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Original Article

Effects of stocking density on feather pecking and aggressive behavior in Thai crossbred chickens

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ABSTRACT

The influence of stocking density on feather pecking and aggressive behavior of Thai crossbred chickens was investigated from age 4–12 wk. In total, 900 day-old mixed sex Thai crossbred chickens were assigned to three replicates of 100 birds per pen, at stocking densities of 8 birds/m^2, 12 birds/m^2 and 16 birds/m^2, respectively. The frequency of feather pecking, the number of pecks per bout, pecking intensity and the frequency of aggressive behavior were recorded once a week by scanning all the birds in the pen. It was found that the stocking density had no effect on the frequencies of feather pecking on body areas except on the wings area ($p < 0.05$). The stocking density had no effect on the occurrence of 1–4 pecks per bout or 5–9 pecks per bout. The stocking density had no significant influence on the pecking, pinching or plucking intensity, except on the intensity of pulling. The different types of aggressive behavior such as stand-off, fight, threat, leap, chase, avoidance and peck were not affected by the stocking density. In conclusion, stocking density did not affect the feather pecking activities and aggressive behavior of Thai crossbred chickens. However, further work is suggested with a larger number of replications to establish that there is no effect of stocking density, as the power of this study was low.
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Introduction

The meat of Thai chicken is very popular among Thai consumers because of its unique taste and texture which is regarded as a greater delicacy than commercial broilers (Wattanachant et al., 2004, 2005; Choprakarn and Wongpichet, 2007; Puttaraksa et al., 2012). The domestic market for Thai chickens has increased substantially and there is also strong potential for sales in overseas markets (Huo and Na-Lampang, 2012). Therefore, changing the raising system of Thai native chickens from the extensive backyard to the intensive industrial scale could increase the incomes for Thai smallholder farmers (Na-Lampang, 2012). Cross breeding of Thai males with commercial layers, rather than pure breeding, is used to obtain higher chick production (Huo and Na-Lampang, 2012). The Department of Livestock Development (DLD) of Thailand recommends that the stocking density for Thai chickens is 8 birds/m^2 for a group of 100–200 birds (Thummabutr et al., 2003). However, the farmers need to raise their chickens at a higher density to reduce the cost of housing.

Feather pecking remains an important welfare issue in laying hens as it increases economic losses due to increased feed consumption and mortality (Rodenburg et al., 2010). It is a multifactorial problem affected by the genetic background of the birds, their early life history and environmental factors, such as the availability of floor substrate, nutrition, adequate lighting and group size and stocking density (Rodenburg et al., 2008). Under commercial conditions, an increase in group size is associated with higher levels of feather pecking (Allen and Perry, 1975; Nicol et al., 1999; Bilčık and Keeling, 2000). However, Stanislaus (2000) claimed that group size rather than stocking density is the important controlling factor in relation to feather pecking.

Feather pecking is characterized by non-aggressive pecks directed towards the plumage of other hens (Kjaer et al., 2001). Aggressive pecks are forceful pecks directed at the head or neck of the recipient, but usually these pecks do not result in much feather damage (Savory, 1995). In fact, the aggressive interactions can both divert energy from growth and may reduce bird welfare (Guaryahu et al., 1994). Reduced levels of aggression have been observed with increasing group size in young (Estevez et al., 1997) and adult

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domestic fowl (Carmichael et al., 1999; Hughes et al., 1997; Nicol et al., 1999; Estevez et al., 2002). According to the previous study of Huo and Na-Lampang (2012), Thai crossbred chickens could be raised up to age 12 wk housed at a density as high as 16 birds/m^2 without any adverse effects on productivity and welfare indicators under enrichment with perches, rice husk bedding and pecking materials. Since Thai chickens have higher aggressiveness than commercial breeds (Jaturasitha et al., 2002) it is necessary to know whether the high density can affect the aggressive behavior and feather pecking in Thai crossbred chickens.

No research has focused specifically on feather pecking and the aggressive behavior of Thai crossbred chickens in Thailand. The current research aimed to assess the effects of the stocking density on feather pecking and aggressive behavior in Thai crossbred chickens. The research hypothesis was that a high stocking density would cause high frequencies and severity of feather pecking and aggressive behavior in Thai crossbred chickens.

Materials and methods

Animals and housing

The Thai crossbreds used in this experiment were a cross between Thai native males ("Luang Hang Khao" or White-tailed Yellow breed) and ISA Brown commercial layer type females. The 900 mixed-sex Thai crossbred chicks were supplied by the Suranaree University of Technology poultry farm and were reared from age 1 d to 12 wk without the use of beak trimming. The experiment lasted from February to April, 2011.

The experimental pens were bedded with approximately 5 cm of rice husk. The pen sizes for the 100-bird treatment groups were 12.5 m^2, 8.33 m^2 and 6.25 m^2, resulting in treatment densities of 8 birds/m^2, 12 birds/m^2 and 16 birds/m^2, respectively. Before stocking, the housing was sprayed with a disinfectant. Natural lighting was used after the brooding period until the chicks were aged 12 wk. The chicken house was protected from wind and rain with plastic sheeting, which also affected the ventilation. A bamboo perch and plastic pecking materials were placed in every pen as enrichment.

Chicks were brooded for 2 wk before being randomly assigned to the treatments. At the end of week 2 (age 14 d), the chicks were vaccinated according to the recommendations of Department of Livestock Development (Theerachai, 2006). The birds were fed a standard commercial three-phase broiler diet. Feed and water were given *ad libitum* throughout the experimental period. During the first 3 wk, feed was added 3–4 times a day. After that feed was added twice a day (0800 h and 1630 h). The ratio of birds per feeder cup (diameter × height: 40 cm × 30 cm) or water bottle (4 L capacity) was 25 to 1. The animal carers followed the guidelines of the Committee on Care and Use of Laboratory Animal Resources (National Research Council of Thailand, 1999). The experimental procedure was approved by the Institutional Animal Care and Use Committee, Suranaree University of Technology, Nakhon Ratchasima, Thailand.

Behavioral observation

Feather pecking activities and aggressive behavior were observed on different days when the chicks were aged 4–12 wk. Each pen was observed once a week from 0900 h to 1200 h, at 10 min intervals. The observer stood in front of the pen about 5 min before observation. All birds in the pen were observed using a scan technique (Martin and Bateson, 1986).

According to the methods of Wechsler and Huber-Eicher (1998) feather pecks that were successively directed at the same receiver were recorded as one bout. A bout ended when there were no more pecks during a period of 4 s. It was differentiated according to whether the interaction was composed of 1–4, 5–9 or more than 10 single feather pecks. This categorization allowed the amount of time to be limited that was required to pay attention to interactions that were composed of more than 10 single pecks in favor of recording all occurrences of feather pecking bouts. For each feather pecking bout, the number of pecks was counted in relation to each of the seven areas of the body pecked, namely, the head, neck, breast, wings, back, rump, and tail.

Only pecks at feathered parts were classified as feather pecking. Pecks at legs, beaks, combs or wattles were neglected. Every feather pecking bout was attributed with increasing intensity to one of the following four types of behavior: 'pecking' at a feather without pinching; 'pinching' a feather and pulling slightly; 'pulling' at a feather with a vigorous backward movement of the head; and 'plucking' a feather. Bouts that were composed of repeated pecks were classified according to the most intense type of behavior observed.

The frequencies of different types of aggression were recorded. The ethogram of aggressiveness (Table 1) that was used followed that of Estevez et al. (2002).

Statistical analyses

The SPSS software (version 16.0; SPSS Inc.; Chicago, IL, USA) was used for the statistical analysis. The frequency of feather pecking in body areas, the intensity of feather pecking and aggressive behavior were analyzed using ANOVA for a completely randomized design with three replicates per treatment. If the data were not normally distributed, they were square root transformed prior to analysis (Estevez et al., 2002). Means were compared using Duncan's multiple-range test and the significance was determined at $p < 0.05$.

Results

Body area pecked

It was found that the stocking density had no significant effect on the frequency of feather pecking on different body areas, except on the wings area (Table 2). For the treatment with a density of 12 birds/m^2, the frequency of pecking on wings was higher than in other treatments; however, there was no difference between the treatments with densities of 12 birds/m^2 and 8 birds/m^2. In the treatment with a density of 12 birds/m^2, the frequency of feather pecking in the wings area was significantly lower than that in the treatment with a density of 16 birds/m^2. The frequency of breast pecking was rare.

Number of pecks per bout

Although there were high occurrences of 1–4 pecks per bout and 5–9 pecks per bout in the treatment with a density of 12 birds/m^2 (Table 3), followed by the densities at 8 birds/m^2 and 12 birds/m^2, there was no significant difference among treatments. The occurrence of more than 10 pecks per bout was close to zero. The stocking density had no effects on either the occurrence of 1–4 pecks per bout or 5–9 pecks per bout.

Pecking intensity

Pecking showed the highest frequency, followed by pinching, pulling and plucking (Table 3). In fact, plucking was a rarely observed. The highest frequency of pulling was in the treatment

Table 1
Aggressiveness ethogram.

Type of aggression	Definition
Chase	When one bird in the batch ran after another bird for more than three steps in an aggressive manner (which was very different from food running)
Fight	When two birds standing in front of each other were threatening and delivering pecks to each other in rapid succession, sometimes accompanied by leaps
Fight with peck	All criteria for a fight with the bird delivering at least one peck to the opponent
Leap	When a bird jumped and kicked its feet forward at the opponents
Peck	When one bird raised its head and vigorously stabbed its beak at the other bird (usually directed towards the comb)
Stand-off	When two birds stood staring at each other for >2 s
Threat	When one bird stood with its head clearly raised (sometimes accompanied by rising of the neck feathers) in front of a second bird who held its head at a lower level
Avoidance[a]	When a bird suddenly lowered its head and walked away from another bird

[a] Only when the observer had not observed an aggressive act being delivered by the other bird, possibly because it was too subtle to be unambiguously apparent to the observer (Esteves et al., 2002).

Table 2
Effects of stocking density on mean ± SE frequency occurrences of feather pecking from weeks 4–12.

Density (birds/m^2)	Back	Head	Neck	Rump	Tail	Wings
8	11.33 ± 0.88	2.00 ± 1.15	2.00 ± 0.58	0.67 ± 0.67	10.00 ± 1.00	7.00 ± 1.53^{a,b,*}
12	12.33 ± 5.54	4.33 ± 0.67	3.33 ± 0.67	2.00 ± 1.00	7.67 ± 3.84	8.33 ± 1.20^{b}
16	9.33 ± 1.76	4.33 ± 1.67	1.67 ± 0.67	1.00 ± 1.00	7.33 ± 6.51	2.67 ± 1.20^{a}

$^{*\ a,\ b}$ Means within the same column with different lowercase superscripts are significantly different at $p < 0.05$.

Table 3
Effects of stocking density on mean ± SE intensity of pecking from weeks 4–12.

Density (birds/m^2)	Intensity				Per time	
	Pecking	Pinching	Pulling	Plucking	1–4	5–9
8	22.00 ± 1.00	5.00 ± 1.20	5.33 ± 1.20^{b,*}	0.67 ± 0.33	32.33 ± 0.88	0.67 ± 0.33
12	29.33 ± 7.31	5.00 ± 1.15	2.33 ± 0.67^{a}	1.67 ± 0.88	35.67 ± 10.04	2.67 ± 2.67
16	16.00 ± 5.51	5.00 ± 0.00	3.00 ± 0.00^{a,b}	2.33 ± 1.33	25.33 ± 6.35	1.33 ± 0.88

^{*,a,b} Means within the same column with different lowercase superscripts are significantly different at $p < 0.05$.

with a density of 8 birds/m^2—it was higher than that for the density of 12 birds/m^2, but not for the density of 16 birds/m^2. There were no significant differences among the frequency of pecking, pinching and plucking in each treatment.

Aggressive behavior

Analysis of the different types of aggressive behavior from weeks 4–12 indicated that the main aggressive behavior was stand-off and leap for Thai crossbred chickens. The stocking density had no significant effects on the frequency of stand-off, threat, leap, chase, avoidance and peck behavior (Table 4).

Table 4
Effects of stocking density on mean ± SE frequency of aggressive behavior in Thai crossbred chicken from weeks 4–12.

Item	Density (birds/m^2)		
	8	12	16
Stand off	43.00 ± 14.00	37.33 ± 7.54	46.66 ± 10.04
Fight with peck	10.00 ± 2.00	12.33 ± 4.63	15.33 ± 1.86
Threat	7.67 ± 2.19	7.33 ± 0.33	5.33 ± 2.03
Leap	22.00 ± 7.51	24.67 ± 4.84	25.33 ± 6.49
Chase	11.00 ± 3.06	10.33 ± 2.91	8.00 ± 5.00
Avoidance	2.33 ± 1.20	3.00 ± 0.58	3.33 ± 1.45
Peck	12.00 ± 2.08	17.00 ± 0.58	12.00 ± 1.53
Fight	1.33 ± 0.88	0.67 ± 0.67	0.00 ± 0.00

Discussion

Some researchers suggest that in order to reduce feather pecking, chicks should be reared at low densities (Huber-Eicher and Audige, 1999). However, the current study indicated that the stocking density had no effect on the occurrence of feather pecking in Thai crossbred chickens. These findings are supported by the results presented by Carmichael et al. (1999) who found that the stocking density (which varied from 9.9 to 19 birds/m^2) had no effect on the incidence of damaging pecking. Wood-Gush and Rowland (cited by Hamada, 2004) reported that most feather pecks were delivered to the rump, followed by the tail and back. A high occurrence of feather pecking in the back area was found in the current study, which was in line with a previous study (Savory and Mann, 1997). As reported by Kjaer and Vestergaard (1998), the number of feather pecks per bout might say more about the severity and risk of damage than the total number of feather pecks. However, low counts of pecks per bout and low intensity levels were found in Thai crossbred chickens. Therefore, the temperament of Thai crossbred chickens may be more 'gentle' than that of Thai fighting cocks.

Thai crossbred chickens have the traits of fighting cocks, so when they are raised in high intensity groups, theoretically one would expect a high frequency of aggressive behavior and cannibalism (Nicol et al., 2013). In order to avoid adverse injuries, the pecking material and perches were used as enrichment in the current study because pecking material such as rubber bands or

foraging substrates were found to reduce feather pecking (Andersson et al., 2001; Arnold, 2005) and perches provide refuges for birds who are being pecked (Savory, 1995).

The group size of 100 birds used in the current study was suitable for a small-scale chicken farm or home raising. The lack of asocial structure in large flocks might be a factor in minimizing antagonistic interactions between individuals (Hughes et al., 1997). Even commercial broilers reared at high stocking densities may find the close proximity of other birds more attractive than aversive (Febrer et al., 2006). Pettit-Riley et al. (2002) found that the frequency of threats and other types of aggression were lower in moderately crowded groups (15 birds/m^2) compared to other crowding levels (10 birds/m^2 and 20 birds/m^2). However, the current study found no such tendency. Although Estevez et al. (1997) found broiler crowding increased from a density of 5 birds/m^2 to 20 birds/m^2 (group size 50–200) the frequency of threats was significantly lower. Thai crossbred chickens in a group size of 100 birds showed a low threat at each treatment density without an results being significant.

The limitation of the current research was that replication using only three groups per treatment was low. Therefore, further research with larger replications would be needed to enhance the power to detect any differences. Further research is needed into whether feather pecking at an early age of Thai crossbred chickens could affect the social structure in their group. The findings from the study of the aggressive characteristics of Thai crossbred chickens will be used in the genetic selection for a meat type broiler in Thailand.

Stocking density did not affect the feather pecking activities and aggressive behavior of Thai crossbred chickens in the study. Thai crossbred chickens could be raised up to age 12 wk at a density as high as 16 birds/m^2 with enrichment provided.

Conflict of interest

None.

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