EFFECT OF DIFFERENT TYPES OF LOCALLY AVAILABLE LITTER MATERIALS ON THE PERFORMANCE OF BROILER CHICKS

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ABSTRACT

The study was conducted at university poultry farm at NWFP Agricultural University, Peshawar, Pakistan to evaluate the overall performance of broiler chicks, reared on three different types of locally available bedding materials, including sawdust, sand and wheat straw. The experiment lasted for 35 days. The starter ration was offered to the birds for the first three weeks, while during the last two weeks, the birds were reared on the finisher ration. Differences in average weight gain, feed consumption, FCR, mortality and dressing percentage for sawdust, sand and wheat straw were found non-significant (P>0.05). The moisture content increased from 13.07 to 46.55 % in sawdust, 1.75 to 18.89% in sand and 6.81 to 41.48 % in wheat straw during the trial. Sawdust contained significantly (P<0.05) higher moisture content followed by wheat straw and sand. Mean water absorbing ability, independently determined for sawdust, sand and wheat straw was 246.00, 152.00 and 180.67 %, respectively. The cost of litter for rearing 1 chick was Rs.2.76, 1.75 and 0.75 for sawdust, sand and wheat straw respectively. (1US $ = Rs.60). It was concluded that any of these three bedding materials may be used. However, sand (having less cake formation than wheat straw) is recommended as a safe and economical replacement as litter for sawdust.

Key words: broiler, litter, sawdust, sand, wheat straw, FCR

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INTRODUCTION

Poultry is a dynamic sub-sector of agriculture that has been growing at an average annual rate of about 10-15 % for the past 5 years, (Economic Survey of Pakistan, 1992-93). In Pakistan poultry produces 0.428 million tons of meat and 6.077 million eggs which contribute a sum of Rs.50.490 million to the national economy annually (ESP, 2001). Poultry farmers are earning maximum profit by investing least inputs mainly due to modern scientific techniques and managemental practices.

To obtain maximum broiler production potential, management of the poultry house is essential. One of the managemental practices is the proper maintenance of poultry litter. Before arrival of chicks in the house, the floor is covered with the litter material. The quality of litter significantly influences the overall performance and ultimately the profit. Litter plays a vital role in absorbing the fecal moisture, promotes drying by increasing surface area of the house floor, insulates chick from cooling effects of the ground and provide a protected cushion. It helps to conserve heat by insulation and provide supplemental heat through fermentation by feacal microorganisms. Litter receives droppings and absorbs moisture from faeces and respiratory processes. It provides a warm, soft and spongy surface for optimum comfort of the birds.

The litter should be easily available with a maximum moisture absorbing capacity, be non-toxic, economical and porous. Proper level and depth of litter is important to avoid high bacterial load and unhygienic conditions resulting in harmful gases which keep the birds in stress, causes insects problems (particularly flies), soiled feathers, footpad lesions and breast bruises or blisters. Different litter materials are used in poultry houses that include wood shavings, straw, sawdust, cane bagasse, recycled paper (shredded paper and paper chips), rocks (pea and volcanic), hulls (rice and groundnut), maize cobs, grape pith, etc. These materials have been used successfully due to their high moisture absorbing capacity.

Sawdust is used as litter material for poultry rearing in most parts of Pakistan. Sawdust was abundantly available in NWFP due to importation of wood from Afghanistan through the western borders. Since the US involvement in Afghanistan, the export of wood was banned by Afghan authorities. As a result not only the wood prices increased but the price of sawdust dramatically increased and its availability was significantly reduced. The need was felt for some alternative suitable litter material. Sand has shown good potential as an alternative litter material for rearing broilers. (Bilgili *et al*, 1999). To overcome this problem, this study was designed to investigate the comparative effect of sawdust, sand and wheat straw as litter material on the overall performance of broiler chicks, to calculate the economics of the three litter materials and to compare their moisture absorbing ability.

MATERIALS AND METHODS

The study was conducted at the University Poultry Farm, NWFP Agricultural University, Peshawar, Pakistan to evaluate the growth performance of poultry chicks reared on sawdust, wheat straw and sand. All the chicks were reared in the same house under identical environmental conditions.

Experimental Design and Birds

The experiment was conducted in Completely Randomized Design (CRD), feeding commercial ration to 3 groups of chicks (A, B and C) with almost similar starting body weight. Each group was replicated in four with ten birds per replicate. Thus a total of one hundred and twenty chicks were divided randomly in to three groups. During the experimental period feed and water were provided *ad libitum* to all the birds in three groups. The litter materials used, were sawdust (L1), sand (L2) and wheat straw (L3). Groups were randomly allotted to three bedding materials. The litter depth was uniformly kept @ 1.0 inch. Broilers were kept with provision of 1 sq.ft / bird. Racking or stirring of the litter material was practiced regularly on daily basis to avoid cake formation and wet litter condition. The birds were vaccinated according to the standard broiler vaccination schedule.

Data Recording

The gain in body weight for each bird was recorded on weekly basis by subtracting the initial body weight from the weight recorded at the seventh day of each week. The feed and water was offered *ad libitum* and the leftover feed was recorded at next morning. Feed consumption was calculated for each group by subtracting the leftover feed from the feed offered. The FCR for each replicate on weekly basis was calculated by dividing the mean weekly total quantity of feed consumed by the mean weekly total gain in body weight. At the end of the experiment, the birds were kept fasting for 5-6 hours and no feed was offered during this withdrawal period to keep the crop of the bird empty at slaughtering time. Three birds were randomly selected from each replicate, weighed and immediately slaughtered. After removing feathers along with the skin, head, legs and all internal organs including heart, gizzard, liver and abdominal fat, the carcass was weighed to determine dressing percentage. Mortality was recorded daily. The dead birds were dissected to determine the causes of death. Samples of litter were taken in plastic bags from each replicate on weekly basis to determine the amount of moisture. Water absorbing or holding capacity was determined according to procedure described by Davasgaium and Boodoo (2000). Economics of each litter material was calculated according to prevailing market prices at the time of the trial.

Data Analysis

The data were statistically analyzed with the standard procedures of Analysis of Variance (ANOVA), using Completely Randomized Design, as described by Steel and Torrie (1981). The means were compared for significance of difference with the Duncan's Multiple Range Test for variables. The statistical package (SAS, 2000) was used to perform the above analysis.

Statistical model

$Y_{ij} = \mu + B_j + \epsilon_{ij}$

Y_{ij} = ith observation of jth bedding material

μ = Overall mean (mean effect)

B_j = Effect due to bedding material

ϵ_{ij} = Experimental or random error

RESULTS AND DISCUSSION

Overall Performance of Broiler Chicks

The birds were reared on the starter ration for the first three weeks and the finisher ration for last two weeks of the trial. There was no significant difference (P>0.05) between the different treatments in final live-weight, feed consumption, FCR, dressing percentage and mortality (Table I). Hence litter had no significant effect on live-weight, feed consumption and feed conversion efficiency. This is in agreement with the findings of Peacock *et al*. (1984) and Davasgaium and Boodoo (2000) who reported similar results in their trials of comparison of different types of litter materials with sawdust. The authors also reported that there was no significant difference between different treatments on the final live-weight and FCR. Results of the present study are in agreement with the findings of Brake *et al*. (1993) who reported that litter type had no effect on body weight, feed conversion and breast blister, while comparing broiler performance on sawdust, pine shavings and kenaf core. Shakila and Naidu (1998) reported different results, stating that body weight gains were significantly lower on sawdust while comparing broiler performance on groundnut hulls, rice husks and chopped straw or sawdust. Bilgili *et al*. (1999) reported that broilers reared on sand had a greater straight run male body weights than those reared on pine shavings. The results also did not agree with the findings of Ogan (2000) who reported significantly different (P<0.05) feed efficiency and weight gain for broilers reared on chopped wheat straw and mixture of sawdust and whole wheat straw than wood shavings and rice hulls. Sosnowka-Czajka and Herbut (2000) also reported significantly different (P<0.05) body weight gain for broilers reared on sawdust compared to those reared on straw cut. The results agree with the findings of Anisuzzaman and Chowdhury (1996) who concluded that feed intake, weight gain and feed conversion efficiency were not affected due to different litter types including sawdust, paddy straw, sand and rice husk. Similar results were given by Singh and Sharma (2000) who reported that neither feed consumption and body weights nor mortality and feed efficiency differed significantly among rice husk, wheat straw, sawdust and chaffed dry pine needles. In the present study, the dressing percentage of the birds on different types of litter was statistically non-significant (P>0.05). These results were similar to those given by Hussain *et al*. (1996) who concluded that there were no significant differences in cumulative weight and feed intake, feed conversion efficiency, mortality and dressing percentage among the birds reared on sawdust, dried common grass (Cynodon dactylon) and 1:1 mixtures of both.

It was observed that birds reared on wheat straw consumed apparently less feed that also resulted in less weight gain (Table-I). The FCR value of birds reared on wheat straw was not significantly different than those reared on sawdust and sand. Comparatively more cake formation was observed in pens containing wheat straw. It was observed that high cake formation in wheat straw restricted the movement of chicks towards feeders and drinkers, resulting in less feed consumption and less weight gain as compared to chicks kept on sawdust and sand. Statistically there was no difference in the three groups. Mortality rate was observed 5 % in chicks reared on sand.

Table I ***Overall performance of birds on different litter materials***

Litter type	Weight gain per bird (g)	Feed consumption per bird (g)	FCR	Mortality (%)	Dressing (%)
Sawdust	1821.25 [a]	3851.50 [a]	2.11 [a]	0 [a]	62.69 [a]
Sand	1823.06 [a]	3835.50 [a]	2.10 [a]	5 [a]	63.39 [a]
Wheat straw	1775.00 [a]	3813.25 [a]	2.15 [a]	0 [a]	62.03 [a]

Means in the column with similar superscripts are not significantly different at P<0.05.

Moisture Content (%) of Litter

Moisture content increased from 13.07 to 46.55 % in sawdust, 1.75 to 18.89% in sand and 6.81 to 41.48 % in wheat straw during the entire trial period (Table-II and IV). Thus sawdust contained significantly (P<0.05) higher amount of moisture followed by wheat straw and sand (Table II-V). These results are in partial agreement with those given by Shakila and Naidu (1998) who reported that percentage moisture was highest in the chopped straw and lowest in the rice husks, while conducting trial on groundnut hulls, rice husks and chopped straw or sawdust. The pattern of weekly moisture increase is shown graphically in Fig-1.

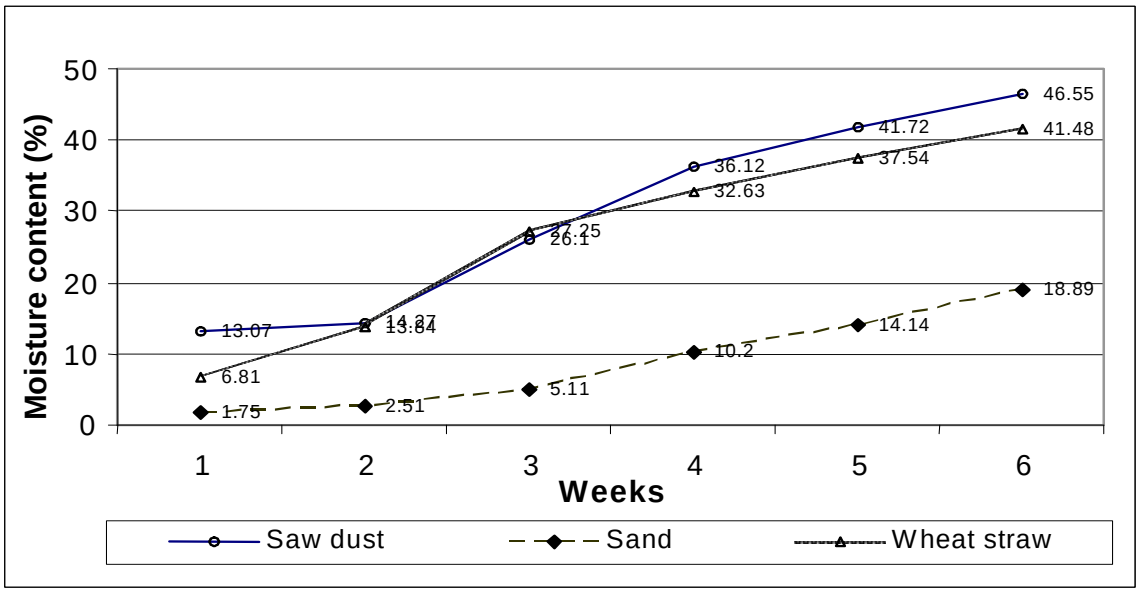

Fig. 1. ***Weekly increase in moisture content***

Brake *et al*. (1993) reported that moisture increased at each sampling time. There was no abrupt change in the moisture content of any of the three bedding materials. However, the moisture content increased more rapidly during week-3 to 6 in all of the three types of bedding materials. This was the result of increased waste deposition and increased respiration of growing broilers as explained by Huff *et al* (1984). Ogan (2000) also reported increase in moisture content of litter with time.

Sand litter, having comparatively small particle size, allowed water absorption deep in to the sand surface thus avoids moisture retention on the surface of the litter, necessary for avoiding cake formation. Additionally, ammonia production was also very rare which provided a comfortable environment. During the racking or stirring, there was no dust problem that minimized the chances of respiratory infections in the chicks. The droppings of the birds became dry very quickly on sand thus avoiding cake formation or vent pasting problems. Further on racking, these droppings got mixed with sand very easily. No problem of breast blisters were observed in the birds reared on sand. This is in contrast to the findings of Anisuzzaman and Chowdhury (1996) who reported that breast blisters were found in birds reared on sand (8.3%). Shanaway (1992) reported that no evidence of breast blisters was found.

Table II ***Mean moisture percentage of different types of litter at week-1***

Litter	Type of litter	Group	Moisture %
1	Sawdust	A	13.07 [a]
2	Sand	B	1.75 [c]
3	Wheat straw	C	6.81 [b]

Means in the column with different superscripts are significantly different at P<0.05.

Table III ***Analysis of variance of moisture percentage at week-1***

Source of variation	DF	SS	MS	F	P
Litter type	2	192.91	96.45	178.94	0.0001
Replication	2	0.17	0.08	0.16	0.85
Error	4	2.15	0.53		
Total	8	195.24			

Water Absorbing Ability of Different Litter Materials

Water absorbing ability of sawdust, sand and wheat straw was 246.00, 152.00 and 180.67 % respectively (Table-VI). Statistically significant difference (P<0. 05) was found among the three types of litter materials (Table-VII). These results closely agree with the findings of Davisgaium and Boodoo (2000) who reported 17.5 % moisture content and 251 % water absorbing ability for sawdust. Ruszler and Carson (1968) reported that litter of smaller

particle size absorbed less moisture than that with larger particle size. However in this study, the particle size of sawdust was smaller than wheat straw and larger than sand. Moisture release however was considered to be the most important factor in litter evaluation as reported by Ruszler and Carson (1974). Concerning water holding capacity, Shanaway (1992) demonstrated that increased water holding capacity in litter increases the carcass quality score and decreases the incidence of breast blisters, while during this trial no evidence of breast blisters were found.

Table IV ***Moisture percentage of different types of litter at week-6***

Litter	Type of litter	Group	Moisture Percentage
1	Sawdust	A	46.55 [a]
2	Sand	B	18.89 [c]
3	Wheat straw	C	41.48 [b]

Means in the column with different superscripts are significantly different at P<0.05.

Table V ***Analysis of variance of moisture percentage at week-6***

Source of variation	DF	SS	MS	F	P
Litter type	2	1300.72	650.36	1377.76	0.0001
Replication	2	0.61	0.30	0.65	0.56
Error	4	1.88	0.47		
Total	8	1303.23			

Table VI ***Mean water absorbing ability of different bedding materials***

Litter	Type of litter	Group	Moisture Percentage
1	Sawdust	A	246.00 [a]
2	Sand	B	152.00 [c]
3	Wheat straw	C	180.67 [b]

Means in the column with the different superscripts are significantly different at P<0.05.

Table VII ***Analysis of variance of water absorbing ability of different bedding materials***

Source of variation	DF	SS	MS	F	P
Litter type	2	13926.22	6963.11	281.02	0.00005
Replication	2	17.56	8.78	0.35	0.72
Error	4	99.11	24.78		
Total	8	14042.89			

Economics of Different Litter Materials

Economics of the three different bedding materials was calculated on the basis of market prices at the time of trial. Keeping the standard floor space of one square foot per broiler, prices of different litter materials were calculated. The cost of sawdust, sand and wheat straw was Rs.2760, 1750 and 750, respectively for rearing 1000 broiler chicks (Table-VIII). The sawdust had an edge on wheat straw and sand due to its very high moisture absorbing ability, but the sand is better than sawdust in respect of availability and economics.

Table VIII ***Economics of different litter materials***

Litters	Amount reqd. / ft^2 (kg).	Price / kg (Rs).	Price / ft^2 (Rs).	Price/ 1000 ft^2 (Rs).
Sawdust	0.6	4.6	2.76	2760
Sand	3.5	0.5	1.75	1750
Wheat straw	0.3	2.5	0.75	750

*1 US $ was equal to 60 Pakistani Rupees (Rs.) at the time of trial i.e. March-April, 2004

CONCLUSION AND RECOMMENDATIONS

It was concluded that any of these three bedding materials may be used effectively as no significant difference was found among them for feed consumption, weight gain, FCR, dressing percentage and mortality. Wheat straw had some problems of cake formation but was the cheapest at the same time. More frequent inversion may resolve this problem. However, sand (having less cake formation than wheat straw) is recommended as a safe and economical replacement as litter for sawdust.

REFERENCES

Anisuzzaman, M. and S.D. Chowdhury. 1996. Use of four types of litter for rearing broilers. Brit. Poult. Sci. 37: 541-545.

Bilgili, S.F., G.I. Montenegro, J.B. Hess and M.K. Eckman.1999. Sand as litter for rearing broiler chickens. J. Appld. Poult. Res. 8: 345-351.

Bilgili, S.F, G.I. Montenegro, J.B. Hess and M.K. Eckman. 1999. Live performance, carcass quality, and deboning yields of broilers reared on sand as a litter source. J. Appld. Poult. Res. 8: 352-361.

Brake, J.D., M.J. Fuller, C.R. Boyle, D.E. Link, E.D. Peebles and M.A. Latour. 1993. Evaluations of whole chopped kenaf and kenaf core used as a broiler litter material. J. Poult. Sci. 72:2079-2083.

Davasgaium, M.M. and A.A. Boodoo. 2000. Use of bagasse as a potential source of litter material for broiler production. Internet address: http://farc.gov.mu/amas97/html/p18txt.htm. Accessed April 2009.

Govt. of Pakistan. 2001. Economic Survey. Finance Div. Econ. Advisor's Wing. Govt. of Pakistan, Islamabad.

Huff, W.E., G.W. Malone and J.L. Chaloupka. 1984. Effect of litter treatment on broiler performance and certain quality parameters. Poult. Sci. 63: 2167-2171.

Hussain, S.A., S. Zahid, S. Akhtar and K. Saleem. 1996. Effect of different types of litter materials on the performance of broilers. Pak. J. Zool. 28: 181-182.

Ogan, M. 2000. The effect of different kind of litter on the broiler performance. Veteriner Fakultesi Dergisi, Uludag Universitesi. 19(3): 1-6.

Peacock, G.G., R.N Brewer, C.A. Flood and J.L. Koon. 1984. Effect of litter on broiler performance. Poult. Sci. 63: (suppl 1): 163 (Abst.).

Qureshi, M.S. 1990. Present status of poultry in Pakistan. Proc. 3rd Int'l. Cong. of Pak. Vet. Med. Assoc. 29**:**19-22.

Ruszler, P.L. and J.R. Carson. 1968. Physical and biological evaluation of five litter materials. Poult. Sci. 41: 249 - 254. (Abst.)

Ruszler, P.L. and J.R. Carson. 1974. Methods of evaluating the potential usefulness of selected litter materials. Poult. Sci. 53: 1420 - 1427 (Abst.)

Shakila, S. and M.A. Naidu. 1998. A study on the performance of broilers on different litter materials. Indian Vet. J. 75: 705-707.

Shannaway, M.M. 1992. Influence of litter water-holding capacity on broiler weight and carcass quality. Archiv-fur-Geflugelkunde. 56 (6): 177–179.

Singh, C.B. and R.J. Sharma. 2000. Utilization of different litter materials for raising commercial broilers in hilly area. Indian. Anim. Res. 34: 78-79.

Sosnowka Czajka, E. and E. Herbut. 2000. Effect of litter type on performance and carcass quality of broiler chickens. Roczniki-Naukowe-Zootechniki. No. Supl.z. 10 ref. 6, 375-378.

Steel, R.G.D. and J.H. Torrie. 1981. Principles and procedures of statistics: A biometrical approach. 2nd Ed. McGraw-Hill, Singapore.