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GROWTH PERFORMANCE, CARCASS TRAITS AND SOME BLOOD PARAMETERS OF BROILER CHICKS AS AFFECTED BY HOUSING SYSTEM

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ABSTRACT: This current investigation was conducted to evaluate the potential effects of housing system (battery cages versus litter floor) on growth performance, some blood parameters and carcass characteristics of broilers. A total number of 224 unsexed one day old Evian broiler chicks were randomly distributed into two treatment groups (112 per each group). Chicks of the 1st group were raised in cages, while those of the second one were raised on litter floor. The results of the present work could be summarize as follows: broilers reared on litter floor exceeded (P≤0.05 and 0.01) those kept in battery cages in each of body weight, daily body weight gain and feed consumption in most of the studied intervals. Each of feed conversion ratio, carcass characteristics, some blood parameters and some immunity agents were not significantly changed between broilers kept in batteries and those reared on litter floor. The present work revealed a better performance and an increase in carcass yield of birds reared on floor system, which could be recommended to increase broilers performance under Sharkia Governorate conditions.

Key words: Housing system, growth performance, carcass, broiler.

INTRODUCTION

Broiler farming is widely adopted in Egypt for its nutritive and economical values. Housing and management of broilers are mainly aimed at providing the conditions that ensure optimum performance of the birds (Hameed *et al*., 2012). Broiler housing system is a crucial factor affecting bird's comfort, health and production efficiency (Bilal *et al*., 2014; Fu *et al*., 2015; El-Sheikh *et al*., 2016). Majority of the broiler producers in Egypt, if not all, engage deep litter housing for rearing. Various management systems of intensive poultry housing (battery cage and litter floor system) have been investigated in the literature (El-Sagheer *et al*., 2012; Shields and Greger, 2013; Lamidi, 2014; El-Sheikh *et al*., 2016). Deep litter housing is durable, permits higher evaporation of moisture, easily changed periodically for birds' comfort, there is economy space and it can be used as manure in the field (Lamidi, 2014).

Although cages for broiler chicken production have been available for many years, but they were not widely adopted because heavy broiler chickens are prone to leg deformities, breast blisters and other skin imperfections such as enlarged feather follicles due to abrasion against the wire cage floor (Shields and Greger, 2013). The later authors added that in the United States, broiler chickens are grown until they reach approximately 2.5 kg, but in hot climate countries such Egypt, broilers are grown to a market weight of just 1.5 kg. So, breast blisters are not as problematic in chickens grown to a lighter weight.

Cage system is highly efficient and economical for broilers (Zulkifli and Khatijah, 1998 ; El-Sagheer *et al*., 2012). It is expected that the cage system will provide more hygienic conditions than the floor one (Al-Bahouh *et al*., 2012). In countries, where laws prohibit the use of battery cages, a number of alternative housing systems have been used such as floor rearing systems,

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furnished cages and aviary systems (Mota-Rojas *et al*., 2008).

Many researches conducted on productivity of broiler chickens in battery cages showed different results. Some studies cleared that floor reared broilers have significantly higher growth rates and heavier final body weights as compared to cage reared groups (Tolon and Yalcin, 1997 ; Fouad *et al*., 2008), while other authors found no significant difference in weight gain (Sogunle *et al*., 2008 ; Swain *et al*., 2002).

So, the objective of the present investigation is to examine the effects of housing system (battery cages versus litter floor) on growth performance, carcass characteristics, some of blood parameters and immunity agents of broiler chicks under Sharkia Governorate conditions.

MATERIALS AND METHODS

The present experiment was carried out at a Private Poultry Farm, Sharkia Governorate, Egypt. A total number of 224 unsexed one day old Evian broiler chicks were randomly distributed into two treatment groups (112 per each) to evaluate the influence of housing system (battery cages versus litter floor) on growth performance, some blood parameters, and carcass characteristics of Evian broiler chicks under Sharkia Governorate conditions.

The birds were received starter diet till three weeks of the age; finisher diet from the fourth to sixth weeks of the age. The basal experimental diets (starter and finisher) were formulated based on the NRC (1994) requirements for broilers (Table 1) and were iso-nitrogenous during the experimental period (1-6 weeks of age). All chicks were wing-banded and had free access to fresh drinking water (according to the housing system). Chicks were provided with feed and water for ad-*libitum* consumption and stocking density was 10 birds/m^2.

All chicks in each group were kept under similar conditions of environmental and hygienic management even under battery or floor systems. Artificial light source was used, giving a total of 23L: 1D hours of light per day throughout the experimental period. Gas heaters were used to provide chicks with needed heat for brooding, where room temperature was about 32^{o}C for the first three days and then decreased 3^{o}C daily until reaching 24^{o}C thereafter to the normal temperature. Electric fans were used to achieve a regular circulation of air up to 35 days of chick's age in all treatment groups. The experimental period was lasted for 6 weeks, and divided into three intervals: 0-3 (starter period), 3-6 (finisher period) and 0-6 (whole experimental period).

Vaccination and medical program were done according to the different stages of the age under supervision of a veterinarian in the farm.

Investigated Measurements

Live body weight: chicks were individually weighed at the initial (one day old), 3 weeks of age and final of the experimental period (6 weeks of the age).

Daily body weight gain: daily body weight gain for each period (0-3, 3-6 and 0-6 weeks of age) was calculated by subtracting the average initial live body weight from the average final body weight and divided by the number of days within the same period.

Feed consumption: at the beginning of the experimental period, a certain amount of each experimental diet was weighed. At the end of the certain period, the residuals were weighed and subtracted from the offered amount to obtain the total feed during the period, which was divided by number of chicks in order to obtain the average amount per chick.

The following equation was applied to obtain the amount per chick:

$$\text{Average feed intake/chick/period} = \frac{\text{Feed consmed (g) during a given period}}{\text{Number of chicks during the same period}}$$

Feed conversion ratio

Feed conversion ratio was estimated as units of grams of feed required to produce one gram of gain, during a certain period as follows:

$$\text{Feed conversion ratio} = \frac{\text{Average feed (g) during a given period}}{\text{Average weight gain (g) during the same period}}$$

Table 1. Ingredients and chemical composition of the experimental basal diets

Item	Diet	
	Starter	**Finisher**
Ingredient (%)		
Yellow corn	57.03	60.49
Soybean meal (44%)	31.65	27.15
Corn gluten meal (62%)	6.50	6.10
Di calcium phosphate	1.70	1.50
Limestone	1.24	1.15
Vit-min premix*	0.30	0.30
NaCl	0.30	0.30
DL-Methionine	0.15	0.01
L-Lysine	0.13	0.15
Soybean oil	1.00	2.85
Total	100	100
Chemical composition**		
CP (%)	22.80	20.89
ME Kcal/kg diet	2948.00	3115.00
Ca (%)	1.00	0.90
P (Available) (%)	0.45	0.40
Lysine (%)	1.20	1.10
M+C (%)	0.93	0.73
CF (%)	3.55	3.31

* Growth vitamin and Mineral premix Each 2.5 kg consists of: Vitam. A1200,000 IU; Vitam. D3, 2000,000 IU; Vitam. E. 10g; Vitam. k3 2 g; Vitam. B1,1000mg; Vitam. B2,49g; Vitam. B6, 105g; Vitam. B12,10mg; pantothenic acid, 10g; Niacin,20g; Folic acid,1000 mg; Biotin,50g; Cholin Chloride, 500 mg; Fe, 30g; Mn,40g; Cu,3g; Co,200 mg; Si, 100 mg.

** Calculated according to NRC (1994).

Blood parameters

At the end of the experimental period (6 weeks of age), blood samples were randomly collected (at slaughtering) from nine birds per each group into sterilized tubes that closed with rubber stoppers as blood specimens were used for the different determinations. Blood samples were centrifuged at 3500 rpm for 20 minutes and serum was analyzed for total proteins (g/dl), albumin (g/dl), uric acid (mg/dl), cholesterol (mg/dl), AST (U/I) and ALT (U/I) using the available commercial kits. Blood IgG, IgA and IgM (µg/ml) were quantified using chicken ELISA kit.

Plasma total proteins (g/dl) were determined according to the method described by Henry (1974). All parameters were determined using the commercial diagnostic kits produced by the manufacturer companies (Spectrum, Diagnostics, Egypt. co. for Biotechnology, SAE). The determination of plasma albumin (g/dl) based on a colorimetric method described by Doumas *et al.* (1971). Globulin was calculated by subtraction of plasma albumin from total plasma protein, and then A/G ratio was calculated. Cholesterol (mg/dl) was determined according to method of Richmond (1973). The activities of AST and ALT enzyme (U/L) were calorimetrically measured using commercial kits purchased from spectrum Diagnostics and determined according to Reitman and Frankel (1957). Uric acid (mg/dl) was determined by RIA technique as described by Akiba *et al.* (1982).

Carcass Characteristics

At the termination of the experimental period (6 weeks of age), three representative birds from each treatment were deprived of food for 12 hours after which they were individually weighed the assigned birds were slaughtered to complete bleeding followed by plucking the feather. After the removal of head, viscera, shanks, gizzard, liver, heart, and reproductive organs, the rest of the body was weighed to determine the dressed weight. The total edible parts included the dressed weight offered to table and the edible organs (*i.e.* heart, empty gizzard and liver), then dressing percentage was calculated on the basis of live weight.

Statistical Analysis

Data collected were subjected to analysis of variance of completely randomized design by applying the General Linear Models Procedure of SAS software (SAS Institute, 9.2, 2008) according to Snedecor and Cochran (1982). The following model was adopted:

$X_{ij} = \mu + T_i + e_{ij}$ Where:

X_{ij} = An observation,

T_i = Housing system effect (i = 1 and 2) and e_{ij} = Experimental error.

All means were tested for significant differences using Duncan’s multiple range procedure (Duncan, 1955). The percentages of carcass and organs were transformed to Arcsine values then re-transformed to the original values after analysis.

RESULTS AND DISCUSSION

Growth Performance

Results related to growth performance (body weight, daily weight gain, feed consumption and feed conversion) are shown in Table 2. Broilers reared on litter floor exceeded ($P \leq 0.05$ and 0.01) those kept in battery cages in each of body weight at 3 and 6 weeks of age, daily body weight gain through all the experimental periods and feed consumption (during 3-6 and 0-6 weeks of age). Feed conversion ratio was not significantly changed between broilers kept in batteries and those reared on litter floor.

The decrease in feed intake for broilers raised in battery cages could be attributed to the decrease in movement and physiological body status or due to the fact that birds in cages were not free as compared to those on litter floor (Simeon, 2015). Bilal *et al*. (2014) attributed the decrease in feed consumption in broilers reared in cage batteries than those kept on litter floor due to that birds reared on the floor have ample space, which facilitated the birds for normal physiological and metabolic responses, ultimately resulted into more feed intake as compared to battery cage system. The same authors attributed the increase in body weight and daily body weight gain in broilers kept on litter floor as compared to those in batteries to bird’s comfort on deep litter system, which plays an important role in relieving cage stress, hence enhancing the physiological and metabolic functions, which resulted in higher body weight than those of battery cage system. Santos *et al*. (2012) indicated that the differences in growth performance between the two housing systems (battery cages versus litter floor) may be partly due to differences in drinker system.

The present results are in agreement with those obtained by El-Sheikh *et al*. (2016) who concluded highly significant differences ($P \leq 0.01$) between litter floor and battery cages on feed consumption and feed conversion ratio in Japanese quail. Fu *et al*. (2015) reported that feed consumption in Beijing-you chicken kept in the free range were higher than the cage group, while body weight of the chickens in the free range group was significantly lower than those of chickens in the cage group. Similar results to the present work were also reported in broilers by Fortomaris *et al*. (2007). On contrary to the present results, Athar *et al*. (1990) and El-Sagheer *et al*. (2012) showed insignificant differences in body weight, body weight gain

Table 2. Growth performance ($\overline{X}$ ±SE) of broilers as affected by housing system

Factor / Trait	Battery cages	Litter floor	Sig.
Body weight (g)			
0 weeks	44.90± 0.26	44.50± 0.25	NS
3 weeks	782.80± 8.50	895.10± 0.12	**
6 weeks	2126.10± 33.82	2356.80± 27.36	**
Daily weight gain(g/day)			
0-3 weeks	35.13± 0.42	38.50± 0.42	**
3-6 weeks	64.55± 1.37	68.25± 1.32	*
0-6 weeks	49.58± 0.82	53.25± 0.71	**
Feed consumption(g/day)			
0-3 weeks	52.81± 1.50	55.32± 2.00	NS
3-6 weeks	115.29± 5.01	125.61± 3.31	**
0-6 weeks	88.51± 2.40	90.41± 2.02	**
Feed conversion ratio (g feed/g gain)			
0-3 weeks	1.48± 0.05	1.41± 0.04	NS
3-6 weeks	1.71± 0.07	1.85± 0.07	NS
0-6 weeks	1.69± 0.23	1.81± 0.05	NS

* = P≤0.05, ** = P≤0.01 and NS= Not significant

and feed consumption among birds raised on litter floor and in batteries. Lamidi (2014) found that the battery cages gave higher body weight gain/week and final body weight at marketing than deep litter in broiler chicks.

The disparity in results of the present work and the other investigations may be due in part to the differences in the cage floor material used and in turn, the differences in growth rate also depend on stocking density, as studies show that crowding in both floor and cages systems (El-Sheikh *et al*., 2016) can reduce growth rates. Growth rate is also influenced by feeding behavior (Shields and Greger, 2013).

Carcass Characteristics

Results found in Figs. 1 and 2 indicates that some carcass characteristics studied did not significantly change between broiler chicks reared in batteries and those kept on litter floor. Litter floor housing may provide the bird with non-digestible structural particles that, upon ingestion, have remarkable effects on growth and meat yield (Santos *et al*., 2012).

Athar *et al*. (1990), Al-Bahouh *et al*. (2012) and Santos *et al*. (2012) mentioned that there was no significant difference in carcass (%) between broilers raised in cages or on the floor. On the other hand, Hrncar *et al*. (2014) indicated that the slaughter weights of ducks in the cage system were significantly higher (P≤0.05) than for those on the deep litter floor system (2936.97 *vs*. 2774.58 g). The same authors added that housing system had no significant effect on carcass yield of broiler ducks. Zhao *et al*. (2012) found that chickens raised in cages were heavier (P≤0.05) in carcass and liver than those raised on floor. The later authors added that chickens reared on floor had high (P≤0.05) percentages of gizzard than those raised in cages. As well as,

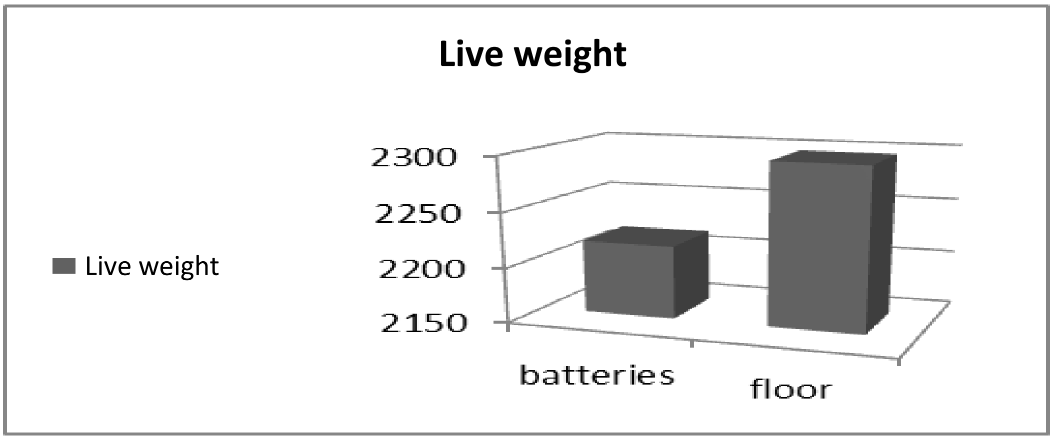

Fig. 1. Live weight of broilers at slaughtering as affected by housing system

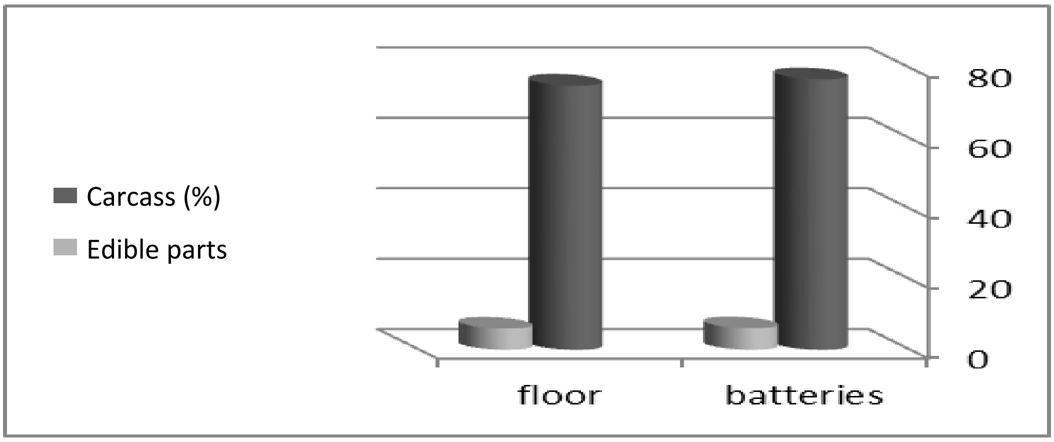

Fig. 2. Carcass and dressing (%) of broilers at slaughtering as affected by housing system

Sogunle *et al*. (2008) concluded that the floor system revealed higher (P≤0.05) values in the dressing percentage than the battery cages one.

Blood Components

It could be seen from the results shown in Table 3 that some blood components (within normal range) studied did not significantly differ between broiler chicks reared in batteries and those kept on litter floor. These findings were explainable with insufficient or balanced effects of housing system on the blood parameters (Ozhan *et al*., 2016). The same authors found that serum cholesterol, triglyceride and protein levels and creatine kinase enzyme activities were statistically not significant. Serum uric acid levels were found to be significantly (P≤0.05) higher in battery cages system as compared with floor one. In agreement with the present results, Sogunle *et al*. (2008) reported that serum total protein, albumin and uric acid of broilers reared in cages and floor indicated statistical similarities (P<0.05) across treatments.

Conclusion

From these results, it could be concluded that raising broilers in battery cages had significant negative effects on most of traits as compared to those of litter floor. However, a better performance of birds reared on floor system could result into an enhanced performance and an increased carcass yield of broilers. In this respect, litter floor pens system could be recommended to increase broilers performance under Sharkia Governorate climatic conditions.

Table 3. Blood parameters (within normal range) of broilers ($\overline{X}$ ±SE) as afected by housing system

Factor Trait	Battary cages	Litter floor	Sig.
Total protein	3.38± 0.22	3.53± 0.23	NS
Albumi	1.45± 0.06	1.48± 0.03	NS
Total cholessterol	144.44± 9.32	146.88± 6.69	NS
Tri-glycerid	98.44± 7..09	110.56±10.29	NS
IgG	351.11± 19.27	365.56± 174.4	NS
Igm	19.22± 2.78	24.22± 2.02	NS
IgA	34.78±3.026	43.33± 3.47	NS
ALT	12.22± 1.60	13.44± 1.47	NS
AST	361.89± 32.03	365.44± 13.74	NS
Creatinin	0.39± 0.03	0.41± 0.03	NS

NS= Not significant

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أداء النمو، صفات الذبيحة وبعض مقاييـــس الــدم لــدجـــاج التســمين المتأثر بنظام الإسكان

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قسم الدواجن - كلية الزراعة - جامعة الزقازيق - مصر

أجريت هذه الدراسة لتقييم تأثير نظم الإسكان (البطاريات والأرضي) على أداء النمو، بعض قياسات الدم، مواصفات الذبيحة لدجاج التسمين، استخدم عددًا إجماليًّا قدره ٢٢٤ كتكوتًا غير مجنسًا عمر يوم من دجاج ايفيان وزعت عشوائيا على مجموعتين (١١٢ لكل مجموعة) تم إسكان كتاكيت المجموعة الأولى في البطاريات بينما تم اسكان كتاكيت المجموعة الأخرى على الأرض، يمكن تلخيص نتائج هذا العمل على النحو التالى: تفوقت كتاكيت التسمين المربى على الأرض معنويا (٠.٠٥، ٠.٠١) على تلك المرباة في البطاريات في كل من وزن الجسم، الزيادة اليومية في وزن الجسم، واستهلاك العلف عند معظم الفترات المدروسة، لم يتغير معنويا كل من معدل تحويل الغذاء، صفات الذبيحة، بعض قياسات الدم وبعض مكونات المناعة بين تلك الطيور المرباة في البطاريات أو على الأرض، التوصية: من نتائج هذا العمل يمكن أن نوصي بتربية كتاكيت التسمين على الأرض تحت الظروف المصرية وذلك للحصول على أفضل أداء وزيادة محصول الذبيحة.

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