

INFLUENCE OF STOCKING DENSITIES ON LITTER MOISTURE, MICROBIAL LOAD, AIR AMMONIA CONCENTRATION AND BROILER PERFORMANCE

T.Jayalakshmi, R.Kumararaj¹, T.Sivakumar², Thanga Thamil Vanan³ and D.Thiagarajan⁴

Department of livestock production and management
Madras Veterinary College, Chennai - 600 007

ABSTRACT

A trial was conducted using 240 numbers of day old commercial straight run broiler chicks (vencobb-100). These chicks were wing banded, weighed and randomly allotted to 12 groups of 20 each, each treatment group were assigned with three replicates with the following densities of 900, 750, 600 and 450 cm² per bird from 0 to 42 days of rearing period. Biweekly body weight of individual birds and weight gain recorded at 14, 28 and 42 days of age to an accuracy of one gram using a standard weighing balance. Litter quality was assessed in terms of litter moisture content, total bacterial, coliform and mould count. The significant improvement in performance has been brought about by significantly lower litter moisture and microbial load, (total bacterial, coliform and mould count) and decreased ammonia concentration. The correlation studies between floor space and other parameters viz, litter moisture, air ammonia and litter microbial load, (total bacterial count, coliform and mould count) revealed negative ($p < 0.01$) correlation. Whereas, positive ($p < 0.01$) correlation was observed between floor space and weight gain. The correlation between weight gain and other parameters like litter moisture, air ammonia, litter microbial load is influenced by floor space. Highest ($p < 0.01$) body weight of 1702.8 g was obtained in the lower (900 cm² per bird) density group.

Key words: litter moisture content, microbial load, air ammonia level, commercial broilers chicks, and deep litter system.

INTRODUCTION

Broiler industry in India has registered a spectacular growth and has transformed itself from a mere backyard proposition into an agri business status. This can be attributed to increased consumers' preference for broiler meat, shortage of other meat animals, shorter growing period, better feed conversion efficiency quicker returns and suitability under intensive system in rural,

semi-urban, urban and metropolitan areas of varied agro-climatic conditions and also to meet the protein requirements of animal origin. In a high stocking density situation air flow at the level of bird is often reduced, resulting in poor in quality, increased temperature and relative humidity, ammonia level decreased access to feed and water (Feddes et al., 2002). High mortality greater incidence of leg problem and contamination were also reported in

M.V.Sc Thesis submitted by the first author to the Tamilnadu Veterinary and Animal Sciences University.¹ Professor and Head² Professor and Head, LRS, Kattupakkam, ³ Associate Professor, ⁴ Professor and Head, Poultry Research Station, Nandanam, Chennai

broilers at high stocking densities. Poor production performance of broilers and meat quality has been attributed to inadequate floor space as a result of which poor micro environmental conditions inside the poultry house, competition for feed and water, increased litter moisture condition, elevated ammonia level due to degradation of uric acid by the micro organisms and various other pollutants. There fore, the present study was aimed at to investigate the effect of varying stocking densities on litter moisture, microbial load and air ammonia concentrations and their association with broiler performance.

MATERIALS AND METHODS

A biological trial was run using 240 numbers of day old commercial straight run broiler chicks (Vencobb-100). These chicks were weighed, wing banded and randomly allotted to 12 groups of 20 each, each treatment group were assigned with three replicates with the following rearing densities viz, 900,750 600, and 450 cm² per bird from 0 to 42 days of rearing period.

Biweekly body weight of individual birds and weight gain were recorded at 14, 28 and 42 days of age to an accuracy of one gram using a standard weighing balance. Litter quality was assessed in terms of litter moisture content and total bacterial, coli form and mould count of litter.

MOISTURE CONTENT OF LITTER

A random sample of litter was taken from each treatment biweekly. Seven to ten grams of well mixed sample was transferred to reweighed empty clean Petri dish and the sample with Petri dish weighed and introduced to the hot air oven maintained at a temperature of 100° C for over night. (AOAC, 1996). On cooling in desiccator they were reweighed and the percentage of moisture of the samples were worked out. For microbial quality estimation a random sample of

litter was taken from each treatment biweekly. Analysis commenced with homogenization of 1g litter in 9 ml diluents (sterile NaCl solution, 0.85% w/v) in a test tube .Subsequently six fold serial dilutions were made (Fries et al.,2005). The samples were subjected for bacterial, coliform and mould count by using commercially available media such as plate count agar, Mac Conkey agar and Sabouraud dextrose agar plates respectively.

AIR AMMONIA

In all poultry pens under this study, air samples were collected twice a week at 08.00 hours and at 14.00 hours for estimation of ammonia.Casella make (T 13180) personal air sampler was used for sampling of air with a liquid midget impringer. The collected air samples were analysed in the laboratory and concentration of ammonia was read from the standard graph provided. The data collected were subjected to statistical analysis as per the methods suggested by Snedecor and Cochran (1994). One way analysis of variance technique was used to study the significant difference between different stocking densities. Co-efficient of correlation was calculated to study the relation between different characters.

RESULTS AND DISCUSSION

Mean \pm SE of biweekly moisture content of litter material in broiler pens as influenced by stocking densities and their analysis of variance are presented in Table 1. Significant ($p < 0.01$) differences between density groups were observed. At 14 days of age, 450cm² per bird density group had the highest litter moisture percent followed by 600, 750 and 900 cm² per bird. During 28, 42 days of age percent litter moisture level was inversely proportional to the space given per bird. As the stocking density increases the litter moisture gets increased. Although all data are statistically significant ($p < 0.01$),The results of this study is also in accordance with the findings of Kumararaj and Narahari(1993), McLean et al.(2002), Thomas

et al.(2004),Dozier et al.(2005),Shivakumar et al.(2004) Dozier et al.(2006). The percent litter moisture level observed at 900 cm² density per bird is as per the recommendations of Narahari (1996).

At 14 days of age the total bacterial count showed a significant difference ($p<0.01$) between stocking densities (Table2). Total bacterial count between 750 and 600 cm were not significantly ($p>0.05$) different. Similar trend was observed at 28 days of age also. However, the total bacterial count at 42 days of age was significantly ($p<0.01$) different between all the densities. The increase in total bacterial count was found to be linear. Significant($p<0.01$) differences in coliform count were observed between stocking density groups at 14 day of age and similar result was also observed at 28 days of age. At 42 days of age no significant differences between 900, 750 and 600 cm² per bird between 600 and 450 cm² per bird density group were observed.

Mould count did not show any statistical significance at 14 days of age. However, significant ($p<0.01$) differences in mould count was cm² observed at 28 and 42 days of age. Broilers reared at the densities of 900, 750, 600 and 450 cm² per bird groups did not reveal any differences in their mould count .But, broilers reared at the stocking density of 450cm² per bird showed.

significantly ($p<0.01$) higher mould count than other densities. At 42 days of age no significance differences was observed between 900, 750 and 600 cm² per bird and also between 750, 600 and 450 cm² per bird densities. Significant ($p<0.01$) difference in total bacterial count, coliform count and mould count was observed due to varying stocking densities. Similar results were reported by Kumararaj and Narahari (1993).

No perceptible ammonia level could be recorded at 14 days of age (Table 3). However,significant differences ($p<0.01$) were noticed between density

groups ammonia level during 28 and 42 days of age. During 28 days of age broilers reared at the densities of 900, 750 and 450 cm² per bird groups did not reveal any differences ($p>0.05$) in air ammonia concentration and also no differences between 600 and 450 per cm² bird were noticed. During 42 days of age, there was no differences ($p>0.05$) between 900, 750 and between 750, 600 cm² and also between 600 and 450 cm² per bird. The above findings are also supported by the findings of Kristiansen and wathes(2000) who reported that ammonia is formed in litter by bacterial break down of litter from broilers and ammonia concentrations are increased by moisture, high temperature, over crowding and poor ventilation. AI-Homidan and Robertson (2003) reported that increases in stocking density resulted in increased concentration of ammonia.

CORRELATION COEFFICIENT

Significant ($P<0.01$) negative correlation (Table 4) was recorded between litter moisture level, air ammonia concentration, total bacterial count, coliform count as well as mould count and floor space. The level of the above parameters found to decrease proportionately as the floor space increases. Significant ($P<0.01$) positive correlation was noticed between floor space and body weight gain.

The findings of Weaver et al. (1982), Quinones et al. (1984), Shanmugasundaram (1984), Beremski (1987), Shanawany (1988), Gracias et al. (1990), Kumararaj and Narahari (1993), Shiva kumar et al. (2004), Galobart and Moran (2005), Dozier et al. (2005) and Dozier et al. (2006) corroborates the findings of the present study also.

Significant ($P<0.01$) positive correlation was obtained between litter moisture and air ammonia level, total bacterial count, coliform count as well as mould count. As the litter moisture increases the above parameters are found to linearly increased with increase stocking density. The weight gain and the rest of the parameters are found to have a significantly ($P<0.01$) negative correlation

under decreased floor space with increased litter moisture.

Ammonia level at different densities in broiler pens is found to be positively associated with total bacterial count, coliform count and mould count. However, air ammonia level in broiler pens is found to be negatively associated with body weight gain, which means as the ammonia level in broiler pen increases, weight gain is depressed. Similar highly significant negative correlation between total bacterial count, coli form count and mould count with weight gain were also noticed.

REFERENCES

- Al-Homidan, A. and J.F.Robertson, 2003. Effect of litter type and stocking density on ammonia dust concentrations and broiler performance. *British Poult. Sci.*, 44(1): S7-S8.
- AOAC, 1996. Moisture in Animal Feed. Method 930.15 in Official Methods of Analysis of AOAC International. 16th ed. AOAC International, Gaithersburg, MD.
- Beremski, C.H., 1987. Rearing broilers on deep litter with or without increasing stocking density. *Zhivotnov'dni Nauki*, 24(7): 54-59. Cited in *Poult. Abstr.*, 1988, 14(9): 2236.
- Dozier W.A., J.P.Taxton, J.L.Purswell, H.A.Olanrewaju, S.L.Branton and W.B.Roush, 2006. Stocking density effects on male broilers grown to 1.8 kilograms of body weight. *Poult. Sci.*, 85: 344-351.
- Dozier, W.A., J.P.Thaxton, S.L.Branton, G.W.Morgan, D.M.Miles, W.B.Rush, B.D.Lott and Y.Vizzer-Thaxton, 2005. Stocking density effects on growth performance and processing yields of heavy broilers. *Poult. Sci.*, 84: 1332-1338.
- Feddes, J.J.R., E.J.Emmanuel and M.J.Zuiclhoft, 2002. Broiler performance, body weight variance, feed and water intake and carcass quality at different stocking density. *Poult. Sci.*, 81: 774-779.
- Fries, R., M.Akan, N.Bandick and A.Kobe, 2005. Micro flora of two different types of poultry litter. *British. Poult. Sci.*, 46: 668-672.
- Galobart, J. and E.T.Moran, Jr, 2005. Influence of stocking density and feed pellet quality on heat stressed broilers from 6 to 8 weeks of age. *International. J. Poult. Sci.*, 4 (2): 55-59.
- Kristensen, H.H and C.M.Wathes, 2000. Ammonia and poultry welfare: a review, *World Poult. Sci. J.*, 56: 235-245.
- Kumararaj, R., and D.Narahari, 1993. Broiler housing and management. All India Co-ordinated Research Project. Final report submitted to Indian Council of Agricultural Research, New Delhi.
- McLean, J.A., C.J.Savory and N.H.C.Sparks, 2002. Welfare of male and female broiler chickens in relation to stocking density as indicated by performance health and behaviour. *Ani. Welfare*, 11: 55-73.
- Narahari, D., 1996. Commercial broiler production. Emkay Publications, Delhi 1st edn., pg:1.
- Quinones, R., G.Polanco and O.Morejon, 1984. A comparison of three housing densities for broilers reared on the floor. *Revisa Avicultura*, 28(4): 241-249. Cited in *Poult. Abstr.*, 1984. 12(2):333.
- Shanawany, M.M., 1988. Broiler performance under high stocking densities. *British Poult. Sci.*, 29: 43-52.

- Shanmugasndaram, S., 1984. A study on cage raising of broilers. Ph.D., thesis submitted to Tamil Nadu Agricultural University, Coimbatore
- Shivakumar, M.C., Jared Mulla, Bhageevathi Pugashetti and Sarah Nidagundi, 2004. Performance of broilers reared on different floor space. *Indian J. Poult. Sci.*, 39(1): 72-74.
- Snedecor, G.W. and W.G.Cochran, 1994. Statistical Methods. The IOWA State University Press, Ames, IA. 8th edn.
- Thomas D.G., V.Ravindran, D.V.Thomas, B.J.Camden, Y.H.Cottam, P.C.Morel and C.J.Cook., 2004. Influence of stocking density on the performance, carcass characteristics and selected welfare indicators of of broiler chicken. *NZ Vet. J.*, 52(2): 76-81.
- Weaver, W.D.Jr., W.L.Beane and J.A.Cherry, 1982. Effect of light, feeding space, stocking density and dietary energy on broiler performance. *Poult. Sci.*, 61: 33-37.

Table 1

Mean \pm SE of per cent litter moisture level of broiler pens as influenced by stocking densities and its analysis of variance

Floor space / bird (cm²)	14th day	28th day	42ndday
900	16.03 ^c \pm 0.08	20.20 ^c \pm 0.86	25.73 ^c \pm 0.64
750	16.97 ^{bc} \pm 0.31	21.97 ^c \pm 0.38	28.60 ^c \pm 0.23
600	20.63 ^b \pm 0.71	26.73 ^b \pm 1.11	32.87 ^b \pm 1.12
450	24.90 ^a \pm 2.26	37.40 ^a \pm 0.81	44.13 ^a \pm 1.10
'F' value	12.78**	40.19**	27.82**

Means bearing at least one common superscript in each column do not differ significantly

** Highly significant (P<0.01)

Table 2

Mean \pm SE of microbial load in litter sample of broiler pens as influenced by stocking densities and

Microbial load (cfu $\times 10^6$ /gm)	Days	Floor space (cm ²)/ bird				
		900	750	600	450	F
Total bacterial count	14 th day	154.67 ^c \pm 15.10	268.00 ^b \pm 25.63	320.33 ^b \pm 3.84	484.00 ^a \pm 6.42	79.66**
	28 th day	325.33 ^c \pm 4.98	479.00 ^b \pm 5.86	522.33 ^b \pm 10.49	665.33 ^a \pm 7.06	357.79**
	42 nd day	441.33 ^d \pm 16.37	658.00 ^c \pm 6.08	735.00 ^b \pm 9.71	878.33 ^a \pm 5.78	307.37**
Coliform count	14 th day	23.33 ^c \pm 2.19	28.33 ^{bc} \pm 0.88	31.67 ^{ab} \pm 1.45	37.67 ^a \pm 1.20	15.88**
	28 th day	28.67 ^c \pm 3.52	32.00 ^{bc} \pm 2.08	39.00 ^{ab} \pm 1.16	42.33 ^a \pm 2.84	5.99*
	42 nd day	34.33 ^b \pm 1.45	41.67 ^b \pm 2.96	43.67 ^{ab} \pm 4.63	57.33 ^a \pm 2.60	9.42**
Mould count	14 th day	8.00 \pm 1.16	12.67 \pm 3.84	13.67 \pm 3.18	19.67 \pm 0.33	3.49 ^{NS}
	28 th day	11.67 ^a \pm 1.45	11.67 ^a \pm 0.33	15.00 ^a \pm 1.53	21.67 ^b \pm 0.88	16.66**
	42 nd day	15.67 ^b \pm 1.20	25.33 ^{ab} \pm 1.76	28.00 ^{ab} \pm 3.78	36.33 ^a \pm 3.76	8.79**

Means bearing at least one common superscript in each row do not differ significantly
 NS Non Significant (P>0.05), * Significant (P<0.05), ** Highly significant (P<0.01)

Table 3 Mean + SE of Air ammonia level (ppm) of broiler pens as influenced by stocking densities and its analysis of variance

Floor space / bird (cm ²)	14 th day	28 th day	42 nd day
900	16.03 ^c ±0.08	20.20 ^e ±0.86	25.73 ^c ±0.64
750	16.97 ^{bc} ±0.31	21.97 ^e ±0.38	28.60 ^e ±0.23
600	20.63 ^b ±0.71	26.73 ^b ±1.11	32.87 ^b ±1.12
450	24.90 ^a ±2.26	37.40 ^a ±0.81	44.13 ^a ±1.10
'F' value	12.78**	40.19**	27.82**

Means bearing at least one common superscript in each column do not differ significantly

** Highly significant (P<0.01)

Table 4 Correlation coefficients between floor space, litter moisture, air ammonia level, litter microbial load and body weight gain of broilers

	Floor	Litter	Air	Total	Coliform	Mould	
Floor space	1						
Litter moisture	-0.93575**	1					
Air ammonia	-0.95274**	0.882983**	1				
Total bacterial count	-0.97825**	0.898917**	0.935204**	1			
Coliform count	-0.84291**	0.851**	0.709435**	0.864363**	1		
Mould count	-0.85871**	0.844966**	0.837117**	0.865281**	0.681041*	1	
Weight gain	0.931093**	-0.82803**	-0.8833**	-0.91714**		-0.7779**	1

*Significant (P<0.05) ** Highly significant (P<0.01)