

## The Effect of Stocking Density on the Behaviour of Broiler Chickens

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**ABSTRACT** A 35-day trial was conducted to examine the influence of floor density on the behaviour of broiler chickens. Day-old male broilers ( $n=756$ ) were randomly assigned to one of four stocking densities (6 replicates of  $n=13$ , 25, 38 and 50) in 24 identical 2.6 m<sup>2</sup> pens. These stocking densities were coded very low (VL), low (L), medium (M) and high (H) and contained a floor space allowance per bird of 2,000 cm<sup>2</sup>, 1,000 cm<sup>2</sup>, 667 cm<sup>2</sup> and 500 cm<sup>2</sup>, respectively. Scan sampling of all groups was carried out at 15-min intervals during two 1-h periods (10.00 h~11.00 h and 14.00 h~15.00 h) for five days each week. The numbers of birds engaged in different behavioural activities were recorded. It was found that the most common behaviour in all densities was lying. There was no clear effect of density during wks 1~4 of the trial, but in wk 5 birds in the L, M and H groups showed lower levels ( $P=0.07$ ) of lying behaviour when compared to birds in the VL group suggesting that an increase in animal density results in decreased opportunities for undisturbed rest. This observation is supported by standing and walking behaviour, which was lower ( $P<0.05$ ) in the VL group in wk 5. Foraging behaviour measured in the study by the numbers of birds pecking the ground declined as the trial progressed, but scratching increased in 2 wk then decreased. Birds in the VL group showed higher ( $P<0.05$ ) level of pecking the ground behaviour compared to birds in the L, M and H groups, but scratching behaviour higher ( $P<0.05$ ) and lower ( $P<0.05$ ) in VL of 1 wk and 2 wk respectively. However, a peak in aggressive behaviour was observed in wk 2 and birds in the VL group showed less ( $P<0.05$ ) agonistic behaviour than birds in the H and M groups. Other behaviours (dustbathing, preening, eating or drinking) were not influenced ( $P>0.05$ ) by stocking density.

(Key words : behaviour, stocking density, broiler chickens)

## INTRODUCTION

In broiler production systems, stocking density (or floor space allowance per bird) is believed to have major implications on bird welfare and has recently been identified as an important welfare concern in Australasia (Anon, 2002). The current industry standard in New Zealand of 476 cm<sup>2</sup> floor allowance per bird (or about twenty 35 day-old birds per m<sup>2</sup>), is determined largely by economic considerations (Anon, 2003).

A number of studies have investigated the effect of various stocking densities on behavioural traits in broiler chickens as reviewed by Ekstrand (1993). It is known that increasing the stocking density leads to changes in behaviour in both commercial (Hall, 2001) and experimental conditions (Blokhuis and van der Haar, 1990; Lewis and Humik, 1990; Marttenchar *et al.*, 1997). In general, increasing the number of birds per unit area was found to increase the incidence of agonistic behaviour and reduce the amount of time spent lying or resting. Most of these studies, however, have evaluated only a narrow range of sto-

cking densities. In the present study, the effects of four stocking densities, ranging from 5 to 20 birds per m<sup>2</sup>, on the behaviour of broiler chickens were compared over a 5-week trial period.

## MATERIALS AND METHODS

### 1. Animal Ethics

Experimental procedures were approved by the Massey University Animal Ethics Committee and complied with the New Zealand Code of Practice for the Care and Use of Animals for Scientific Purposes.

### 2. Study Conditions and Design

The study was conducted in floor pens in an environmentally controlled room with 24 h fluorescent lighting. The room was divided into 24 identical 2.6 m<sup>2</sup> pens, with partitions of solid wood/wire mesh between the pens. Each pen was exactly similar in layout, with one bell drinker and one feed hopper per pen. The floor was cemented and covered in a 5 cm deep layer of

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wood shavings. Room temperature was maintained at  $32\pm 1^\circ\text{C}$  during the first week of the study and gradually decreased to  $24^\circ\text{C}$  by the end of the third week. Mechanical fans in the walls of the shed controlled ventilation.

A total of 1,000 day-old male broiler chicks obtained from a commercial hatchery. Upon arrival, the chicks were weighed and 756 birds within a weight range of 36~44 g were allocated to 24 pens as per required stocking density (13, 25, 38 or 50 birds per pen). The four stocking densities provided a floor space of 2,000 cm<sup>2</sup>, 1,000 cm<sup>2</sup>, 667 cm<sup>2</sup> or 500 cm<sup>2</sup> per bird, respectively, corresponding to 5, 10, 15 and 20 birds per m<sup>2</sup> of floor area. The allocation of birds was made to ensure minimum variation in initial weights between replicate pens. Each stocking density was assigned to six replicate pens.

The birds, raised under normal commercial management practices, were fed *ad libitum* in a two-phase broiler-feeding regime. Fresh water was freely available throughout the study. The diet regime consisted of a starter crumble for the first 21 days (21.5 % crude protein; 2950 kcal/kg apparent metabolisable energy), followed by a grower/ finisher pellet (19.5 % crude protein; 2,950 kcal/kg apparent metabolisable energy) till day 35. Feeding and drinking space available per bird was kept constant in all treatments by covering respective proportions of the feeding area in the feed hopper and drinking area in the drinker. The location of the feed hopper and the drinker were identical in each pen.

### 3. Observations

Scan samples (scan sampling) of all groups were recorded (Martin and Bateson, 2008). The observers were randomly assigned to one of the three groups of 8 pens before each recording period. Scans were made at 15-minute intervals during two 1-hour periods (10.00~11.00 h and 14.00~15.00 h) for five days each week, providing 40 records per pen per week of each behaviour. The number of birds engaged in each of the following activities was recorded in the same order every 15 minutes: lying, standing idle, locomotion (walking or running), eating from feeder, drinking, scratching ground, pecking ground, dust bathing, preening, wing stretching and flapping and agonistic behaviour.

### 4. Statistical Analysis

The data were subjected to repeated measures analysis (SAS,

2003), with pen means as the experimental unit. If significant treatment effects were observed, means were separated using the Least Significant Difference test. Significance implied  $P<0.05$ . Percentage data were converted to degrees before being analysed and subsequently back-transformed to generate an estimate of pooled standard error.

## RESULTS AND DISCUSSION

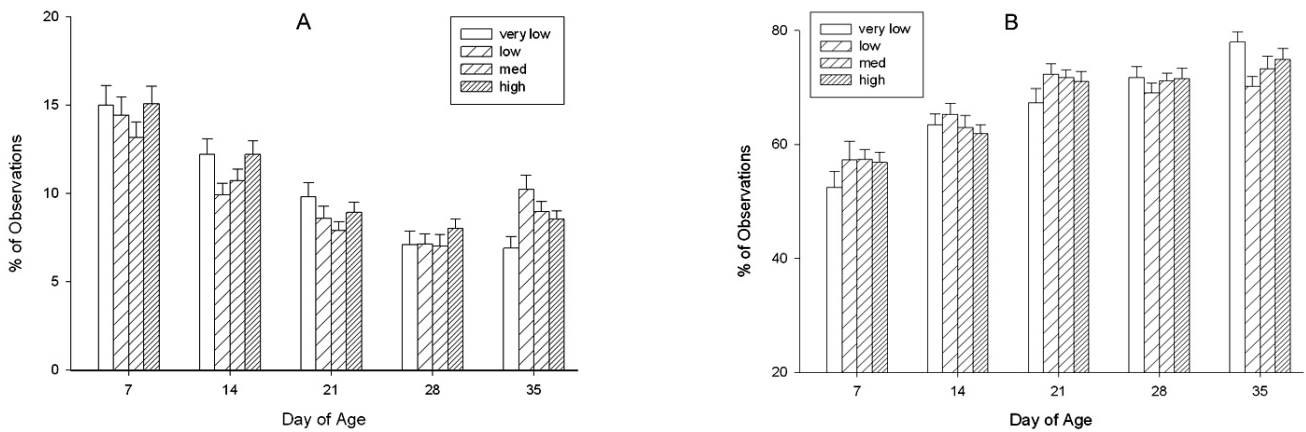
The most commonly observed behaviour in all of the densities was lying. When observations from all the groups were combined, the behaviour increased from 55.9% in the first week to 74.1% in the fifth week.

There was no clear effect of density in the first four weeks of the trial, but in week 5 birds in the L, M and H groups showed a decreased tendency ( $P=0.07$ ) to show lying behaviour when compared to birds in the VL group (Fig. 1B). This observation is supported by standing and walking behaviour, which was significantly lower ( $P<0.05$ ) in the VL group in week 5 (Fig. 1A). Other studies have shown that as stocking densities increase, chickens spend less time resting, suggesting that an increase in animal density results in decreased opportunities for undisturbed rest (Lewis and Humik, 1990; Hall, 2001).

Foraging behaviour measured in the study by the numbers of birds pecking and scratching, declined as the trial progressed, although there was a strong density effect over the first 3 weeks of the trial (Fig. 2A). Birds in the VL group showed significantly higher ( $P<0.05$ ) levels of both behaviours compared to birds in the L, M and H groups over the same 3 weeks despite this decline.

Levels of aggression were very low in the study (Fig. 2B). Selection for growth appears to have decreased aggressiveness and reduced dominance behaviour or delayed its onset, regardless of bodyweight (Ekstrand, 1993). However, a peak in aggressive behaviour was observed in week 2 and birds in the VL group showed significantly less ( $P<0.05$ ) agonistic behaviour compared to birds in the H and M groups.

The percentage of birds eating or drinking was not influenced ( $P>0.05$ ) by housing density. The drinker and feeder space available to each bird, which was constant in all groups, appeared to be the most important factor in relation to these behaviours. Similarly, for dustbathing and preening there was no clear effect



**Fig. 1.** The average percentages of birds (A) standing idle or walking and (B) lying during the trial.

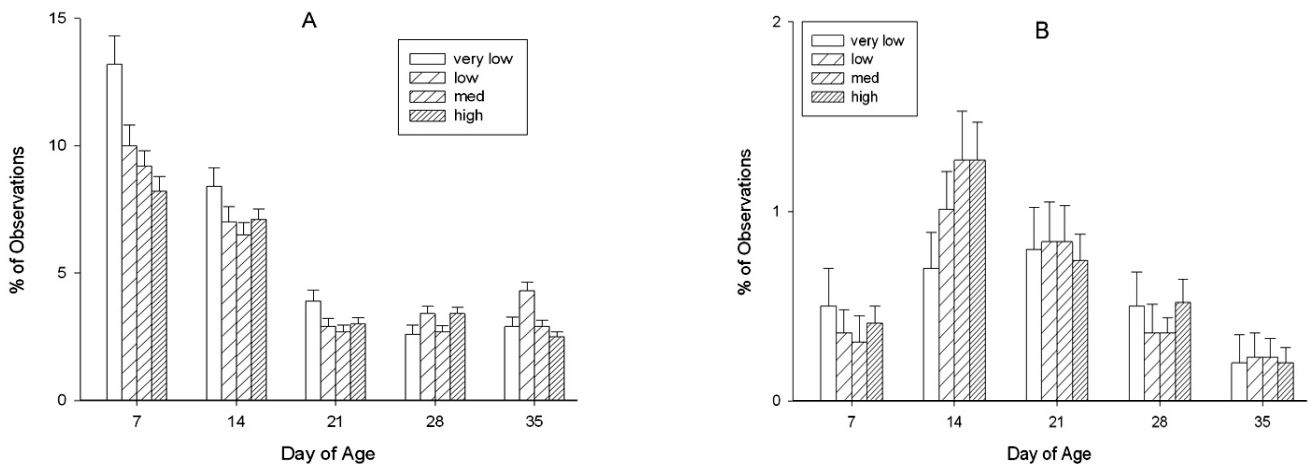
between the different densities. The average percentages of birds performing these behaviours during the trial period are shown in Table 1.

In the present study, significant ( $P < 0.05$ ) behavioural differences were observed only in the lowest density group (500 cm<sup>2</sup> per bird). Birds in this group showed more foraging behaviour in the first three weeks, and spent more time lying undisturbed in the final week of the trial. Birds in the other groups (2,000 cm<sup>2</sup>, 1,000 cm<sup>2</sup> and 667 cm<sup>2</sup> per bird), showed very similar behaviours throughout the study. This is in contrast to a study by Hall (2001), which identified behavioural differences associated with increases in stocking densities from 34 kg/m<sup>2</sup> and 40 kg/m<sup>2</sup>. Clearly these different results demonstrate an interaction between stocking density and other variables such as group size, bird type, temperature, ventilation,

litter type, and lighting and feeding regime which influences behaviour (Ekstrand, 1993). This complex interaction between stocking density and other variables needs to be explored further under the range of conditions found within the broiler industry worldwide if the welfare concerns associated with stocking densities are to be addressed.

**Table 1.** The percentages of birds feeding, drinking, dustbathing, and preening, averaged over all densities

Behaviour	Week 1	Week 2	Week 3	Week 4	Week 5
Feeding	3.9	6.3	6.3	7.4	6.0
Drinking	2.9	3.3	4.4	3.3	3.0
Dustbathing	0.1	0.4	0.4	0.8	0.2
Preening	4.4	4.4	3.8	4.9	3.5



**Fig. 2.** The average percentages of birds (A) pecking and scratching and (B) displaying aggression during the trial.

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