

Department of Animal Hygiene,
Fac. of Vet. Med., Assiut University.

**STUDY ON THE EFFECT OF STOCKING DENSITY
AND FLOOR SPACE ALLOWANCE ON BEHAVIOUR,
HEALTH AND PRODUCTIVITY
OF TURKEY BROILERS**
(With 4 Tables and 2 Figures)

By

M.A. ABDEL-RAHMAN

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دراسة على تأثير الكثافة العددية والمساحة المتاحة من الأرضية على
سلوكيات وصحة وإنتاجية بدارى الرومى

معتز أحمد محمد عبد الرحمن

أجريت هذه التجربة بغرض دراسة تأثير الكثافة العددية والمساحة المتاحة من الأرضية على مدى إراحة بدارى الرومى النامية. أستخدم فى هذه التجربة عدد ٦٠ من بدارى الرومى النامية (٣٠ ذكور و ٣٠ إناث) من السلالة المحلية الغير مقلمة المنقار. قسمت هذه الطيور بطريقة عشوائية إلى ثلاث مجموعات بحيث كانت كل مجموعة مكونة من ١٠ ذكور و ١٠ إناث. تم تسكين المجموعات فى غرف جيدة التهوية والإضاءة تحت الظروف البيئية السائدة. غذيت هذه الطيور طوال فترة التجربة الممتدة من عمر أسبوع حتى عمر ١٢ أسبوع بحرية على مخلوط المركزات الخاص بدارى الرومى النامية مع استخدام العدد الكافى من الغذائية وتوزيعها بطريقة مناسبة فى الغرفة. كانت الكثافة العددية المستخدمة فى هذه التجربة كالتالى:- المجموعة الأولى :- ٥ طائر / م^٢ (مساحة الأرضية للمجموعة = ٤ م^٢). المجموعة الثانية :- ٦,٥ طائر / م^٢ (مساحة الأرضية للمجموعة = ٣,٥٨ م^٢). المجموعة الثالثة :- ٨ طائر / م^٢ (مساحة الأرضية للمجموعة = ٢,٥ م^٢). تم ملاحظة سلوكيات هذه الطيور وحالتها الصحية أثناء التجربة وأخذت عينات دم منها وذلك لتحديد مستوى هرمون الكورتيكوستيرون بها. كذلك تم تسجيل أوزان هذه البدارى بنهاية فترة التجربة. أثبتت النتائج التى تم الحصول عليها أن الكثافة العددية العالية أتت بانعكاسات سلبية واضحة على سلوكيات بدارى الرومى النامية وحالتها الصحية وأوزانها وكذلك مستوى هرمون الكورتيكوستيرون بدمها. وقد أوصت النتائج بوضع الكثافة العددية المناسبة والمساحة المتاحة من الأرضية فى الاعتبار وذلك عند تربية بدارى الرومى النامية وتصميم مساكنها.

SUMMARY

This experiment was carried out to study the effect of stocking density and floor space allowance on the welfare of growing turkey broilers. 60 non-beak trimmed, sexed one week old growing turkey broilers of the native breed were used in this investigation (sex ratio equal to one). Birds were randomly assigned into 3 groups, each of 20 broilers, 10 males and 10 females. Each group was housed under the prevalent environmental conditions in a well ventilated and well lighted room with different floor areas according to the experimented stocking density. Birds were freely fed the commercial concentrate mixture for the growing turkey broilers where the maximum necessary number of feeders was eventually distributed through the room. Drinking tap water was freely available throughout the experiment. Each group of the experimented turkeys was reared from one week old to 12 weeks old under one of the following stocking densities: 1-Treatment one (T1): 5 birds / m² where the total floor area = 4 m² 2-Treatment two (T2): 6.5 birds / m² where the total floor area = 3.08 m² 3-Treatment three (T3): 8 birds / m² where the total floor area = 2.5 m². The behavior of the broilers under experiment was observed and recorded. Plasma corticosterone level was estimated. Body weight was calculated and its health status was observed. The obtained results indicated that turkey welfare was poorer at the highest stocking density with a significant reflection on their behavior, blood corticosterone level, body weight and health status. Therefore, stocking density and floor space allowance must put in consideration during rearing of turkeys and construction of their farms.

Key words: Stocking density, behaviour, productivity, Turkey

INTRODUCTION

Welfare is a very important matter in poultry industry. Concern about the welfare of broilers has recently increased specially during the final weeks of the rearing period when the weight of birds per m² is high (FAWC, 1992, 1995). As with broilers, welfare problems in turkeys at high stocking densities could include decreased walking activity because of the limited floor space available (Blokhuys & Van der Haar, 1990 and Lewis & Hurnik, 1990). Birds may walk over other crouching birds and thus causing lesions as clawed feet scratch the hips of resting birds

(Proudfoot and Hulan, 1985). In addition, resting birds may be continuously disturbed and distressed by other walking birds (Martrenchar *et al.*, 1997). Moreover, Birds may be obliged to lie more often on litter of poor quality because of the high faecal content. Consequently, damage to the breast and feet may occur (Harms & Simpson, 1977; Martland, 1984 and Ekstrand & Algers, 1997).

It is well documented that the final weight of turkey broilers decreases when stocking density increases (Coleman & Leighton, 1969; Proudfoot *et al.*, 1979; Denbow *et al.*, 1984; Moran, 1985; Noll *et al.*, 1991 and Martrenchar *et al.*, 1999). On the other hand, although many authors have considered the effect of density on behavioral and health traits of chicken broilers, few studies have considered turkey broilers (Denbow *et al.*, 1984; Leighton *et al.*, 1985; Moran, 1985 and Ekstrand & Algers, 1997).

Therefore, the aim of the present study is to focus on the effect of stocking density on the welfare of turkey broilers reared under commercial conditions.

MATERIALS and METHODS

I- Birds and housing: -

60 non-beak trimmed, sexed one week old growing turkey broilers of the native breed were used in this investigation (sex ratio equal to one). Birds were randomly assigned into 3 groups, each of 20 broilers, 10 males and 10 females. Each group was housed under the prevalent environmental conditions in a well ventilated and well lighted room with different floor areas according to the experimented stocking density. The floor was cemented and the litter was of wood shavings, about 7 cm thickness. Birds were freely fed the commercial concentrate mixture for the growing turkey broilers where the maximum necessary number of feeders were eventually distributed through the room. Drinking tap water was freely available throughout the experiment.

II- Experimental design: -

Each group of the experimented turkeys was reared from one week old to 12 weeks old under one of the following stocking densities:

1-Treatment one (T1) 5 birds / m²: total floor area = 4 m²

2-Treatment two (T2) 6.5 birds / m²: total floor area = 3.08 m²

3-Treatment three (T3) 8 birds / m²: total floor area = 2.5 m²

These stocking densities were chosen according to practical considerations. T1 (5 birds / m²) is the density recommended by welfare

code for turkeys issued by the agriculture departments of the United Kingdom (FAWC, 1995). T3 (8 birds / m²) is the average density of commercial turkey flocks (Koehl, 1995). However, T2 (6.5 birds / m²) is an intermediate density recommended by Martrenchar *et al* (1999).

These treatments resulted in the following floor space allowance per bird :-

1-Treatment one (T1) 5 birds / m² : 20 dm²

2-Treatment two (T2) 6.5 birds / m² : 15.4 dm²

3-Treatment three (T3) 8 birds / m² : 12.5 dm²

III- Procedures: -

The experiment was carried out for 11 consecutive weeks starting from the week 2 till the week 12 of age.

A-Behavioural observations: -

The behavior of the broilers under experiment was observed and recorded according to Martrenchar *et al.* (1999) using focal sampling technique in which each hour was divided into 6 sessions, 10 minutes each, and the behavior of birds was observed independently during each session. Bird's behavior was observed at weeks 6, 9 and 12. Turkeys were observed for 3 hours / day for 3 days / week. The behavioral observations were carried out in the morning between 9:00 and 12:00 during the 1st day, in the afternoon between 12:00 and 15:00 during the 2nd day and before dusk between 15:00 and 18:00 during the 3rd day. This design of observation gave a chance to observe the broilers in each housing condition for one hour / day for 3 days / week for 3 weeks. Behavioral observation was carried out using the scan sampling method according to Altmann (1974) where the observer can study all tested hens without being seen by them. By the end of the experiment, the percentage of each observed behavioral activity was calculated.

Behavior was classified into 7 mutually exclusive categories: -

Standing: -

Where the bird standing or walking and not performing any other categorized activity (Martrenchar *et al.*, 1999).

Resting: -

Where the bird lying on the litter and not performing any other categorized activity (Martrenchar *et al.*, 1999).

Feeding: -

Where the bird pecking at or eating the food (Denbow *et al.*, 1984).

Drinking: -

Where the bird dipping its beak into water or swallowing (Denbow *et al.*, 1984).

Pecking at the environment: -

Where the bird pecking or scratching litter, walls, food troughs or waterers (Aerni *et al.*, 2000).

Pecking at another bird: -

Where the bird pecking the plumage or other tissues of other birds with or without pulling feathers (Aerni *et al.*, 2000).

Preening: -

Where the bird nibbling, stroking or combing her plumage with the beak (Kjaer and Sorensen, 1997).

B- Plasma corticosterone concentration: -

Estimation of plasma corticosterone level is considered of reliable indicator for assessment the adverse effects that directly inflicted on health and behavior of birds from exposure to stressors of the housing environment (Dantzer and Mormede, 1983). During the last two days of the 11 weeks experimental period, one blood sample / day was taken from 3 males and 3 females / treatment according to Yahovs *et al.* (1997) by puncturing the brachial vein into Epindoorf's tubes containing EDTA anticoagulant. The tubes were kept at the room temperature for 30 minutes then stored at a refrigerator for 60-90 minutes and then centrifuged at 3000 r.p.m for 10 minutes and the separated plasma was transferred to another Epindoorf's tube using micropipette. The plasma samples were kept at -20 °C until analysis where they were estimated for their levels of corticosterone using TDxFLx system with fluorescence polarization and competitive binding techniques according to Dandliker & Feigen (1970) and Dandliker & Saussure (1973).

C- Productivity: -

Male and female turkey broilers were weighed by the end of week 12 to determine the final body weight of each sex reared under different stocking densities.

D- Healthy state of the body: -

By the end of this experiment, broilers were examined for presence of the following body lesions according to Martrenchar *et al.* (1999): -

- 1-Breast lesions (blisters, pustules or haematoma)
- 2-Foot lesions (dermatitis).
- 3-Hip lesions (scratches and scabs).

IV- Statistical analysis: -

Statistical analyses of the collected data were carried out according to procedures of completely random design, SAS (1995).

RESULTS

The results of this study were illustrated in tables 1,2,3 and 4.

DISCUSSION

I- Stocking density and behavior of turkey broilers: -

The data represented in table (1) and assimilated on figure (1) showed the effect of stocking density and floor space allowance on standing, resting, feeding, drinking, pecking the environment, pecking another bird and preening activities of growing turkey broilers. These data revealed that, stocking density and floor space allowance had a significant effect on standing, resting and pecking another bird ($p < 0.01$). However, other activities were not significantly affected.

With regard to standing, resting and pecking another bird, the obtained data indicated that the percentage of these activities as a result of housing of the experimented birds under the previously mentioned treatments of stocking density and floor space allowance (T1, T2 and T3) were 27.3, 40.1, 53.3 for standing; 43.1, 32.7, 19.6 for resting and 2.7, 2.8, 6.2 for pecking another bird, respectively. This finding indicated that, low stocking density was reflected with more floor space allowance for each bird which encouraged them to lay down and get more rest. However, the frequency of disturbance of resting turkeys by other birds tended to be higher when stocking density increased and so, the percentage of resting activity decreased while that of standing one increased (Blokhuis and Van der Haar, 1990; Lewis and Hurnik, 1990 and Martrenchar *et al.*, 1999). As a result of this stressful situation with overcrowdness and decreased floor space allowance during T3 (8 birds/m²), pecking of other birds was significantly increased.

With regard to feeding, drinking, pecking the environment and preening, the obtained data indicated that the percentage of these activities were 8.5, 7.2, 6.8 for feeding; 12.1, 11.1, 9.2 for drinking; 3.3, 2.2, 2.4 for pecking the environment and 3.0, 3.9, 2.5 for preening as a result of housing of the experimented birds under T1, T2 and T3, respectively. These data indicated that, such activities were not significantly affected by the stocking density and floor space allowance ,

a finding which agreed with Denbow *et al.* (1984); Cunningham *et al.* (1992); Classen *et al.* (1994) and Martrenchar *et al.* (1999).

II- Stocking density and blood corticosterone of turkey broilers: -

Exposure of birds to emotional stimuli results in a conduction of nervous impulses from the cerebral cortex to hypothalamus with consequent release of adrenocorticotrophic hormone from the anterior pituitary with resultant release of glucocorticoids from the adrenal cortex which have a great role in mobilizing glucose to deal with homeostasis challenge (Seyle's, 1976 & Gross and Siegel, 1983). The data represented in Table (2) and assimilated on figure (2) showed the effect of stocking density and floor space allowance on the average plasma corticosterone level of the experimented turkey broilers. These data revealed that, stocking density and floor space allowance had a significant effect on the plasma corticosterone level of both male and female growing turkey broilers ($p < 0.01$). Average plasma corticosterone levels of turkey broilers were 7.13, 12.59, 18.12 $\mu\text{g}/100 \text{ ml}$ for males and 6.92, 10.86, 17.43 $\mu\text{g}/100 \text{ ml}$ for females when they were housed under the conditions of T1, T2 and T3, respectively. This finding indicated that, increased stocking density is a stressful situation reflected with a significant increase in the plasma corticosterone concentration of both male and female growing turkey broilers.

III- Stocking density and productivity of turkey broilers: -

The data represented in table (3) showed the effect of stocking density and floor space allowance on body weight of growing turkey broilers. These data indicated that, stocking density and floor space allowance had a significant effect on the final weight of the experimented male and female growing turkey broilers ($p < 0.01$). Average final weights of turkeys were 4450, 3900, 3300g for males and 3660, 3150, 2600g for females when they were housed under the conditions of T1, T2 and T3, respectively. This finding illustrated that, the final body weight of growing turkey broilers was linearly decreased when the stocking density increased and the floor space allowance decreased although feeder space per bird was the same in each treatment. This finding agreed with Martrenchar *et al.* (1999) and may be related to the stress and disturbance resulted from increased density with more competition during the feeding activity (Coleman and Leighton, 1969; Proudfoot *et al.*, 1979; Denbow *et al.*, 1984; Moran, 1985 and Noll *et al.*, 1991).

IV- Stocking density and health status of turkey broilers: -

The data represented in table (4) showed the effect of stocking density and floor space allowance on the occurrence of breast lesions, foot lesions and hip lesions of growing turkey broilers. These data indicated that, stocking density and floor space allowance had a significant effect on the occurrence of these lesions ($p < 0.01$). The occurrence of these lesions were 0, 0, 25 for breast lesions; 0, 0, 40 for foot lesions and 0, 0, 60% for hip lesions when they were housed under the conditions of T1, T2 and T3, respectively.

The higher percentage of the occurrence of foot lesions in growing turkey broilers when reared under the conditions of T3 (the average density of commercial turkey flocks) may be related to wetting or dampness of the litter due to high faecal contents and water spillage around the waterers as a result of increased disturbance and crowding, a finding that resulted in increased ammonia and other corrosive substances which could be a litter irritant and led to foot dermatitis (Harms and Simpson, 1977 and Martland 1984 & 1985). Moreover, reduced mobility following increased density resulted in increased occurrence of breast lesions where the birds' breasts would spend more time in contact with this wet litter (Ekstrand & Algers, 1997 and Martrenchar *et al.*, 1999). However, The higher percentage of the occurrence of hip lesions in growing turkey broilers reared under increased density may be resulted from overcrowding and walking of disturbed birds over other crouching birds and thus causing hip lesions with their clawed feet (Proudfoot and Hulan, 1985).

CONCLUSION

In conclusion, under the present experimental conditions, increased stocking density and decreased floor space allowance were stressful conditions that had potentially deleterious effects on the welfare of growing turkey broilers with a significant reflection on their behavior, blood corticosterone level, body weight and health status. Therefore, stocking density and floor space allowance must be put in consideration during rearing of turkeys and construction of their farms.

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Table 1: Effect of the studied stocking densities on the behavior of growing turkey broilers

Item	Stocking densities		
Behavior	T1 (5birds / m ²)	T2 (6.5birds / m ²)	T3 (8birds / m ²)
.....Average % of total activity.....			
Standing	27.3±2.1 ^a	40.1±1.9 ^b	53.3±3.2 ^c
Resting	43.1±1.5 ^a	32.7±1.3 ^b	19.6±1.6 ^c
Feeding	8.5±1.4	7.2±0.8	6.8±0.9
Drinking	12.1±0.6	11.1±0.4	9.2±0.6
Pecking the environment	3.3±0.3	2.2±0.1	2.4±0.1
Pecking another bird	2.7±0.3 ^a	2.8±0.1 ^a	6.2±0.2 ^b
Preening	3.0 ±0.2	3.9±0.3	2.5±0.1

Figures in the same row with different superscripts differs significantly (p < 0.01).

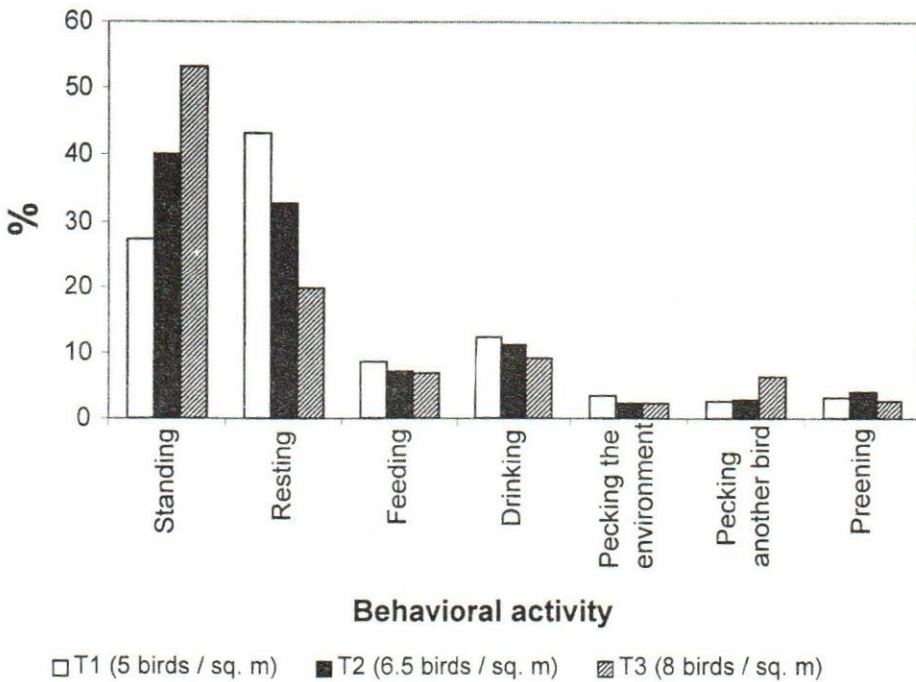


Fig. (1): - Effect of the studied stocking densities on the behavior of growing turkey broilers

Table 2: Effect of the studied stocking densities on plasma corticosterone level of growing turkey broilers

Item	Stocking densities		
	T1 (5birds / m ²)	T2 (6.5birds / m ²)	T3 (8birds / m ²)
.....Average in µg / 100 ml			
Male	7.13±0.81 ^a	12.59±1.16 ^b	18.12±1.31 ^c
Female	6.92±0.91 ^a	10.86±1.21 ^b	17.43±1.26 ^c

Figures in the same raw with different superscripts differs significantly (p < 0.01).

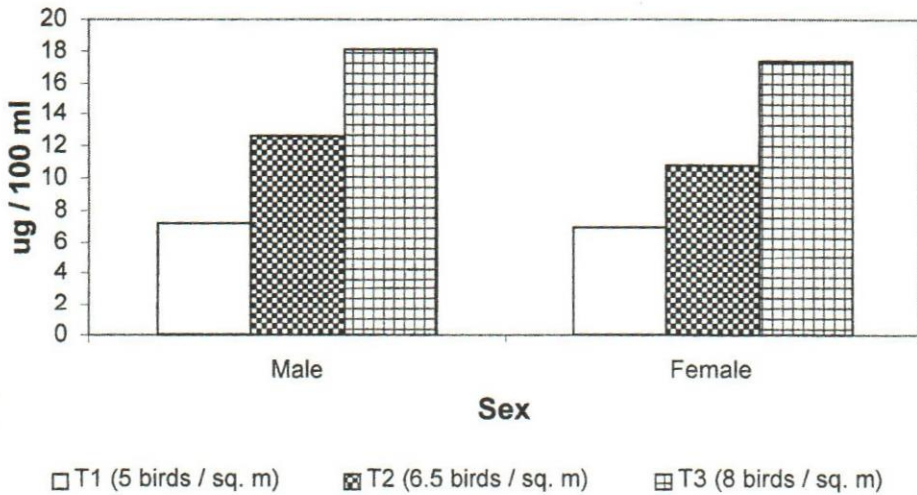


Fig. (2): - Effect of the studied stocking densities on plasma corticosterone level of growing turkey broilers

Table 3: Effect of the studied stocking densities on body weight of growing turkey broilers

Item	Stocking densities		
	T1 (5birds / m ²)	T2 (6.5birds / m ²)	T3 (8birds / m ²)
.....Average in gram.....			
Male	4450±150 ^a	3900±120 ^b	3300±130 ^c
Female	3660±110 ^a	3150±150 ^b	2600±110 ^c

Figures in the same raw with different superscripts differs significantly (p < 0.01).

Table 4: Effect of the studied stocking densities on the health state of the body of growing turkey broilers

Item	Stocking densities		
	T1 (5birds / m ²)	T2 (6.5birds / m ²)	T3 (8birds / m ²)
.....% of occurrence			
Breast lesions	0 ^a	0 ^a	25 ^b
Foot lesions	0 ^a	0 ^a	40 ^b
Hip lesions	0 ^a	10 ^a	60 ^b

Figures in the same raw with different superscripts differs significantly (p < 0.01).