultry Research. 8: 152 – 159.

Yakubu A., Salako A.E., Ige A.O., 2007. Effects of genotype and housing system on the laying performance of chickens in different seasons in the semi-humid tropics. International Journal of Poultry Science, 6(6):434-439.