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EFFECT OF POULTRY HOUSING SYSTEMS ON EGG PRODUCTION

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Abstract

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An industrial experiment with *ISA-Brown* commercial layers was carried out during the laying period (from 18 to 76 weeks of age) in 2009/2010 at the poultry complex „Eggs and Chickens - Zora" JSC – Donchevo. The layers were reared under three poultry management systems: in conventional cages type *BKN-3* – 66 300 layers distributed equally in five poultry houses; in enriched cages type *Eurovent 1500-EU-60* – 123 430 layers distributed equally in two poultry houses; and in barn with slat flooring with manure pit and deep litter – 30 000 layers distributed equally in four poultry houses.

The results showed that for the whole laying period the layers kept in conventional cages exhibited an average egg laying capacity of 336.1 eggs per hen, the egg laying capacity was over 90 % from 25 to 50 weeks of age, the mortality was the lowest - 5.35 % and feed conversion ratio per egg was the highest - 155.9 g. The layers kept in enriched cages gave the highest yield of eggs from a hen - 339.2, the egg laying capacity was over 90 % from 26 to 59 weeks of age, the mortality was 7.96 % and feed conversion ratio per egg was the lowest - 150.1 g. The layers reared in the floor/litter system l were characterized with the lowest yield of eggs per hen - 330.5 eggs, the egg laying capacity was over 90 % from 26 to 61 weeks of age, the mortality was the highest - 9.43 % and feed conversion ratio per egg was 151 g.

Key words: layers, laying hen, poultry housing system, egg laying capacity

Introduction

Since the publication of Ruth Harrison's book "Animal Machines" in 1964, there has been widespread public pressure in Europe - supported by European institutions - to "ban the battery cage". By 1970, most hens kept for egg production in the developed world were housed in conventional laying cages, often called battery cages. According to animal welfare activists, the conventional cages cause many welfare problems (Craig and Adams, 1984; Appleby, 2003). They compromise most or all of the independent Farm Animal Welfare Council's five freedoms - freedom from hunger and thirst; from discomfort; from pain, injury, and disease; to express normal behaviour; and from fear and distress (Webster and Nicol, 1988). Baxter (1994) commented that "Concern over the welfare of caged hens arises in two general areas: first that the barren environment within a cage prevents the performance of hens' natural behaviour patterns and, secondly, that the small amount of space in a cage imposes severe restrictions on hens' general freedom of movement".

According to Appleby and Hughes (1991) the impetus to investigate alternative systems for egg production has arisen because of the public perception that cages are deleterious to poultry welfare. The rationale for housing hens in alternative systems is to provide them with increased freedom of movement, the ability

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to express a wide range of behaviour patterns, a more appropriate type of nest site and access to substrate for ground scratching and dust bathing. However, cages also have positive effects on welfare in that they provide a clean, disease-free environment and small group sizes. The balance of these advantages and disadvantages has been assessed differently by different authors. For example, Craig and Adams (1984) considered that in high-density cages welfare suffered compared with low-density cages or floor systems, whereas Hill (1986) concluded physical measures of welfare were marginally worse in alternative systems. Laying cages are still the most economic way to produce eggs and the best system for disease prevention (Hulzebosch, 2006). Cannibalism is rare in battery cages, even among birds with untrimmed beaks, but it must be noted that beak trimming of pullets who will be housed in cages when mature is nevertheless usual, partly to reduce feather pecking (Appleby, 2003).

The European Union (EU) and national governments (particularly in Northern Europe) funded research on noncage systems for egg production and enriched cages. (Wegner, 1990; Horne and Achterbosch, 2008).

On June 15, 1999, the new European Union (EU) Directive on welfare of laying hens was promulgated, which requires conventional laying cages to be phased out by 2012 (CEC, 1999). This Directive 1999/74/EC has encouraged technical changes in current systems. Not only have traditional cages been modified (so-called 'enriched cages'), but also new alternative systems (e.g. aviaries) have been developed. There is an ongoing need to evaluate the actual welfare status of hens in these novel systems including those on commercial farms (Blokhuis et al., 2007)

The aim of this research is to investigate the egg production of laying hens reared in three types of poultry management systems.

Material and Methods

An industrial experiment with *ISA-Brown* commercial layers from 18 to 76 weeks of age in the biggest Bulgarian poultry complex „Eggs and Chickens - Zora" JSC-Donchevo, region Dobrich was carried out in 2009/2010.

The laying hens were reared in three types of poultry housing systems: conventional cages, furnished/enriched cages and slat flooring with manure pit.

Moving of the pullets from sector "growing chickens" to sector "laying hens" took place at 16 weeks of age during the pre-layer period.

Rearing in conventional cages

The experiment was carried out with 66,300 layers distributed equally in five poultry houses. A conventional colony system from the type *BKN-3* (three-tiers) was used. In the each cage four layers were housed with useful area of 550 cm^2/ hen.

Rearing in furnished/enriched cages

The experiment was carried out with 123,430 layers distributed equally in two poultry houses. Furnished/enriched cages – *Eurovent 1500-EU-60* manufactured by Big Dutchman International GmbH, were used. The enriched colony systems comprised eight tier cages. The group size was 60 layers per compartment. The surface of the compartment was 45 225 cm^2 i.e. 750 cm^2 colony surface /hen and 600 cm^2 usable area /hen.

Rearing in barn - slat flooring with manure pit and deep litter (floor/litter)

The experiment was carried out with 30,000 layers distributed equally in four poultry houses. Big Dutchman International GmbH made the equipment. The slat flooring with manure pit covered with solid plastic occupied 2/3 of the total housing surface and the other 1/3 was the litter. Stocking density was 9 hens per 1 m^2.

In the three poultry housing systems, microclimatic monitoring data about the temperature, relative humidity, gas composition and ventilation at 8.00 AM and 2.00 PM were recorded in the reporting card. Nipple drinkers supplied layers with water.

The layers kept in the three farming systems were fed with the same type of compound feed corresponding to the age and physiological condition (Table 1). The amount of feed was determined according to the age and laying capacity of hens in order to simultaneously satisfy their needs and not to leave excess feed.

During the study, the following indices were determined:

• Laying capacity weekly, % $I_{egg} = \frac{N_{egg}}{7.N_{hens.}}.100$

- *where* N_{egg} *are eggs produced per week,* N_{hens} *num-*

ber of laying hens
- Egg weight, g - *Range of egg weight grading was made on the MOBA 2500*
- Feed conversion ratio per egg, g
- Livability of the layers, %

Results and Discussion

Egg laying capacity

For the whole production period of 58 weeks, the average egg laying capacity of the layers kept in conventional cages, in enriched cages and in barn on slat flooring with manure pit and deep litter was 336.1 eggs, 339.2 eggs and 330.5 eggs respectively. The difference between the egg productivity was small between both cage systems – by 0.92 % higher in enriched cages. The egg productivity of layers reared in barn was lower by 1.67 % and by 2.56 % than those, kept in conventional and enriched cages.

The layers kept in conventional cages reached over 90 % egg laying capacity at 24 weeks of age – 90.8 %, which was preserved until 50 weeks of age. The layers reached peak egg laying capacity at 35 weeks of age (94.5 %). At the end of the laying period the egg, laying capacity decreased to 74.1% (Figure 1).

The layers kept in furnished cages had over 90 % from 26 weeks of age (93.6 %), to 59 weeks of age. The peak egg laying capacity was reached at 37 weeks of age – 94.3 %. At the end of the laying period, the egg laying capacity decreased to 78.7 %.

The layers reared on slat flooring with manure pit and deep litter had over 90 % egg laying capacity from 26to 61 weeks of age. The layers gained peak egg laying capacity at 36 weeks of age – 95.9 %. At the 76 weeks of age, the egg laying capacity decreased to 81.1 %.

The laying hens reared in the three types of poultry management systems did not reach 50 % intensity of egg laying at 144days of age, as recommended for ISA Brown commercial layers, but from 30 weeks of age to the end of the production period, their egg laying capacity was higher.

The increase in egg weight from 18 to 33 weeks of age is presented on Figure 2. The highest weight of eggs was observed in layers kept in enriched cages (58.10 g), followed by those kept in conventional cages (56.42 g)

Table 1
Composition of diets, %

Ingredients	Laying period	
	First phase 18-50 weeks *(3-3-x)*	Second phase 51-76 weeks *(3-4-x)*
Wheat	30.00	31.96
Yellow corn	29.74	16.00
Wheat bran	-	16.00
Soybean meal - 44%	11.50	7.00
Sunflower meal - 33%	9.20	17.70
Limestone	9.30	8.90
Dicalcium phosphate	0.11	0.75
Sodium chloride	0.22	0.22
Sodium bicarbonate	-	0.17
DL-Methionine	0.13	0.06
L- Lysine	-	0.06
Sunflower oil	2.30	0.90
Vitamin-mineral premix	-	0.25
Orego-stim	-	0.03
Bioconcentrate Lay	7.50	-
Total	100.00	100.00
Calculated composition		
Metabolizable energy, MJ/kg	11.49	10.46
Crude protein, %	17.60	16.70
Crude fibre, %	4.40	5.00
Lysine, %	0.89	0.75
Methionine + Cystine , %	0.75	0.68
Tryptophan, %	0.16	0.19
Calcium, %	3.58	3.57
Phosphorus availability , %	0.40	0.36

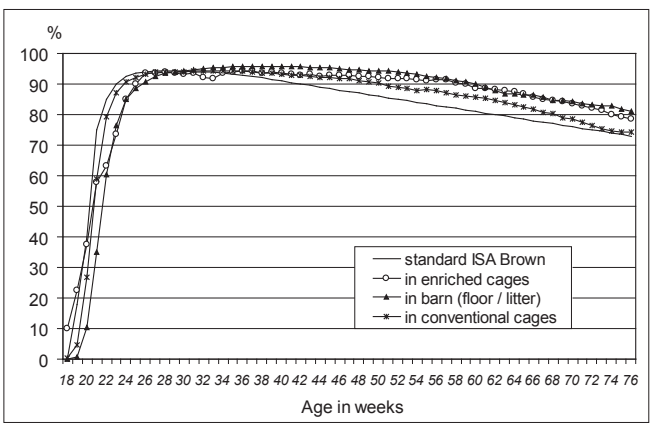

Fig. 1. Laying capacity, %

and finally, in a barn poultry system (55.5 g). Laying hens reared in the three poultry management systems had a higher weight of eggs compared with the recommendation for ISA Brown commercial layers. The average egg weights in birds from three farming systems were identical at the end of 33rd week of age - 61 g.

Feed consumption

For the entire laying period, the best-feed conversion ratio was observed in layers reared in enriched cages and on slat flooring with manure pit and deep litter – 150.1 g and 151 g respectively. The feed conversion ratio in layers kept in conventional cages was 155.9 g i.e. by 3.86 % and by 3.25 % lower versus other both poultry housing systems. The average feed consumption per day was 118.8 g, 121.1 g and 120.7 g for the layers reared in conventional cages, enriched cages and in floor/litter system (Figure 3).

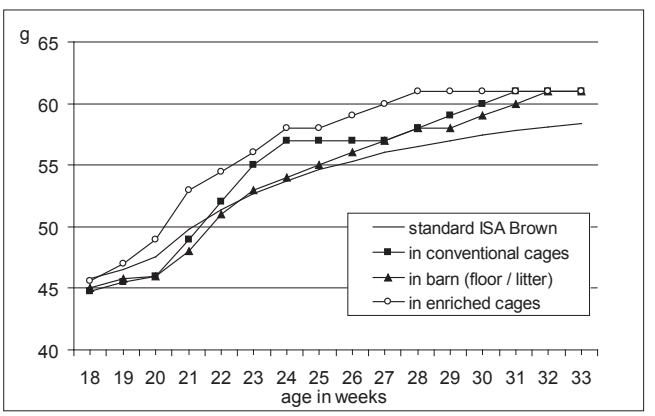

Fig. 2. Egg weight, g

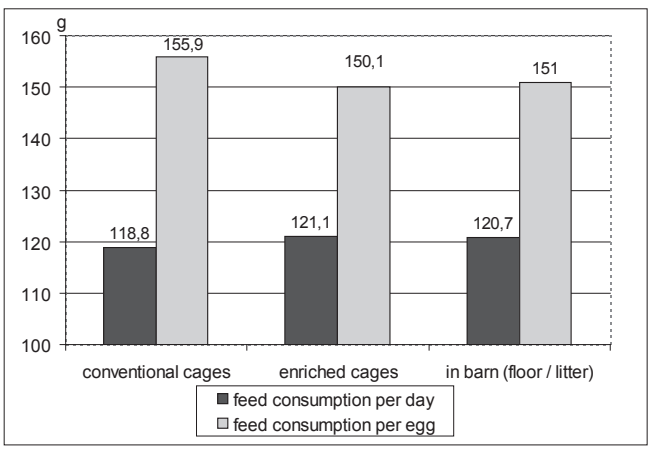

Fig. 3. Feed consumption

Livability of the layers

In the three types of poultry management systems, the layers began to lie at 18 weeks of age. For the laying period from 18 to 76 weeks of age the mortality of layers kept in conventional cages was the lowest - 5.35 %, followed by those in enriched cages – 7.96 % and the highest in slat flooring with manure pit and deep litter – 9.43 %. The changes in weekly mortality are presented in Figure 4. The highest mortality was recorded in the beginning except for the layers kept in the conventional cages, and by the end of laying period. Significantly, higher mortality was observed in the layers reared in slat flooring with manure pit and deep litter in the first weeks of production period (18 – 26 weeks of age). In our opinion, this is probably due to the frequent contact between unfamiliar fowl and emerging hierarchical struggles and relationships, as well as the grouping of layers in the common nests and suffocation in the beginning of laying period.

Pecking is a serious problem, could lead to deep wounds, severe tissue damages, blood loss, and increased mortality. Kreienbrock et al. (2004) reported higher mortality rates and lower production in this type of traditional floor system compared to conventional cages. According to Tauson and Holm (2001), as regards plumage condition, bumble-foot syndrome on the footpads and pecking wounds on the skin and comb, these traits were also inferior to the results in the furnished cage. On the other hand, being one of the first systems alternatives to cages, the single-tier litter floor system with partly slatted floor is still among the com-

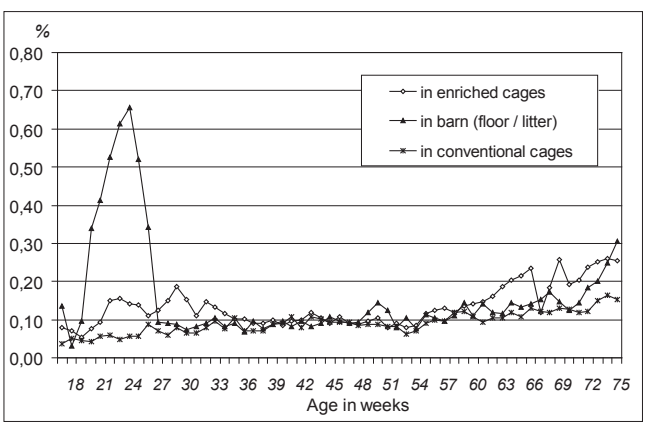

Fig. 4. Mortality, %

monest for keeping hens on litter. Providing plenty of space to perform a wide range of behaviour repertoires and strong skeletal bones, this system offers birds good conditions (Tauson, 2005).

Conclusion

The results showed that for the laying period from 18 to 76 weeks of age the average egg laying capacity of the layers kept in conventional cages, in enriched cages and in barn on slat flooring with manure pit and deep litter was 336.1 eggs, 339.2 eggs and 330.5 eggs per hen respectively, the mortality was 5.35 %, 7.96 % and 9.43 %, while the feed consumption per egg was 155.9 g, 150.1 g and 151 g respectively.

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