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Egg production and quality of local female chicken by dietary self-selection reared under semi-scavenging system in the tropics

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Egg production and quality of local female chicken by dietary self-selection reared under semi-scavenging system in the tropics

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Abstract. The feeding standard for local chicken breeds in Indonesia has not been published yet. The present study were aimed to measure egg production and quality while estimating the ME and CP needs during production for local female chickens reared under semi-scavenging system in the tropics (Indonesia) through dietary self-selection. A total of 138 twenty two week-old chicks were randomly distributed into 12 sheltered pens, 10-14 birds each. Two feeding methods (control and self-selection) were assigned to pens, so each treatment consisted of 6 replicates. The control group received a control diet complying with the Hy-line Brown Nutrient Requirements Standard, whereas the self-selection group had access to the control and four other diets (high energy-high protein, low protein-high energy, high protein-low energy, and low protein -low energy diet). Feeds and drinking water were provided ad libitum to 53 weeks of age. Feed consumption (FC), CP intake, ME intake, concentration of dietary CP and ME and egg production were recorded weekly. Egg quality was measured three times. Daily temperature and relative humidity in the morning (07:00), noon (12:00), and afternoon (17:00) were 21.8 to 28.1°C and 46 to 88%; 24.7 to 34.5°C and 35 to 72%; and 23.5 to 34.5°C and 36 to 80%, respectively. Data were analyzed using Proc Mixed of SAS, but egg quality was analyzed by ANOVA. The results showed that feeding method had apparent effect on CP intake ($P=0.018$) and ME intake, dietary concentration of CP and ME, egg production ($P<0.001$) but not on FC. The effect of week and feeding method by week interaction were also very significant for all performance, except egg production was not affected with feeding method by week interaction. Weekly CP and ME intake of the self-selection group were greater than those of the control (105.8 vs. 101.3 g/bird; $P=0.018$ and 1,709 vs. 1,575 kcal/bird; ($P<0.001$), respectively). Dietary concentrations of CP and ME in the self-selection group was higher ($P<0.001$) than those in the control group (189.3 vs. 180.7 g/kg and 3,053 vs. 2,810 kcal/kg, respectively). Egg production of the self-selection group was higher ($P<0.001$) than those of the control (60.5% vs. 55%). Over all, egg quality (eggshell thickness, shell strength, shell weight, egg weight, Hm, color, compare, HU, and yolk weight) was similar, except color and compare were higher in choice-fed birds when they grew older. Local female chickens were able to select diets to adjust their nutrient requirements by selecting more of an energy-rich diet and less of a protein-rich diet. CP and ME requirement by local female chickens were more likely greater than the current formulated for them in order to increase egg production.

Keyword – egg production, local female chicken, dietary self-selection, semi-scavenging system, tropics.



1. Introduction

Local chickens have a potential to produce a considerable amount of meat and eggs. In 1997, the contribution of local chickens to total poultry meat production was about 32% [1] and to total egg production was about 17% [2]. In addition, the price of meat and eggs of local chickens are relatively stable and the taste of these products have a high preference of local consumers. However, Department of Agriculture of Indonesia [3] reported that the contribution to total poultry meat and egg production were decline to 18% and 12.8% respectively. The reduction in these contributions during the last 10 year depict the lower productive performance of local chickens. These conditions probably due to lack of improvement in nutrient requirements.

In Indonesia, there is no establish the nutrient requirements for any purpose production of local chickens yet. Diet formulated for these chickens are still using non tropical feeding standards such as the NRC [4] or standard for Hy-line Brown Laying hen. This is unlikely suitable to meet nutrient requirements of local chickens in the tropic because high ambient temperature would influence stress level [5], heat production, energy utilization, and metabolic activities of the chickens [6] [7]. The improvement an egg production was achieved by dietary of 2,900 kcal ME /kg with 15% crude protein [8]. The increasing CP from 13.6% to 16% in local chicken was increase egg production [9]. The improvement in egg production more than 58% was also found by diet containing 18.4% CP and 2,750 kcal ME/kg [10]. These all information provided by using intensive rearing systems and improving energy and CP, and therefore the chickens did not have an opportunity to choose the nutrient requirements. The present study were aimed to calculate egg production and quality while estimating the ME and CP needs during production for local female chickens reared under semi-scavenging system in the tropics (Indonesia) through self-selection feeding method.

2. Materials and methods

A total of 138 of 22 week-day-old local female chickens, the reminder chickens from the previous trial, were distributed to 12 sheltered pens connected with netted scavenging yard (pen dimension: 3 m long × 1.75 m wide × 2 m high; yard dimension: 3 m long × 1.75 m × wide × 2 m high). Sand was used as litter in roofed pen and it was regularly added to each pen to maintain a good litter condition. There was no material added as litter in yard. The birds had free access to go in and out to pen and yard.

Five feed troughs were placed in each pen in order to enable the birds an easy and equal access to feed. Birds had access to feed and water ad libitum. In order to avoid any confounding in place and choice of feed from feeding troughs, the site of each feeding trough in a pen was changed every day according to a predetermined random schedule. Each pen had one bell shaped drinker with a 3 liter capacity and the wooden slat of a perch measured 175 cm long x 4 cm wide x 3 cm high with rounded angles about 1 m above the floor.

The temperature and humidity cycle were recorded daily by using a wireless weather center (La Crosse Technology, type WS2-550). The light of each pen was maintained 23-h light and 1-h dark per day to ensure the birds having an opportunity to choose the feed and to increase the feed intake during night time with probably low temperature. The light was provided by 75 Watt bulb which was positioned under a bluish white metal with Chinese shaped-head.

The experiment was conducted as a completely randomized design with repeated measures. The factor was a dietary treatment (control, single diet fed birds versus choice-fed birds). Each dietary treatment was assigned to six replicated pen with 10 and 14 birds each. Thus, the pen was the experimental unit.

The control groups received a control diet which was formulated to contain ME, CP, and other nutrients for laying phase [18-53 wk of age]) as recommended by The Hy-line Brown Commercial Management Guide [11]. The self-selection groups were given access to the control diet [2,814 kcal/kg and 18.4% CP] and four other diets (high protein -high energy, HPHE [23.0% CP and 3,101 kcal/kg], low protein-high energy, LPHE [14.3% CP and 3,133 kcal/kg], high protein-low energy, HPLE [23.4% CP and 2,638 kcal/kg], and low protein -low energy diet, LPLE [14.6% CP and 2,677

kcal/kg)). This gave the birds the opportunity to eat from all the diet and, thus, compose their own diet. Feeds and drinking water were provided ad libitum to 53 weeks of age.

Before meal time, all feeders were taken out of the pen and weighed, and new feeders were placed back. The protein sources were soybean meal and fish meal. The energy sources were maize, rice bran and vegetable oil.

Data of feed consumption (FC), ME intake, CP intake, concentration of dietary ME and CP and egg production were recorded weekly. All performance data were taken on the same experimental units, repeated in time: 31 weekly observations were available for each individual experimental unit. Repeated measurement on the same animal cannot be regarded as independent units of observation and mixed model can be used to account for the covariance structure among repeated observations [12]. Data were subjected to Proc Mixed, and differences ($P \leq 0.05$) among treatment means were distinguished by PDIF with SAXTON macro [13].

The egg quality (Eggshell thickness (mm), Shell strength (lb/cm²), egg weight, hmm, color, compare, HU, shell weight and yolk weight) were measured three times (29, 44 and 52 week). Egg quality were analyzed by ANOVA according to completely randomized design [13].

3. Results and discussions

3.1. Temperature and humidity

Temperature (T) and humidity (RH) are given as the average, minimum and maximum $\pm$ SD for each period time recorded. During the period of this experiment, average T and RH in the morning (07:00) were $24.2 \pm 0.8^\circ\text{C}$ and $78 \pm 3.1\%$. The minimum T and RH were 22.5°C and 68% and the maximum T and RH were 27.0°C and 81% . In the day (12:00), the average T and RH were $30.8 \pm 2.2^\circ\text{C}$ and $53 \pm 6.3\%$. The minimum T and RH were 25.6°C and 42% and the maximum T and RH were 33.5°C and 72% . In the afternoon (17:00), the average T and RH were $28.7 \pm 2.1^\circ\text{C}$ and $62 \pm 8.4\%$. The minimum T and RH were 23.5°C and 46% and the maximum T and RH were 32.5°C and 80% .

Diurnal T and RH cycling in the house during the experiment was depend on the natural condition because no effort have been done to control the T and RH. The increasing and decreasing of T in the house was followed by the decreasing and increasing of RH. These conditions were very helpful for the birds to release the body heat to the environment, especially during the high temperature which generally occur in the period of the day (12:00) until afternoon (17:00). The high T and RH are the detrimental combination to the bird due to the difficulty in releasing the body heat. That humidity is consider having the key role due to the growth of broiler was decline when RH more than 60-65% either at 28 or 30°C [14].

3.2. Bird performance

Probability values for every parameter are presented in Table 1. Differences in performance of the local female chickens in each period at different dietary treatments are presented in Figure.

Table 1. Probability values of main effects and interaction between dietary treatment¹ (F) and week for different traits.

Main Effect	Feed Intake (g/bird/week)	CP Intake (g/bird/week)	ME Intake (kcal/kg/bird/week)	CP Concentration (g/kg)	ME Concentration (Kcal/kg)	Egg Production (%)
F	0,9609	0,0185	<.0001	<.0001	<.0001	<0.001
Week	<.0001	<.0001	<.0001	<.0001	<.0001	<0.001
F*Week ²	<.0001	<.0001	<.0001	<.0001	<.0001	0,9997

¹Control diet (CP: 18.4%; ME: 2,814 kcal/kg); high protein -high energy, HPHE [23.0% CP and 3,101 kcal/kg], low protein-high energy, LPHE [14.3% CP and 3,133 kcal/kg], high protein-low energy, HPLE [23.4% CP and 2,638 kcal/kg], and low protein -low energy diet, LPLE [14.6% CP and 2,677 kcal/kg]).

²F x week=interaction between dietary treatment and week.

The results showed that there was no effect of feeding methods on FC of the chickens, although fluctuations were observed during 37 to 41 weeks of age (Figure). However, average CP and ME intake indicated that the chickens given a choice to feed consumed more CP and ME than those offered the control diet (105.8 vs. 101.3 g/bird/wk and 1,708.7 vs. 1,574.8 kcal/bird/wk, respectively; $P < 0.018$ and $P < 0.001$) suggesting self-adjustment capability of the chickens to nutrients' need. Capability in adjusting protein and energy are always continue from the beginning and than the protein and energy intake of self-selected fed birds were higher than control [15]. Final body weight of broiler chickens given dietary low CP feedstuff were emulated with 20% CP-fed chickens if they have free access in yard [16].

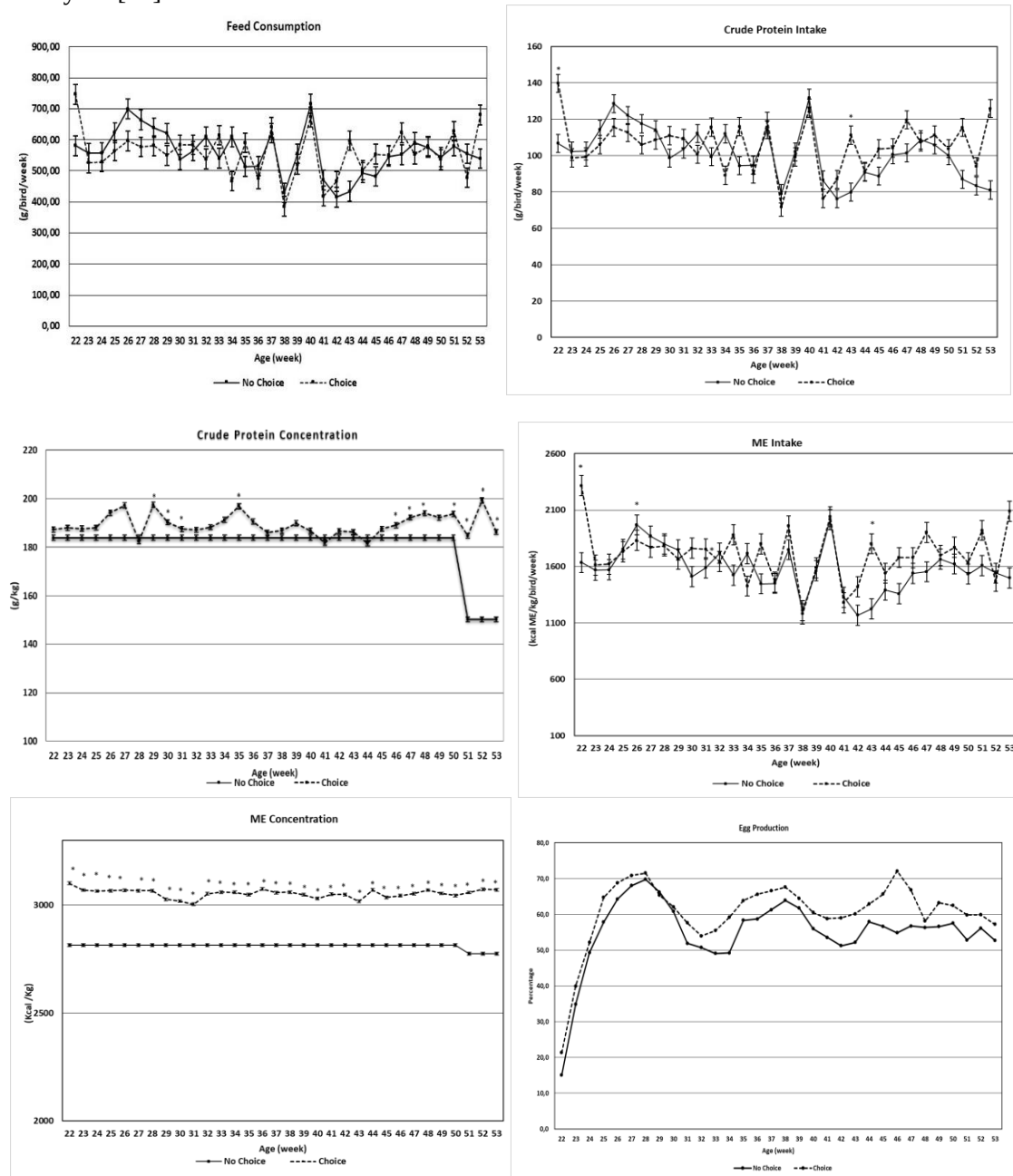


Figure 1. Least square means of performance parameter in local female chickens from 22 to 53 week (31 weeks) as affected by dietary treatments.

Feeding methods did not affect total FC, but free choice fed birds preferred more to consume HPHE diet (44.47%) and LPHE diet (36.26%) than the other diet (control, 17.13%; HPLE, 1.13% and LPLE, 1.0%). These preferences confirm the previous study that broiler chickens reared in high temperature [5] and unsex indigenous chickens in low land tropical region [17] chose more high energy diet than high protein diet. These preferences determined the concentration of CP and ME of the diet consumed by the chickens (Figure). The higher CP concentration consumed by the choice fed birds could indicate that the choice feeding method gives more chance to maintain its CP need especially from 22 to 53 weeks of age (in the average: 189.3 vs. 180.7 g/kg; $P < 0.001$). The graph also clearly illustrated a greater ME concentration in the diet consumed by choice fed birds than control fed birds (3,053 vs. 2,810 kcal/kg; $P < 0.001$). The greater CP and ME concentration in the diet consumed by choice fed birds indicated that chickens were able to select diets containing nutrients of their needs. The ability of chickens to meet their protein and energy requirement by composing several diet in broiler chickens [17] [18]. This finding demonstrates that local chicken likely requires more CP and ME than they used to be fed.

Feeding method had a very significant effect on egg production ($P < 0.001$). The graph showed that egg production of choice-fed birds was higher than of control-fed birds (Figure). The egg production in choice-fed group was more from the beginning of production. The higher egg production could be due to higher CP concentration consumed by the choice-fed birds. Level of protein diet influence egg production [19] and 10% more protein diet in commercial layer chickens produced higher hen-day egg production compared with 10% lower protein diet for every phase production [20].

Eggshell thickness, shell strength, shell weight, egg weight, Hm, color, compare, HU, and yolk weight were similar ($P > 0.05$), but color and compare were higher ($P < 0.001$) in choice-fed birds when they grew older. The higher CP concentration in the diet consumed by the choice-fed birds had no strong effect on yolk weight. The weight of yolk increase significantly by increasing protein level of diet [20].

4. Conclusions

Local female chickens were able to select diets to adjust their nutrient requirements by selecting more of an energy-rich diet and less of a protein-rich diet. The results of this study suggested that CP and ME requirement by local female chickens were more likely greater than the current formulated for them in order to increase egg production. Footnotes

Footnotes should be avoided whenever possible. If required they should be used only for brief notes that do not fit conveniently into the text.

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