Performance, Carcass Yield, Hematological Parameters, and Feather Pecking Damage of Thai Indigenous Chickens Raised Indoors or with Outdoor Access

W. Molee, P. Puttaraksa, S. Pitakwong, and S. Khempaka

Abstract**—**An experiment was conducted to determine the effect of the rearing system on growth performance, carcass yield, hematological parameters, and feather pecking damage of Thai indigenous chickens. Three hundred and sixty 1-d-old chicks were randomly assigned to 2 treatments: indoor treatment and outdoor access treatment. In the indoor treatment, the chickens were housed in floor pens (5 birds/m^2). In the outdoor access treatment, the chickens were housed in a similar indoor house; in addition, they also had an outdoor grass paddock (1 bird/m^2). All birds were provided with same diet and were raised for 16 wk of age. The results showed that growth performance and carcass yield were not different among treatment (P>0.05). Outdoor access had no effect on hematological parameters (P>0.05). However, the feather pecking damage of the chickens in the outdoor access treatment was lower than that of the chickens in the indoor treatment (P<0.05).

Keywords**—**Hematology, performance, rearing system, Thai indigenous chickens

I. Introduction

THAI indigenous chicken is popular among Thai people for its more delicious meat compared with that of the commercial broilers. Demand for Thai indigenous chicken meat is generally higher than supply because it is regarded as tastier and healthier. Particularly high demand and prices for them occur from May to June and November to January due to festivities and religious events [1]. Most of Thai indigenous chickens are raised by rural households with minimum feed and management; consequently their growth rate and feed efficiency are very poor. Some producers are interested to produce Thai indigenous chickens in the conventionally confined system. However, there is the problem of feather pecking damage because of Thai indigenous chickens have traits of fighting cocks. Recently, the demand for natural and organic foods in Thailand has increased. Thai indigenous chickens are slow-growing genotypes that suitable to raise with access to the outdoors (free-range system) to serve the needs of some consumers who interest in natural poultry product. Therefore, a study of suitable rearing system can lead to improve efficiency of Thai indigenous chicken production. Yet, little information is available concerning the free-range raising system for Thai indigenous chickens. Various slow-growing genotypes are available in Europe, and researchers have suggested that the meat quality is more appropriate for a special market [2]-[4]. The production with outdoor access resulted in increased feed intake [5] and poorer feed conversion [3], [5]-[6] compared with a conventional system. The proportions of breast and thigh meat of the free-range chickens were higher than that of the conventional chickens [3]. Moreover, the production with outdoor access could reduce stress conditions that may increase comfort and animal welfare. However, Wang *et al*. [6] reported that the free-range raising system could reduce growth performance and abdominal fat, but no effect on carcass traits and meat quality in slow-growing local breeds of chickens in China. A better understanding of the factors, including genotype, age, sex, diet, density, environment, exercise, and pasture intake will help improve performance in free-range production [4]. Therefore, the aim of this study was to determine the effect of the rearing system on growth performance, carcass yield, hematological parameters, and feather pecking damage of Thai indigenous chickens.

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II. Materials and Methods

A. Birds, Diets, and Management

An experiment was conducted at the University Farm, Suranaree University of Technology from June to September 2010. Three hundred and sixty straight-run day-old Thai indigenous chicks were randomly allocated to 2 groups: indoor and outdoor access treatment, respectively. Each treatment was represented by 6 replications with 30 birds each (180 birds per treatment). In the indoor treatment, birds were housed in floor pens (5 birds/m^2). In the outdoor access treatment, birds were housed in a similar indoor house (5 birds/m^2); in addition, they also had an outdoor grass paddock (1 bird/m^2). All birds were fed ad libitum the same diet [0-3 wk: starter; 3-6 wk: grower; 6 wk to slaughter (16 wk): finisher], without animal ingredient sources and without antibiotics or growth promotants (Table I).

TABLE I
INGREDIENTS AND NUTRIENT COMPOSITION OF THE EXPERIMENTAL DIETS

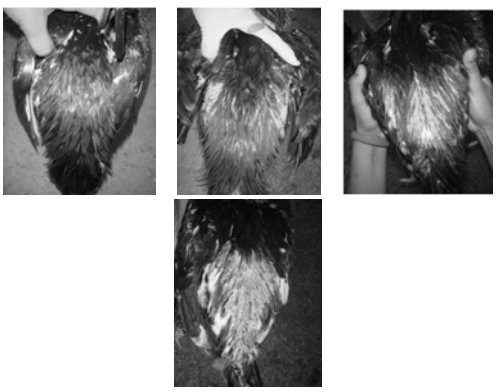
Ingredients (%)	0-3 wk	3-6 wk	6-16 wk
Corn	38.55	46.65	55.30
Soybean meal	25.85	25.60	23.50
Full fat soybean meal	16.00	9.00	4.50
Rice bran	10.00	10.00	10.00
Palm oil	5.45	5.00	3.00
Salt	0.25	0.25	0.25
DL-Methionine	0.35	0.25	0.20
L-Lysine	0.00	0.15	0.05
Calcium carbonate	1.55	1.60	1.80
Dicalcium phosphate	1.50	1.00	0.90
Premix[a]	0.50	0.50	0.50
Analyzed composition (%)			
Moisture	9.78	9.49	9.87
Crude protein	21.34	19.78	17.33
Fat	12.19	10.17	7.72
Crude fiber	4.88	5.21	3.83
Ash	8.70	6.80	5.10
Calcium	1.02	0.89	0.82
Calculated composition			
Available phosphorus (%)	0.45	0.35	0.30
Metabolizable energy (kcal/kg)	3,100	3,100	3,100

[a]Provided (per kilogram of diet):Vitamin A, 15,000 IU; Vitamin D_3, 3,000 IU; Vitamin E, 25 IU; Vitamin K_3, 5 mg; Vitamin B_1, 2.5 mg; Vitamin B_2, 7 mg; Vitamin B_6, 4.5 mg; Vitamin B_{12}, 25 µg; Pantothenic acid, 35 mg; Folic acid, 0.5 mg; Biotin, 25 µg; Nicotinic acid, 35 mg; Choline chloride, 250 mg; Mn, 60 mg; Zn, 45 mg; Fe, 80 mg; Cu, 1.6 mg; I, 0.4 mg; Se, 0.15 mg.

B. Data Collection and Analytical determinations

Birds and feed were weighted to determine body weight (BW), feed intake (FI), and feed conversion ratio (FCR).

Feather pecking damage was measured at the end of the experiment (16 wk of age). The feather damage in the back region of the chickens was observed and was divided into 4 levels, including level 0: no feather loss; level 1: less than 25% feather loss; level 2: 25 to 50% feather loss; level 3: more than 50% feather loss (Fig 1).



level 0 level 1 level 2 level 3

Fig. 1 Level of feather pecking damage

Blood samples were collected from 12 birds at random from each treatment at 16 wk of age for hematological parameters, including total red blood cell (RBC), total white blood cell (WBC), lymphocytes, heterophils, monocytes, eosinophils, and basophils [7]. The heterophil to lymphocyte (H:L) ratio was calculated.

At 16 wk, after fasting of 10 h, 24 birds were randomly selected from each treatment. All birds were weighed individually and killed by manual exsanguination, thereafter the birds were manually eviscerated. After chilling for 24 h, the eviscerated carcass, breast meat (including pectoralis major and pectoralis minor), leg meat (including thigh and drumstick), and abdominal fat were equally measured. Carcass yield was defined as the weight of the feather picked, eviscerated carcass (with the head, neck, and hocks removed) relative to live BW. Yields of breast, leg, and abdominal fat were expressed relative to live BW after fasting.

C. Statistical Analyses

Data collected in completely randomized design were subjected to an analysis of variance, and treatment means were compared using Duncan's multiple range test. The data of feather pecking damage were compared using chi square frequency test. The level at which differences were considered significant was $P<0.05$. SPSS for windows (Release 10) (SPSS Inc., Chicago, IL) was used for statistical analyses.

III. RESULTS AND DISCUSSION

A. Growth Performance

The effect of rearing system on growth performance, including BW, FI, and FCR of 16-wk-old Thai indigenous chickens is shown in Table II.

TABLE II
EFFECT OF REARING SYSTEM ON GROWTH PERFORMANCE OF THAI INDIGENOUS CHICKENS

Rearing system	Final BW (g)	FI (g)	FCR
Indoor	1,432.29	4,444.23	3.17
Outdoor access	1,450.57	4,510.33	3.17
P-value	0.55	0.47	0.45
Pooled SE	8.55	25.57	0.03

n = 6 per treatment

The rearing system did not significantly influence BW, FI and FCR ($P>0.05$). These observations are in contrast with previous studies found that FCR with outdoor access treatment was higher than with conventional treatment but there was no effect on BW [3], [5]-[6]. Moreover, some study reported that growth rate in the outdoor access treatment was higher than in the confined treatment but there was no effect on FCR [8]. The birds raised in the outdoor access system increased exercise in yards, thus increasing their energy requirement [6]. However, in the present study, there was no difference in feed consumption between the two groups; this result could reply that the chickens in both groups received the same amount of energy from feed. Furthermore, the free-range chickens can receive the energy from forages, insects, and worms, which are not controlled and are inherently variable.

Therefore, they got more the energy to compensate the energy loss from the exercise, which may be the reason why there was no difference in growth performance between the 2 groups.

B. Carcass Yield

The effect of rearing system on eviscerated carcass, breast meat, leg meat, and abdominal fat of 16-wk-old Thai indigenous chickens is shown in Table III.

TABLE III
EFFECT OF REARING SYSTEM ON CARCASS YIELD OF THAI INDIGENOUS CHICKENS

Yield (%)	Indoor	Outdoor access	*P*-value	Pooled SE
Eviscerated carcass	65.48	65.17	0.51	0.27
Breast meat	14.04	13.52	0.19	0.23
Leg meat	18.24	18.63	0.45	0.29
Abdominal fat	0.34	0.35	0.89	0.05

n = 24 per treatment

There was no effect of the rearing system on eviscerated carcass, breast meat, and leg meat (P>0.05), which consistent with [6], [9], [10]. In contrast, some studies found that percentages of breast and leg meats increased when birds had an outdoor access [3]. In the present study, outdoor access had no effect on abdominal fat yield (P>0.05). This observation is in contrast with previous studies reported that the abdominal fat yield of chickens in the outdoor access treatment was lower than chickens in the indoor treatment [2], [3], [6]. The greater motion reduced the abdominal fat and favored muscle mass development [2], [3]. Genotype is one of the factors affect the yield of carcass in chickens. Thai indigenous chickens are slow-growing genotypes and more active. Normally, their carcass yields, particularly abdominal fat, are lower than other meat-type chickens.

C. Hematological Parameters

The effect of rearing system on hematological parameters of 16-wk-old Thai indigenous chickens is shown in Table IV.

TABLE IV
EFFECT OF REARING SYSTEM ON HEMATOLOGICAL PARAMETERS OF THAI INDIGENOUS CHICKENS

Parameters	Indoor	Outdoor access	*P*-value	Pooled SE
Total RBC ($\times10^6$/mm^3)	2.21	2.09	0.20	0.06
Total WBC ($\times10^4$/mm^3)	0.87	0.82	0.51	0.05
Lymphocyte (%)	69.04	70.71	0.34	1.22
Heterophil (%)	22.79	20.79	0.09	0.82
Monocyte (%)	2.42	2.75	0.48	0.33
Eosinophil (%)	3.83	3.63	0.69	0.37
Basophil (%)	2.04	2.13	0.82	0.26
H:L ratio	0.33	0.29	0.11	0.02

n = 12 per treatment

There was no effect of the rearing system on hematological parameters, including total RBC, total WBC, lymphocytes, heterophils, monocytes, eosinophils, basophils, and H:L ratio (P>0.05). The H:L ratio has recently been proposed as a reliable measure of stress. Previous studies demonstrated that H:L ratio increased during the adaptive phase of stress in broilers [11]-[12]. In the present study; the chickens were raised in low stocking density (5 birds/m^2 or about 7 kg of BW/m^2) to avoid the feather pecking behavior. The stocking densities, at least from 20 to 55 kg of BW/m^2, did not cause physiological stress in broilers [13]-[14].

D. Feather Pecking Damage

The effect of rearing system on feather pecking damage of 16-wk-old Thai indigenous chickens is shown in Table V.

TABLE V
EFFECT OF REARING SYSTEM ON FEATHER PECKING DAMAGE OF THAI INDIGENOUS CHICKENS

Level	Indoor (birds)	Outdoor access (birds)
0 (no feather loss)	50	128
1 (<25% feather loss)	41	27
2 (25-50% feather loss)	48	17
3 (>50% feather loss)	30	4
P-value	0.001	

Although there was no effect of the rearing system on the stress (as indicated by H:L ratio) of chickens in 2 groups. But the feather pecking damage of chickens in the outdoor access treatment was lower than chickens in the indoor treatment (P=0.001). Birds can begin to peck each other at any age. In the 3rd week of life, pecking commenced leading to feather loss and it increases thereafter [15]. The initial level of feather pecking and aggression was most common in the smaller flocks at the lowest stocking densities [16]-[17], because these birds attempted to form social hierarchies. Birds in the larger flocks at higher densities appeared to adopt non-social, [16], [18]. Thai indigenous chickens have traits of fighting cocks; therefore the outdoor access system or free-range system is suitable for them.

IV. CONCLUSION

The outdoor access or free-range systems had no effect on growth performance, carcass yield, and hematological parameters, but could reduce the feather pecking damage of Thai indigenous chickens. The further experiments are needed to determine the effect of free-range system on meat quality of Thai indigenous chickens.

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