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Research Article

# Effect of deep-litter floor and battery cages system on the feed consumption and egg production rate of commercial Layers

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## Abstract

This study was designed to determine the effects of deep litter floor and battery cages housing system on layer feed consumption and egg production rate. Thirty two commercial hybrid layers (hyline) of 10 months production age were randomly selected and distributed equally in four deep litter ground cages, and thirty (hyline) layers were kept in battery cages, which consisted of triple deck cages, provided with automatic nipple watering system and front trough feeders. During the experimental period there were slight changes in live body weight, it was about -0.01 kg in deep litter and about 0.04 kg in battery cages system. Layers housed in deep litter system significantly consumed more feed compared to that kept in battery cages except at first week, and best averages of feed conversion ratios were calculated for layers housed in deep litter than that kept in battery cages, differences were significant for second, third, fourth and fifth weeks of experimental period. Egg production rate were significantly different in layers housed in deep litter system through the production period except the first weeks.

## Introduction

Poultry is an important farm species in almost all countries. It is an important source of animal protein and can be raised in situations with limited feed and housing resources. Chicken egg is one of the finest foods, offering humans an almost complete balance of essential nutrients with proteins, vitamins, minerals and fatty acids of great biological value [1]. In addition of being one of the foods of lowest cost, it increases the consumption of food of high nutritional value for the low-income population [2]. Feed and housing are two main factors of successful poultry farming business. Housing is important for raising layer poultry commercially and in small scale. A good layer poultry housing system keeps the bird safe, well growing, productive and protects the poultry birds from adverse weather conditions, injury and predators [3]. Scientists have made various conflicting reports about the contamination of eggs under different housing systems. The majority of commercial laying hens in the world are housed in cage systems in contrast to non-cage systems such as aviaries, barns or free range [4]. Cage poultry houses are difficult to clean and disinfect [5] and with Salmonella contamination has been shown to be more persistent in successive flocks housed in cages than on-floor due to poor standards of cleaning and disinfection in cage farms [6]. Keeping higher egg production potentials of commercial layers aside management would then be key factor to ensure high profitability [7]. Some important factors from the managerial point of view are appropriate size of operation efficient, utilization of resources, economical feeding, improved housing and appropriate stocking rate. Savory and Pištěková, et



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al. [8,9] stated that from the welfare view point cage systems were burdened with a lack of space for laying hens, however, conversely they ensured the better health status of laying hens. Petermann [10] concluded that alternative aviary systems with deep litter were burdened with higher mortality of laying hens. De Boer and Cornelissen [11] considered battery cages to be more favourable than aviary systems, in particular from the viewpoint of stock economics, ammonia emission, egg quality and farmer welfare. Duncan [12] analysed advantages and disadvantages of battery cage systems. He considered the low incidence of diseases, low incidence of social frictions, and the absence of problems resulting from litter as the main advantages. The disadvantages were found to be a lack of both physical and psychological space for laying hens, lack of space for daily activities and nesting and dust bathing opportunities, and a higher incidence of foot lesions. Cooper and Albentosa [13] assessed the advantages and disadvantages of cages systems in a similar way. Furnished cages will be the only legal form of cages in the EU from 2012. Tauson [14] compared two alternative systems – furnished cages and aviary systems. According to this author the furnished cages try to combine advantages of small group size in cages and to reduce disadvantages of poor air condition, and sometimes inferior hygiene, in floor-kept hens. Tauson [15] stated that developed models of furnished cages provided similar production results to conventional cages, but differences still existed e.g. in egg quality traits between the models. Baxter (1994) emphazized the unsatisfactory welfare of laying hens in conventional cages resulting, in particular, from the insufficient movement in a cage. Appleby and Hughess [16] stated that no system was ideal from the aspect of production, welfare, layers' health, and mortality. Hetland, et al. [17] compared 2 400 layers in conventional 3-hen cages and two furnished cage systems with 8 or 16 birds. Egg production was lower in furnished cages than in conventional cages. The frequencies of rear body wounds also increased as the group sizes increased [18] studied production, interior and exterior egg quality, health, plumage, keel bone and foot condition in hens that were housed in battery cages with three hens per cage and in two aviary systems with tiered wire floors and litter Lovsta with two tiers and Marielund with three tiers. They did not observe any effects on egg quality traits. So the objective of this study is assist in development of profitable sustainable low cost poultry production systems suitable for small holders. Specifically it was aimed at comparing two housing systems and its effects on production.

## Materials and method

This experiment was conducted in the Poultry Production Research Unit, Department of Animal Production, Faculty of Natural Resources and Environmental Studies, University of Kordofan, Elobeid. The experiment extended from 10 September to 4 November. 2016. Elobeid city (latitudes $13^{o}$ 14/ $35.3^{o}$ N and $13^{o}$ 05/43.2 N and longitudes $30^{o}15$/ 12.0 and $30^{o}10/54.5^{o}$ E. Elobeid is the capital of North Kordofan State with population that was estimated at 398993 [19]. Sixty two of commercial hybrid layers (High line) were randomly selected from layer flock at production age of ten months. The birds vaccinated against Newcastle and Fowl pox diseases and treated against round and tape worms. The experimental birds were fed commercial layer ration ad Libutum (Table 1). The average daily feed consumption per bird was calculated from the total hen-day feed consumption, and the average egg production per bird was calculated from the total hen-day production.

### Experimental layer ration

For the sake of feeding level and quality, gross and chemical composition of the experimental ration is presented in Tables 1.1, 1.2.

### Data analysis

The completely randomized experimental design was used for data analysis. Analysis of variance was used for detecting variations among different treatment means. Duncan Multiple Range Test (DMRT) was used to assess the significance among treatment means according to Gomez and Gomez (2000). SAS v0.9 software (Statistical Analysis System) was used to analyze data.

## Results

### Experimental layers initial live body weight

The initial live body weight of the experimental layers ranged from 1.33 kg to 1.46 kg and 1.4 kg to 1.47kg for the layers housed in deep litter floor and layers kept in battery cages, respectively (Table 2).

### Experimental layers final live body weight

Table 3 shows that the final live body weight was ranged from 1.38 kg to 1.42 kg for layers in deep litter floor and 1.36 kg to 1.42 for layers in cages.

**Table 1.1:** Gross composition.

| Ingredient | Percentage (%) |
|---|---|
| Sorghum | 57 |
| Peanut/groundnut(cake) | 20 |
| Concentrate | 05 |
| Limestone | 10 |
| Wheat bran | 07 |
| Sodium Chloride | 0.5 |
| Premix | 0.5 |
| Total | 100 |

**Table 1.2:** Experimental layer ration.

| Chemical composition | |
|---|---|
| Calculated analysis | |
| Crude protein (%) | 18 |
| Metabolism energy (Kcal/kg) | 2870 |
| Crude fiber (%) | 4.6 |
| Fats (%) | 3.65 |
| Calcium (%) | 3.7 |
| Phosphorus (%) | 0.7 |



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## Birds feed consumption

Table 4 shows the average weekly feed consumption, layers housed in deep litter system consumed significantly ($p \le 0.05$) greater feed compared to layers kept in battery cages during the whole experimental period except the first week Table 5.

Table 2: Initial live body weight (mean ± sd) Kg of experimental layer.

| | Replication | | | |
|---|---|---|---|---|
| Housing type | R1 | R2 | R3 | R4 |
| A | 1.37±0.07 | 1.33±0.11 | 1.46±0.12 | 1.43±0.12 |
| B | 1.47±0.15 | 1.45±0.13 | 1.40±0.09 | 1.42±0.14 |

* Where: A= deep-litter housing and B= cages housing.
** Numbers between brackets are number of hens.

Table 3: Final live body weight (mean ±sd) Kg of the experimental layers.

| | Replication | | | |
|---|---|---|---|---|
| Housing type | R1 | R2 | R3 | R4 |
| A | 1.38±0.12 | 1.41±0.09 | 1.42±0.17 | 1.41±0.16 |
| B | 1.42±0.15 | 1.42±0.12 | 1.36±0.12 | 1.38±0.11 |

* Where: A= deep-litter housing and B= cages housing.
** Numbers between brackets are number of hens.

## Egg production and production rate

The total of egg produced by layers kept in deep-litter and battery cages were about 1118 and 921, respectively. So the differences in egg production percentage were significant ($p \le 0.05$) through the whole production period except the first and last weeks in deep litter and cages respectively (Table 6).

# Discussion

The study showed no significant differences in body weight gain during the experimental period for layers housed in deep litter floor and layers kept in battery cages, the average body weight gain of battery cages layers (0.04) kg was slightly better over the average body weight gain of deep litter layers (-0.01) kg and that could be due extra energy and heat production and moving [20]. The study explained that hen's in deep litter floor had higher feed consumption rate than that kept in battery cages. The mean values of weekly feed consumption at the end of experiment were 740.6 and 707.6 g for layers housed in deep litter floor and layers kept in battery cages, respectively. Leeson and summers [21] and Harms, et al. [22] noted that there was a significant relationship between feed consumption and body weight and feed consumption and lying rate. As body weight and production rate increased, feed consumption of hens also increased. The best-feed conversion ratio was observed in layers

Table 4: Feed consumption per bird/day (Gram /Day) of experimental layers.

| | Age (week) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Housing type | W1 | W2 | W3 | W4 | W5 | W6 | W7 | W8 |
| A | 93 | 101$^{a}$ | 104$^{a}$ | 105$^{a}$ | 95$^{a}$ | 111$^{a}$ | 121$^{a}$ | 116$^{a}$ |
| B | 95 | 94$^{b}$ | 100$^{b}$ | 98$^{b}$ | 89$^{b}$ | 105$^{b}$ | 117$^{b}$ | 113$^{b}$ |

* Where: A= deep-litter housing and B= cages housing.
** W1, W2, W2, W4, W5, W6, W7 and W8 are age of layers after starting the experiment by 1, 2, 3, 4, 5, 6, 7 and 8 weeks, respectively.
*** Numbers with different superscripts in the same column are significantly differ (Duncan multiple range test Differences in feed conversion ratios were significant ($p \le 0.05$) during the second, third, fourth and fifth week of experimental period (Table 5).

Table 5: Feed conversions (Kg/dozen) of experimental layers.

| Housing | Age (week) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Type | W1 | W2 | W3 | W4 | W5 | W6 | W7 | W8 |
| A | 1.92±0.02 | 1.9$^{a}$ ±0.09 | 1.91$^{a}$ ±0.02 | 1.83$^{a}$ ±0.04 | 1.83$^{a}$ ±0.04 | 2.23±0.06 | 2.05±0.01 | 2.33±0.04 |
| B | 1.95±0.06 | 2.15$^{b}$ ±0.04 | 2.14$^{b}$ ±0.02 | 2.12$^{b}$ ±0.02 | 2.19$^{b}$ ±0.05 | 2.42±0.03 | 2.51±0.02 | 2.28±0.04 |

* Where: A= deep-litter housing and B= cages housing.
** W1, W2, W2, W4, W5, W6, W7 and W8 are age of layers after starting the experiment by 1, 2, 3, 4, 5, 6, 7 and 8 weeks, respectively.
*** Numbers with different superscripts in the same column are significantly differ (Duncan multiple range test 5%).
**** Numbers between brackets are number of hens.

Table 6: Weekly production rate (%) of the experimental layers.

| Housing | Age (week) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Type | W1 | W2 | W3 | W4 | W5 | W6 | W7 | W8 |
| A | 58.04 | 63.84$^{a}$ | 60.27$^{a}$ | 66.07$^{a}$ | 60.71$^{a}$ | 59.82$^{a}$ | 70.54$^{a}$ | 59.82 |
| B | 58.57 | 52.38$^{b}$ | 56.19$^{b}$ | 55.71$^{b}$ | 48.57$^{b}$ | 51.9$^{b}$ | 55.71$^{b}$ | 59.52 |

* Where: A= deep-litter housing and B= cages housing.
** W1, W2, W2, W4, W5, W6, W7 and W8 are age of layers after starting the experiment by 1, 2, 3, 4, 5, 6, 7 and 8 weeks, respectively.
*** Numbers between brackets are egg production rate (%).
**** Numbers with different superscripts in the same column are significantly differ (Duncan multiple range test 5%).



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reared in deep-litter and battery cage respectively. Highest best feed conversion was observed in deep-litter, battery cage at week fourth 1.91, and 2.12 kg respectively. Also report noted by Gerzilov, et al. [23] and [5] the feed conversion ratio in layers kept in deep-litter was high versus other both poultry housing systems. For the whole 8 weeks of production period, over all eggs produced were1118 and 921 for layers housed in deep-litter floor and layers kept in battery cages, respectively. Differences in egg production percentage were significant ($p \leq 0.05$) through the whole production period except the first week. However, the literature reveals that egg production from conventional cage layers is higher than in alternative systems such as aviary, floor management or free-range system [24-27]. Other studies conducted in several European countries indicate that egg production in furnished cages is comparable to that in conventional cages [28]; Meanwhile, Pohle and Cheng [29] reported that layers maintained in furnished cages laid more eggs at 40 weeks compared to conventionally caged birds ($P \leq 0.05$) because of considerable improvements in welfare levels [30].

## Conclusion

This study showed that deep litter system could provide a good managerial system than battery cages system in open-sided houses. And some advantages of deep litter system have been known, including high feed consumption and feed conversion beside a good egg production rate. The results of this study have demonstrated that there exist differences in productive performance and the housing system. Therefore it is important to select an appropriate housing system for a particular strain of layer in order to produces eggs with highest quality.

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