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Feather performance, walking ability, and behavioral changes of geese in response to different stocking densities

Luyao Yin, Haiming Yang, Lei Xu, Jun Zhang, Hao Xing, Zhiyue Wang*

College of Animal Science and Technology, Yangzhou University, Yangzhou, Jiangsu Province 225009, PR China

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ABSTRACT

In recent decades, goose production has become more specialized and widespread, and rearing geese in plastic wire-floor pens is common in China. This type of rearing pattern is more productive than other rearing patterns since it allows for more birds per square meter. However, it brings some problems due to high stocking density such as poor feather performance and walking ability, and some behavioral changes. This experiment was conducted to preliminarily evaluate the effects of different stocking densities on goose welfare in terms of feather performance, walking ability and behavioral changes. A total of 336 healthy, 28-day-old, male Yangzhou goslings were allotted to 30 plastic wire-floor pens according to five stocking densities (2, 3, 4, 5 and 6 birds/m^2), adopting randomised block method. Each treatment was represented by six replicates. Feather performance was assessed by two types of measurements: back-feather damage rate, and feather contamination degree which was carried out by feather scoring. Walking ability was assessed by gait scoring. All birds in each pen were individually scanned for back-feather damage measurement at 42 days of age, and individually scored for gait at 68 and 69 days of age. One bird from each pen was randomly selected for feather scoring at 69 days of age. The higher the feather score and the gait score, the worse the goose welfare. From 60–65 days of age, three geese from each pen were randomly selected and tagged for behavioral observation. Results showed that when stocking density was 4 or more birds/m^2, standing on one leg (relaxing) behaviour reduced significantly ($P \leq 0.05$); when stocking density was 5 or more birds/m^2, feather contamination degree ($P \leq 0.05$) and preening behaviour ($P \leq 0.05$) both increased significantly; when stocking density was 6 birds/m^2, the behaviours of lying and feather pecking, and back-feather damage rate all increased ($P \leq 0.05$, for all), whereas walking ability declined, which was reflected by the increased proportion of geese with normal gait ($P \leq 0.05$) and the decreased proportion of geese with gait problems ($P \leq 0.05$). In conclusion, a high stocking density (5 or more birds/m^2) led to an increase in feather pecking and poor performances in feather and walking ability, which were harmful to goose welfare and may decrease the quality of goose products. Therefore, based on our experimental conditions, we recommend that the stocking density of geese should be fewer than 5 birds/m^2 to ensure relatively good welfare and avoid negative effects. In addition, in our experiment, different stocking densities were in accompany with different group size, in the future, additional studies will be done to explore how stocking density and group size affect goose welfare.

1. Introduction

With the rapid development of the poultry industry, many producers have adopted the highest possible stocking density in production because the economic benefit per square meter is often higher when the birds are stocked more densely. However, an excessively high stocking density can adversely influence the performance, behaviour, and welfare of the birds, a situation that has attracted attention in recent years.

Although relevant studies on geese are limited, many researchers on chickens (Dawkins et al., 2004; Estevez, 2007; Lay et al., 2011) and ducks (Baéza et al., 2003) have indicated that high stocking density can cause adverse effects such as behavioral changes, poor feather and poor walking ability. Baéza et al. (2003) studied changes in behaviour, welfare, performance, and carcass quality of Muscovy ducks in response to three stocking densities (7, 9, and 11 male ducks/m^2) and found that the stocking density of 9 birds/m^2 gave the best results for all measurements. Xie et al. (2014) indicated that the body weight and the weight gain of starter and growing ducks were both reduced when stocking density increased, but the carcass, breast meat, leg meat, abdominal fat, and foot pad lesions of ducks were not significantly

* Corresponding author at: College of Animal Science and Technology, Yangzhou University, Wenhui East Road 48#, Yangzhou City, Jiangsu Province 225009, PR China.
E-mail address: dkwzy@263.net (Z. Wang).

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influenced by stocking density. In recent decades, goose production has become more specialized and widespread, and rearing geese in wire-floor pens is common in China. This type of rearing pattern is more productive than other rearing patterns since it allows for more birds per square meter. However, it results in more adverse effects on goose health and welfare, which may decrease the quality of goose products. Our previous work suggested that when stocking density was 5 or more birds/m^2, the growth of individual birds was diminished (Yin et al., 2017); the current article aims to investigate stocking density effects on goose welfare.

Animal welfare requests that animals have hygiene environment, and have enough space and freedom to perform normal behaviours. Feather performance (Onbaşılar and Aksoy, 2005; Steenfeldt and Nielsen, 2015), gait scoring (Dawkins et al., 2004; Makagon et al., 2015), and behavioral observation (Nielsen et al., 2004) have been demonstrated to be effective in evaluating the welfare of chickens and ducks. Thus, in our experiment, the welfare of geese in response to different stocking densities was assessed in terms of feather performance, walking ability, and behavioral changes. In a word, the aim of this study was to investigate the effects of stocking density on goose welfare in terms of feather performance, walking ability, and behavioral changes; and to create a preliminary criterion for goose stocking density.

Previous researches controlled stocking density mostly by increasing the number of birds in pens with same size. However, an increase in stocking density is often accompanied by an increase in flock size. Zimmerman et al. (2006) designed an experiment which separated the effects of stocking density and group size by setting two different flock sizes (large and small) in the highest stocking density group. In their study, more aggression, preening and allopreening were recorded in small flocks than in large flocks, suggesting that when investigating stocking density effects, it is necessary to consider the effect of group size. In our study, we aim to preliminarily explore the stocking density effects on geese, thus, we carried out it based on a small-scale experiment. In the future, a large scale experiment which is closer to commercial practice will be done.

2. Materials and methods

All the procedures of our experiments were approved by the animal care and use committee of Yangzhou University (Yangzhou, China).

2.1. Animals, experimental design, and management

This experiment was carried out at Yangzhou University (Yangzhou, China) from April to June 2016. A total of 336 healthy 28-day-old male Yangzhou goslings from the same hatchery (Gaoyou, Yangzhou, China) were randomly allotted to 30 plastic wire-floor pens according to 5 different stocking densities, adopting randomised block method. All the birds were reared in the same house with the same ventilation and lighting regimen. The pen size was 2.83 m^2 (2.28 × 1.24 m), and the stocking densities were 2 birds/m^2, 3 birds/m^2, 4 birds/m^2, 5 birds/m^2, and 6 birds/m^2 during the period from 28 to 70 days of age. Each treatment was represented by six replicates.

All geese were provided with the same diets, which were formulated mainly according to the NRC (1994) and prior research results from our laboratory (Shi et al., 2007; Wang et al., 2010). Birds had ad libitum access to feed and water. Water was provided by the same half-open plastic cylindrical water tank, and pelleted feed was provided in feed troughs on the one side of each pen. Mortality and the body weight of the dead goose were recorded when death occurred, and a cubical space was isolated by a plastic wire net to ensure that the density treatment was not affected.

Table 1
Description of criteria for goose feather score and gait score[1].

Score	Feather[2]	Gait[3]
0	Completely clean	Goose walks at least ten steps with ease and is well balanced
1	Less than 1/4 of the area is contaminated	Goose has slight defect in the gait
2	1/4–1/3 (contain 1/3) of the area is contaminated	Goose has obvious defect in the gait – trembling, unsteady
3	1/3 to 1/2 of the area is contaminated	Goose only walks with difficulty when it is driven or strongly motivated
4	More than 1/2 of the area is contaminated	Goose is unable to walk on its feet

[1] The areas that were feather scored included back, wings, and thoracoabdominal area of each randomly selected goose in each pen. Gait scoring was conducted by scanning all geese of each pen.
[2] Adapted from Mahmoud et al. (2015).
[3] Adapted from Kestin et al. (1992) and Jones et al. (2005).

2.2. Back-feather damage

Approximately 10 days after starting our experiment, we noticed that the goose back skin in some treatments was bared, so at 42 days of age, the number of the geese with or without a back feather damage in each pen was recorded, and the back-feather damage rate was calculated as the proportion of geese with back-feather damage in each pen. Data are presented as the back feather damage rate in each pen.

2.3. Feather scoring

At 69 days of age, one goose from each pen was randomly selected and feather scored. The scoring was based on the degree of feather surface contamination and was conducted by the same person, who was blind to the treatment. The areas which were scored included the back, wings, and thoracoabdominal area of each selected goose, and a scoring system from 0 (completely clean) to 4 (more than 1/2 of the area was contaminated) was used. The scoring criteria are shown in Table 1 (adapted from Mahmoud et al., 2015).

2.4. Gait scoring

At 68 and 69 days of age, all birds of each pen were individually scanned for gait score by the same person who was blind to the treatment. A scoring system from 0 (goose can walk normally) to 4 (goose is unable to walk on its feet) was used. The scoring criteria are shown in Table 1 and are based on the modification of the systems of Kestin et al. (1992) and Jones et al. (2005). Data are presented as the proportion of geese with each class of gait score in each pen.

2.5. Behavioral observations

From 60–65 days of age, five battery-operated video cameras were used to record the behaviour of the geese in each pen every day, after which the videos were observed by the same observer. Three days before recording, the geese were observed randomly for 15 min per day to determine the behavioral category and ethogram based on Van Krimpen et al. (2011) and Rodriguez-Aurrekoetxea et al. (2015). Then, three geese were randomly selected from each pen and tagged on the neck with a blue permanent marker for observation. From 60–65 days of age, one replicate of each treatment was recorded every day in the morning (from 9:00 to 10:20 h); to eliminate the artificial interference at the beginning and the end of the recording, the middle 1 h of each video was chosen for data collection. Sampling method used was all occurrences of each Behavioral category (Altmann, 1974). Data are presented as all event frequencies of the three tagged birds from each pen. Behaviour categories and the ethogram are shown in Table 2.

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