



# Effect of Age and Type of Cage (Close House and Open House) on Hen House, Feed Efficiency, Mortality and Livability of Laying hens

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## Abstract

The purpose of this study was to determine the effect of chicken age and type of cage on the hen house, feed efficiency, mortality and livability of laying hens. This research is an experimental study using 20000 laying hens. This study used 2x5 factorial completely randomized design (CRD). The two factors were the age of the chickens (U) (30, 50 and 70 weeks) and the type of cage (K) (open house and close house). Based on the results of statistical analysis, it was found that the cage type had a very significant effect ( $p < 0.01$ ) on hen house, feed efficiency, mortality and livability. Chicken age had a very significant effect ( $p < 0.01$ ) on hen house, feed efficiency and livability and significantly ( $p < 0.05$ ) on mortality. The interaction between the two factors has a very significant effect ( $p < 0.01$ ) on hen house, feed efficiency, mortality and livability. The average hen house obtained in this study ranged from 74.33-89.43%; feed efficiency 61.78-75.95%; mortality 0.01-0.35% and livability 81.83-98.33%. Based on the results of statistical analysis it was concluded that the interaction between laying hens age and cage type closely related to hen house value, feed efficiency, mortality and livability. The best results were obtained from the interaction of chickens aged 30 weeks in a close house cage.

**Key words:** close house, feed efficiency, hen house, laying hens, mortality, open house

## Introduction

Livestock is one of the agricultural sub-sectors that play an important role in supplying animal protein sources (Nafaati, Utomo and Hasanah, 2021). Laying hens are a type of livestock which are cultivated for two purposes because they can be used as egg producers as well as meat producers. The business of laying hens has good prospects for development because eggs are a source of animal protein that is cheap and easy to process into food (Haryuni, 2018). The nutritional content of egg includes 73.7% water; 12.9% protein; 11.2% fat and 0.9% carbohydrate (Haryuni, Widodo and Sudjarwo, 2015).

The low price of eggs and high nutritional content are one of the reasons consumers use eggs as a source of protein. The reasons for consumers in Indonesia in deciding to buy a product include income, price and taste (Satria and Mayasari, 2019). In order to maximize the sup-

ply of chicken eggs, many efforts have been made to increase the productivity of laying hens. These efforts include genetic improvement, feed and maintenance management (Haryuni, Widodo and Sudjarwo, 2017; Haryuni and Lidyawati, 2019). One of the improvements in management is through choosing the age of productive chickens and the right type of cage.

The place for production activities for laying hens is in the cage. This requires the suitability and comfort of the cage for maximum production chickens without any disturbance (Amijaya, Yani and Rukmiasih, 2018). Types of cages that are widely developed in Indonesia are open houses and close houses. Open house cage is a cage that allows laying hens to directly contact the environment so that stress often occurs due to temperature fluctuations that are too extreme (Nuryati, 2019). Closed house is a cage that is designed to minimize the influence of the environment outside the cage. This cage system

has advantages such as facilitating supervision, temperature and humidity of the cage can be adjusted according to the needs of laying hens, can minimize the percentage of death and increase production performance (Widana, Sukanata and Kayana, 2019). Therefore, research is needed to find out more about the effect of chicken age and type of cage on the hen house, feed efficiency, mortality and livability of laying hens.

**Material and Method**

This research is an experimental study using 20000 laying hens. This study used a 2x5 factorial completely randomized design (CRD). The two factors were the age of the chickens (U) (30, 50 and 70 weeks) and the type of cage (K) (open house and close house). This research was conducted in July-September 2021 at Buana Intan Sejati Farm located in Kawedusan Village, Kec. Ponggok Kab. Blitar, East Java.

**Feeding Management**

Feed is given 2x a day, in the morning at 06.00 WIB and in the afternoon at 13.30 WIB. In this study, there was no difference in feeding and drinking water ad libitum. The nutritional quality of the feed in this study is presented in Table 1. The treatments in this study were as follows.

- K1U1 = 30 weeks laying hens in OH cage
- K1U2 = 50 weeks laying hens in OH cage
- K1U3 = 70 weeks laying hens in OH cage
- K2U1 = 30 weeks laying hens in CH cage
- K2U2 = 50 weeks laying hens in CH cage
- K2U3 = 70 weeks laying hens in CH cage

**Variable**

The variables observed in the study to determine the production performance of laying hens include:

**Table 1.** Nutritional quality of feed

Nutrient	Amount
Metabolic energy	2713,8 kcal/kg
Crude protein	18,67%
Crude fat	3,93%
Crude fiber	6,84%
Calcium	4,08%
Posphorus total	1,05%

**Hen house**

Hen house is the percentage of the number of eggs produced during the calculation divided by the total population at the beginning. The formula for calculating the hen house is:

$$HH (\%) = \frac{\text{Number of egg production}}{\text{Number of chickens in the beginning period of rearing}} \times 100\%$$

**Feed efficiency**

Feed efficiency is the percentage of the ratio between egg production and feed intake.

$$\text{Feed efficiency (\%)} = \frac{\text{Egg production}}{\text{Feed intake}} \times 100\%$$

**Mortality**

Mortality is the death rate of chickens during chicken rearing (Haryuni *et al.*, 2022). The formula for calculating the mortality is:

$$\text{Mortality (\%)} = \frac{\text{Number of dead chickens}}{\text{Chicken population}} \times 100\%$$

**Livability**

Livability is the number of chickens that live during chicken rearing. The formula for calculating the livability is:

$$\text{Mortality (\%)} = \frac{\text{Number of live chickens}}{\text{Chicken population}} \times 100\%$$

**Statistic analysis**

The data obtained during the study were tabulated and statistically analyzed using ANOVA with 2x5 factorial completely randomized design (CRD). The results of statistical analysis show a real or very real impact are continued with Duncan's Test (Haryuni *et al.*, 2021).

$$Y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \epsilon_{ijk}$$

Information:

- $Y_{ijk}$  : The results of observations for factor A at the i-th level, B factor at the j-th level, on the k-th test
- $\mu$  : General average
- $\alpha_i$  : The mean of factor A at level i
- $\beta_j$  : The average of factor B at the j-th level
- $(\alpha\beta)_{ij}$  : Interaction between A and B on factor A at level i and factor B at level j
- $\epsilon_{ijk}$  : Experimental error for the i-th level of factor B, j-th level of factor B on the k-th test/group

**Table 2.** Average production performance

Treatment	Variable			
	Hen house (%)	Mortality (%)	Feed efficiency (%)	Livability (%)
<b>Cage type factor</b>				
K1	78.68 <sup>a</sup> ± 0.60	0.26 <sup>b</sup> ± 1.39	65.09 <sup>a</sup> ± 0.67	89.15 <sup>a</sup> ± 1.54
K2	83.35 <sup>b</sup> ± 1.91	0.11 <sup>a</sup> ± 1.32	71.42 <sup>b</sup> ± 2.06	93.03 <sup>b</sup> ± 1.77
<b>Chicken age factor</b>				
U1	86.33 <sup>b</sup> ± 0.09	0.14 <sup>a</sup> ± 0.06	72.49 <sup>b</sup> ± 0.35	96.32 <sup>c</sup> ± 1.00
U2	81.21 <sup>a</sup> ± 3.57	0.17 <sup>a</sup> ± 0.00	69.37 <sup>a</sup> ± 4.23	92.52 <sup>b</sup> ± 0.60
U3	75.51 <sup>a</sup> ± 0.01	0.24 <sup>b</sup> ± 0.06	62.90 <sup>a</sup> ± 0.04	84.44 <sup>a</sup> ± 1.30
<b>Interaction of chicken age and cage type</b>				
K1U1	83.23 <sup>d</sup> ± 0.18	0.17 <sup>b</sup> ± 0.00	69.04 <sup>d</sup> ± 0.15	94.31 <sup>c</sup> ± 0.51
K1U2	78.50 <sup>c</sup> ± 3.26	0.27 <sup>c</sup> ± 0.06	64.45 <sup>c</sup> ± 0.35	91.32 <sup>c</sup> ± 0.20
K1U3	74.33 <sup>a</sup> ± 0.20	0.35 <sup>d</sup> ± 0.04	61.78 <sup>a</sup> ± 0.15	81.83 <sup>a</sup> ± 1.15
K2U1	89.43 <sup>e</sup> ± 0.37	0.01 <sup>c</sup> ± 0.00	75.95 <sup>e</sup> ± 0.34	98.33 <sup>f</sup> ± 0.28
K2U2	83.93 <sup>d</sup> ± 0.28	0.13 <sup>b</sup> ± 0.08	74.29 <sup>d</sup> ± 0.59	93.71 <sup>d</sup> ± 0.31
K2U3	76.70 <sup>b</sup> ± 0.33	0.18 <sup>b</sup> ± 0.08	64.02 <sup>b</sup> ± 0.30	87.04 <sup>b</sup> ± 0.74
<i>Different notations in the same column indicate that the cage type had a very significant effect (p&lt;0.01) on hen house, feed efficiency, mortality and livability. Chicken age had a very significant effect (p&lt;0.01) on hen house, feed efficiency and livability and significantly (p&lt;0.05) on mortality. The interaction between the two has a very significant effect (p&lt;0.01) on hen house, feed efficiency, mortality and livability</i>				

## Results and Discussion

The average production performance of laying hens (hen house, feed efficiency, livability and mortality) laying hens in each treatment can be seen in Table 2.

### Hen House

Based on the results of statistical analysis, it was found that the type of cage, age of the chickens and the interaction between the two factors gave a very significant effect ( $p < 0.01$ ) on the hen house. The average hen house obtained in this study ranged from 74.33-89.43%.

Table 2 shows that low feed efficiency was found in laying hens aged 70 weeks in open house cages, which was 74.33%. The highest hen house was found in laying hens aged 30 weeks in a close house cage. The temperature of the cage is very important for the continuity of the laying hens business because it has a big effect on egg production. Inconducive cage temperature can cause low egg production. The temperature of the cage is too high or too low, causing the livestock to become stressed and feed consumption becomes erratic following temperature fluctuations (Hu *et al.*, 2022). The advantages of the close cage include minimizing the occurrence of extreme temperature fluctua-

tions in the cage that trigger stress in laying hens (Respati, Hakim and Kusuma, 2020).

The environmental temperature that can be tolerated by laying hens for maximum production is at 25 °C and temperatures above 25 will trigger heat stress which is characterized by high panting which aims to balance the body temperature of laying hens with environmental temperature (Hu, Xiong and Gates, 2021).

### Feed Efficiency

Knowledge of feed conversion ratio (FCR) is the basis for understanding feed efficiency (Anene *et al.*, 2021). The performance of the digestive system is the key to feed efficiency, so many scientists are researching feed additives to maximize the work of the digestive tract. In principle, the feed consumed by laying hens that can be digested and absorbed optimally in the digestive tract will be widely used for egg production and feed becomes more efficient (Yulianto, Arif and Lokapirnasari, 2021).

Based on the results of statistical analysis, it was found that the type of cage, age of chickens and the interaction between the two factors gave a very significant effect ( $p < 0.01$ ) on feed efficiency. The average feed efficiency obtained in this study ranged from 61.78-75.95%.

Table 2 shows that feed efficiency in close house cages is better than open house cages and feed efficiency decreases with increasing age of laying hens. Aging that occurs in laying hens due to increasing age causes a decrease in the physiological function of the reproductive organs so that feed efficiency in laying hens decreases with increasing age of chickens (Zia *et al.*, 2021).

Laying hens in close house cages have higher feed efficiency because the cage is equipped with a temperature, humidity and lighting control system to keep the chickens in a comfortable zone (Widana, Sukanata and Kayana, 2019), while in open house cages, high environmental temperatures can trigger metabolic stress (Nuryati, 2019). Metabolic stress in laying hens causes disturbances in the hypothalamus and has an impact on hormone production disorders. This causes low egg production and feed efficiency (Haryuni *et al.*, 2022).

### Mortality

The mortality rate of laying hens illustrates the management of maintenance carried out on farms. This mortality rate is closely related to the cleanliness of the cage, the circulation of the cage and the health status of laying hens. The low mortality rate indicates that the rearing system of the laying hens is good (Haryuni *et al.*, 2022). Based on the results of statistical analysis, it was found that the age of the chickens had a significant effect ( $p < 0.05$ ) on mortality. The type of cage and the interaction between the two factors gave a very significant effect ( $p < 0.01$ ) on mortality. The average mortality obtained in this study ranged from 0.01-0.35%. The mortality rate obtained in this study is reasonable. Based on the guide book strain hy-line brown, the mortality rate at 70 weeks is 3.80% (Hy-Line International, 2019).

Table 2 shows that the mortality rate of laying hens in a close house cage is lower than laying hens in an open house and this mortality rate will increase with increasing age of laying hens. The mortality rate in open house cages is higher due to high heat stress (Nuryati, 2019). Aging that occurs in laying hens due to increasing age causes cell damage and decreases the ability to survive (Luo *et al.*, 2021). Decreased ability to sustain life coupled with heat stress leads to high mortality rates in open house cages.

### Livability

Based on the results of statistical analysis, it was found that the type of cage, age of the laying hens and the interaction between the two factors gave a very significant effect ( $p < 0.01$ ) on livability. The average livability obtained in this study ranged from 81.83-98.33%.

Table 2 shows that livability in close house cages is higher than in open house cages and livability decreases with increasing age of laying hens. The results obtained in this study were lower than the standard livability of the hy-line brown strain. The standard livability of the 70-week-old hy-line brown strain was 95% (Hy-Line International, 2019).

The increasing age of laying hens causes the ability of the physiological functions of the body's organs to decrease, this causes metabolism and the ability to survive to decrease (Christophe and Duangjai, 2020). This becomes serious when coupled with heat stress. Heat stress that occurs in laying hens stimulates an increase in the production of the hormone cortisol. The hormone cortisol plays a role in carbohydrate metabolism. High levels of cortisol in the blood cause an imbalance of energy homeostasis that triggers metabolic disorders and ultimately the ability to survive is getting lower (Haryuni *et al.*, 2022).

### Conclusion

Based on the results of the study, it can be concluded that the interaction between chicken age and cage type is closely related to hen house value, feed efficiency, mortality and livability. The best results were obtained from the interaction of chickens aged 30 weeks in a close house cage.

### Suggestion

Maintenance of laying hens using a close house cage must pay attention to the readiness of the technician who controls the work of the equipment in the cage.

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