GLOBAL JOURNAL OF PURE AND APPLIED SCIENCES, VOL.7, NO. 4, SEPTEMBER 2001: 641-645
 ISSN 1118-0579

ASSESSMENT OF STOCKING DENSITIES ON THE PERFORMANCE, BEHAVIOUR AND CARCASS CHARACTERISTICS OF BROILER CHICKENS IN THE HUMID TROPICS

SAMUEL. A. OFFIONG, EMMANUEL S. BAMIGBOYE and OLUSEGUN O. OJEBIYI

(Received 9 January 2001; Revision accepted 16 May, 2001)

ABSTRACT

A study was conducted to determine the effect of floor space on the performance, agonistic behaviour and carcass characteristics of broiler chickens raised in a humid tropical environment. A total of three hundred and sixty (360) five weeks old broiler chickens were used in the study. Six different stocking densities (treatments) were assessed (0.037m^2, 0.056m^2,0.074m^2, 0.093m^2, 0.100m^2 and 0.128m^2 per bird) with 0.093m^2 per bird serving as the control. Results showed that the parameters measured - weight gain, feed consumption, final liveweight, feed conversion ratio, carcass characteristics and mortality were not significantly affected by treatment. The frequency of vice habits (pecking, threat and chasing) increased linearly as stocking density decreased and the frequency of breast blisters, hock burns, and leg weakness increased as stocking density increased. There was significant decrease in the frequency of walking, dust bathing and scratching behaviours as stocking density increased. Birds in the more crowded pens (0.037m^2 and 0.056m^2 per bird) had low resistance to stress, which resulted in relatively high mortality rates.

Key words: Broiler Chickens, stocking density, vice habits, dressing percentage, Carcass Characteristics.

INTRODUCTION:

The welfare of farm animals is an important requirement which farm operators need to ensure in the management of their stock for maximum productivity. This is very crucial in our modern day intensive animal production. One of the major problems of broiler production in the tropics has been that of limited information on stocking density or space requirement for optimum performance of the chickens. In this respect, most recommendations in use in Nigeria are based on those made from studies conducted under the temperate environment. The applications of such specifications have not always been too conducive for maximum productivity in our tropical environment. Only limited work has been done to properly establish the effects of stocking density on the performances of broiler chickens raised under tropical conditions. More information is required in this area of husbandry in order to obtain values that would be widely applicable in Nigeria.

Increasing stocking density has been observed to depress market weight (Deaton et al 1968; Proudfoot et al 1979, and Hughes and Allen, 1985). On the other hand, increasing bird density has been found to have no influence on final body weight but resulted in less efficient feed conversion (Casteel et al 1994).

In enclosed commercial broiler operations, fixed stocking densities of up to 20 birds per square meter are typical (Elson 1993). This represents approximately 5kg and 8kg per square meter in the 2nd and 4th weeks respectively of the birds' life. This may present little discomfort during this growth phase, but may result in reduced comfort later in life in terms of locomotion and other activities. In addition, there will be increased contact with soiled litter, which may predispose the birds to dermatitis (McIlory et al 1987).

Several authors have given different recommendations on space allowance for broiler chickens. These include 0.078m^2 per bird (Bolton et al 1972); 0.0988m^2

SAMUEL A. OFFIONG, Department of Animal Science, Faculty of Agriculture, University of Uyo, Uyo, Nigeria
EMMANUEL S. BAMIGBOYE, Federal Ministry of Agriculture, Uyo, Nigeria
OLUSEGUN. O. OJEBIYI, Federation for Economic and Training, (FERT) Uyo, Nigeria

per bird, (Proudfoot 1973), $0.692m^2$ per bird (McDonald 1976) and $0.064m^2$ and $0.074m^2$ per bird (Offiong et al 1979).
The objective of the present study was to evaluate the effect of different stocking densities on the performance, behaviour and carcass characteristics of broiler chickens raised under humid tropical environment.

MATERIALS AND METHODS

A total of three hundred and sixty (360) chickens were used in the experiment. The birds had been raised to 5 weeks of age before they were put on the study. They were housed in an open sided poultry house partitioned into pens, which were separated, by wooden partitions and wire netting. The Completely Randomised Experimental Design (CRD) was used. There were 6 treatments, each having two replicates. Each replicate consisted of thirty (30) birds so that each treatment had sixty (60) birds. The birds were weighed into groups and the weights adjusted such that the average initial weights of the groups were statistically similar. The groups were randomly assigned the following floor spaces per bird;

Treatment 1- $0.037m^2$ /bird
Treatment 2- $0.056m^2$ /bird
Treatment 3- $0.074m^2$ /bird
Treatment 4- $0.093m^2$ /bird
Treatment 5- $0.100m^2$ /bird
Treatment 6- $0.128m^2$ bird
(Treatment 4- $0.093m^2$ /bird served as the control).

Weighed quantities of feed were provided daily for the duration of the experiment. Water was also provided *ad libitum*. Weekly feed consumption and weekly weights were recorded. At the end of the experiment the final body weights, overall feed consumption and weight gain were used to compute the efficiency of feed utilization for the groups. Mortality in the different treatment groups was accurately recorded. The behaviour of the birds in each group in feeding, drinking, standing, walking, dozing, squatting, chasing, stretching and preening habits were recorded daily at regular intervals (morning, 8 - 9a.m., afternoon, 1 – 2p.m. evening, 5 - 6p.m.). The experiment ended when the birds were 9 weeks old. Two birds per replicate i.e four birds per treatment (2 males and 2 females) were randomly selected for carcass evaluation. The birds were fasted for 18 hours before being slaughtered. They were weighed prior to killing which was done by cervical dislocation as described by Bremner (1977). They were immersed in hot water to loosen the feathers. After plucking the carcasses were weighed, dressed and cut up for weighing to determine the effect of the treatments on the body parts.
Data collected were subjected to analysis of variance procedure according to Steel and Torrie (1960). Duncan Multiple Range Test, as outlined by Steel and Torrie (1960), was used to determine the significance of the differences at the 5% level of probability.

RESULTS:

The performance of the birds in the various parameters is presented in table 1. The results show progressive increase in mean liveweight across treatments as stocking density decreased. Birds in treatments 1 ($0.037m^2$/bird) and 2 ($0.056m^2$/bird) had lower final body weights as compared to the control ($0.093m^2$/bird), treatment 5 ($0.100m^2$/bird) and treatment 6 ($0.128m^2$/bird). These differences were however not statistically significant ($p>0.05$).
The cumulative feed intake increased linearly as stocking density decreased, though the differences were not statistically significant ($p>0.05$). The values obtained for feed conversion ratio and weight gain were not significantly different ($P>0.05$) among the groups. Mortality occurred only in the high-density treatment groups ($0.037m^2$/bird and $0.056m^2$/bird).
Data on carcass characteristics and organ weights are presented in Tables 2 and 3 respectively. Mean values in respect of thigh and drumstick, wing breast and neck weights showed that the different floor space treatments did not significantly affect these parameters. The different stocking densities did not significantly affect the weight of any of the organs expressed in g/100g body weight. The dressing percentages also were not significantly affected by the treatments. The observations on behavioural characteristics are presented in Table 4, as the mean for the four weeks. On the average 17 birds (the highest) were seen feeding in treatment 6; 12 birds (the least) were seen in treatment 1 and 14 birds in the control. From our observation the different stocking densities did not appear to affect walking, standing, drinking, sleeping/dozing or chasing/pecking behavioural characters.

DISCUSSION:

In this experiment final body weight of the birds became depressed as stocking density increased. This observation agrees with the findings of Deaton et al (1968), Proudfoot et al, (1979), Offiong et al, (1979) and Hughes and Allens (1985). This could be associated with limitation of feeding space due to overcrowding or competition for feed. This may suggest that the effects of over-crowding could be overcome by increasing feeder space. On the other hand, a tendency towards an increase in feed intake was observed as floor space increased, suggesting that densely stocked birds had little or insufficient room for feeding, a finding similar to that of Bolton et al (1972). The feed consumption of broiler chickens was depressed as floor space per bird decreased progressively from 0.093m² to 0.037m². It is also possible that with closer body contact in the densely stocked pens, the birds insulated themselves to reduce heat loss thus resulting in reduced demand for feed energy and consequently showed reduced feed intake since birds eat to satisfy their energy requirement. This fact may partly account for reduced feed consumption as the floor space per bird decreased. Observations on body weight gain in this study were consistent with that of Offiong et al (1979) and Frazer and Broom (1990). Adams and Craig (1985) also observed decreased productivity function in both weight gain and final body weights with increased stocking density.

Feed conversion ratios of birds in treatments 1,2,5, and 6 indicated that those birds were less efficient than birds in treatments 4 (the control) and 3, although the differences were not significant (p>0.05). This was not consistent with the report of Casteel et al (1994) and Cravener et al (1992).

Mortality was observed in the high-density treatment groups: 0.037m² per bird (13.33%) and 0.056m² per bird (5%). This may be stress related, resulting from reduced resistance due to adverse conditions imposed

TABLE 1:

Effects of Stocking density on the Performance Characteristics of Broiler Chickens (5-9 Weeks)

PERFORMANCE CHARACTERISTICS	FLOOR SPACE PER BIRD (M²) 0.037	0.056	0.074	0.093	0.100	0.128
Mean initial liveweight (kg)	0.60	0.62	0.61	0.60	0.62	0.65
Mean final liveweight (kg)	1.67±0.102	1.74±0.085	1.78±0.034	1.80±0.023	1.79±0.120	1.83±0.014
Mean final liveweight gain (g/bird)	1070±90.12	1120±76.46	1170±68.29	1201±101.01	1170±70.92	1180±77.02
Mean cumulative feed intake (g/bird)	2608±42.0	2674.50±38.68	2740±50.70	2826.50±72.92	2881±82.8	2948±99.08
Feed conversion ratio	2.44	2.39	2.34	2.35	2.45	2.50
Mortality (%)	13.3	5	-	-	-	-

TABLE 2:

Effect of floor space on Carcass Characteristics of Broiler Chickens at 9 Weeks of age

FLOOR SPACE/BIRD (M²)	DRESSING %	BREAST WEIGHT (g)	WING WEIGHT (g)	THIGH/DRUM STICK WEIGHT (g)	NECK WEIGHT (g)
0.037	66.74±60	297.18±13.0	73.58±2.4	189.81±18.1	50.46±6 1
0.056	68.75±4.6	285.53±38.4	70.75±6.7	173.24±20.9	45 48±2.6
0.074	69.68±11.7	289.30±41.6	60.31±6.9	155.54±18.7	44.12±8.3
0.096 (Control)	65.38±8.2	283.44±41.5	72.64±4.3	172.64±16.3	47.69±8.2
0.100	64.74±43	443.16±43.3	64.74±2.2	154.07±11.5	40.99±1.8
0.128	69.52+7.0	303.57+57.4	71.51+4.3	186.12+44.9	52.90+3.2

TABLE 3:

Effect of floor space on Organ Weight of Broiler Chickens (9 weeks of age) g/100g body weight

FLOOR SPACE/BIRD (M²)	LIVER	GIZZARD	HEART	SPLEEN
0.037	2.92	1.94	0.43	0.15^{ab}
0.056	2.91	2.30	0.45	0.14^{ab}
0.074	3.08	2.07	0.50	0.14^{ab}
0.093	3.09	2.29	0.51	0.18^{a}
0.100	3.05	2.45	0.40	0.13^{b}
0.128	2.84	2.19	0.38	0.18^{a}

^{ab} Mean values with same superscript along the column are not significantly different (p>0.05)

TABLE 4:

Effect of different floor spaces on some Behavioural/Patterns of Broiler Chickens subjected to different Stocking densities from 5-9 weeks of age

BEHAVIOUR	FLOOR SPACE/BIRD (M²) 0.037	0.056	0.074	0.093	0.100	0.128
	NUMBER OF BIRDS PERFORMING DIFFERENT ACTIVITIES/HOUR					
Feeding	12	13	13	14	15	17
Standing idly	3	5	6	9	11	12
Drinking	6	9	11	12	12	14
Walking about	3	4	7	10	13	15
Sleeping/dozing	18	15	12	11	7	5
Chasing/pecking	2	3	5	8	10	11

by the restricted floor space. Casteel et al, (1994) reported that increasing stock density seemed to stress birds and such birds exhibit low resistance because the stress has lowered their ability to produce antibodies.

The problem of wet litter was observed mostly in the highly stocked groups, thus confirming similar observations by Al-Rawi and Craig, (1975); Adams and Craig, (1985); Cravener et al (1992); Gordon and Tucker, (1993); Matthes, (1993), Thomson, (1993), and New-berry and Hall, (1988). In addition to wet litter, Proudfoot et al (1979), reported high levels of ammonia production in such litter. Management problems especially involving feeding and watering after about 6 weeks of age have been reported in pens with densely stocked birds (Al-Rami and Craig, 1975, Adams and Craig, 1985; Cravener et al 1992, Lewis and Hurnik, 1990, Proudfoot et al, 1979; Gordon and Tucker, 1993, Matthes, 1993; Thomson, 1993, and Newbery and Hall, 1988).

In the present study, it was observed that most of the birds tended to sit on their hocks in the densely stocked groups (treatments 1, and 2) as compared to the other groups. Movement of attendants and birds within the pens was relatively difficult. It was observed that sleeping/dozing behaviour tended to increase with increase in stocking density. This observation agrees with the findings of Meddis (1975) that there was increased sleeping and dozing and reduced activity in broilers of high stocking densities. Murphy and Preston, (1988), also reported that lying time is a function of both stocking density and total space availability.

Observations on locomotory behaviour suggest reduced movement with birds stocked at high density, thus agreeing with the reports of Andrew et al (1997), Blokhuis and Van de Har, (1990), Newberry and Hall, (1988).

Agonistic behaviour as observed, showed that vice habits (pecking and chasing) tended to increase as stocking density decreased, thus agreeing with the reports of Murphy and Preston, (1988), Okpokho et al; (1987) and Uner et al (1997).

Observation on feeding and drinking behaviours showed that a higher number of birds at lower stocking density were engaged in feeding and drinking. This observation is at variance with that of Casteel et al, (1994). However, a greater number of birds under the high stocking density (treatments 1, and 2) spent more time sleeping and dosing, observation similar to that of Uner et al (1997).

Apart from the spleen weights that were significantly affected ($P < 0.5$) by the treatments, the stocking densities did not affect the other organ weights. Freeman, (1982), however, explained that the spleen as a lymphoid tissue could be affected when stocking density is employed as a stressor, but in this experiment the spleen weights of the most densely stocked groups were of medium sizes. Treatment 5 ($0.100m^2$ spacing) having the least spleen weight (0.13g) could be due to an abnormality which was difficult to explain.

CONCLUSION:

In conclusion it was observed under the condition of this experiment, that the higher stocking densities depressed performance somewhat. The stocking density of $0.074m^2$/ bird appeared to be the maximum that could be applied beyond which performance was depressed. The frequency of beneficial activities such as feeding, drinking, standing and walking about and even dust bathing were depressed beyond $0.074m^2$/bird, indicating that beyond this level adverse effects begin to manifest. It is noteworthy how the frequencies of these beneficial activities correlate with improved performance, which is not unconnected with the welfare of the birds in the experiment.

The more crowded pens ($0.037m^2$ and $0.056m^2$) per bird were most severely affected resulting in high mortality rates. Activities such as walking, dust bathing, scratching increased as stocking density decreased.

REFERENCES

Adams, A. W. and Craig, J. V., 1985. Effect of crowding and cage shape on productivity and profitability of caged layers. A survey. Poultry Sci., 64:238-1242.

Al-Rawi, B. and Craig, J. V., 1975. Agonistic behaviour of caged chickens related to group size and area per bird. Appl. Anim. Ethol. 2:29-80.

Andrew, S. M., Omed, H. M. and Philips, C. J. C. 1997. The effect of a single or repeated period of high stocking density on the behaviour and response to stimuli in broiler chickens. Poultry Sci. 76: 1655-1660.

Blokhuis, H. J. and Van de Har, J. W., 1990. The effect of stocking density on the behaviour of broilers. Arch. Geflugelked. 54: 74-77.

Bolton, W., Dewer, W. A. and Jones, R. M., 1972. Effect of stocking density on performance of broiler chickens. Brit. Poult. Sci. 13:157-162.

Bremner, A. S., 1977. Poultry meat hygiene and inspection - Bailliere Tindall. London. pp. 50.

Casteel, E. T., Wilson, J. L. and Buhr, R. J., 1994.

The influence of extended post hatch holding time and placement density on broiler performance. Poultry Sci. 73:1679-1684.

Cravener, T. L., Roush, W. B. and Mashaly, M. M., 1992. Broiler production under varying population densities. Poultry Sci. 21:427-433.

Denton, J. W., Reece, F. N. and Vardaman, T. H., 1968. The effect of temperature and density on broiler performance. Poultry Sci. 47:293-300

Elson, A., 1993. Housing systems for broilers. Proceedings of the 4th European symposium on poultry welfare. Savory C. J. and University federation of Animal Welfare. Potters Bar. pp. 210.

Frazer, A. F. and Broom D. M., 1990. Farm animal behaviour and welfare. English language Book Society/Bailliere Tindal 3rd ed. pp. 127-134

Freeman B. M., 1982. Stress and welfare. In: Poultry diseases. 2nd ed. Gordon, R. F. and Jordan, F. T. N. (eds). Bailliere Tindal, London, pp. 127-134.

Gordon, S. H. and Tucker, S. A., 1993. Effect of broiler stocking density on litter condition and hockburn. In: 4th European symposium on Poultry welfare. Sept. 18-21. Edinburgh, U. K. pp. 209.

Hughes, B. L. and Allen, W. H., 1985. High density brooding in a solar facility. Poultry Sci. 64:817-823.

Lewis, N. J. and Hurnik, J. F., 1990. Locomotion of broiler chickens in floor pens. Poultry Sci. 69: 1087-1093.

Matthes, S., 1993. Skin diseases in broiler chickens. In: 4th European Symposium on Poultry Welfare Sept. 18-21. Edinburgh. U. K. pp. 272.

McDonald, M. W., 1976. A simulation study of the effect of increased growth rate of broilers on economics of production. Poultry Sci. 55:1094-1098.

Mcllory, S. G., Goodall, E. A. and Mc Murray, C. H., 1987. A contact dermatitis of broilers epidemiological findings. Avian pathol. 16:93-105.

Meddis, R., 1975. On the function of sleep. Anim. Behav. 23: 676 - 691.

Murphy, L. B. and Preston, A. P., 1988. Time-budgeting in meat chickens grown commercially. Brit. Poultry Sci. 29:571-580.

Newberry, R. C. and Hall, J. W., 1988. Space utilization by broiler chickens in floor pens. In: proceedings of the international congress of Applied Ethology in Avians. Unshelm J. Van Putten, G., Zeeb, K. and Ekesbo, I. (eds.) Kara K. TBI. Darmsiadt. Germany pp. 305-309.

Offiong, S. A., Fulani, I. J. and Olomu, J. M., 1979. The effects of stocking density on the performance of broiler chickens. Nig. J. Anim. Prod. 6: (1 & 2) : 21-25.

Okpokho, N. A., Craig, J. V. and Milliken, G. A., 1987. Density and group size effects on caged hens of two genetic stocks differing in escape and avoidance behaviour. Poultry Sci. 66: 1905-1910.

Proudfoot, F. G., 1973. Response of broilers to variations under continuous and intermittent photoperiod. Can. J. Anim. Sci. 53: 349-354.

Proudfoot, F. G., Hulan, H. W. and Ramey, D. R., 1979. The effect of four stocking density on broiler carcass grade the incidence of breast blisters and other performance traits. Poult. Sci. 58: 791 – 793.

Steel, R. G. D. and Torrie, J. H. 1960. Principles and Procedures of Statistics. McGraw-Hill Book Co. Inc. New York, Toronto, London pp. 20-40.

Thompson, M. G., 1993. Influence of increasing stocking rate on performance and carcass quality of broilers. In: 4th European Symposium on Poultry Welfare. Sept. 18-21. Edinburgh. U. K. pp. 385-384.

Uner, K. Buchenauer, D., Schmidt, T. and Simon. D., 1997. Untersuchen Zum Verhalthen von masthanchen in Praxisbetrieben. K. T. B. L. Schrift. Kuratorium fur Technik and Bauwesen in der Landwritschaft, Darmstadt Germany.