

## EFFECT OF USE OF DIFFERENT LITTER MATERIAL COMBINATIONS ON GROWTH PERFORMANCE AND ECONOMICS OF BROILER PRODUCTION

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The purpose of the study was to evaluate the effect of use of different litter material combinations on growth performance and economics of broiler production. Four hundred twenty day old, commercial broiler chicks (VenCobb<sup>400</sup> Strain) were divided into seven groups, with three replicates of 20 chicks in each. Water and feed were provided *ad libitum* throughout the experimental period of 42 days. The control A had rice husk, while other treatment groups B, C, D, E, F and G having combinations such as soybean straw with groundnut hulls, wheat straw with soybean straw, saw dust with soybean straw, groundnut hulls with wheat straw, groundnut hulls with saw dust and saw dust with wheat straw, respectively. The diet was prepared as per BIS (2007) standards. There were highly significant effects of different types of litter material combinations of different treatment groups on weekly body weight, mortality, moisture percent, pH and cake formation score of litter material. The net profit obtained per bird after selling the birds @ Rs. 68/- per kg on live weight for treatment groups *viz*; A, B, C, D, E, F and G were Rs. 9.42, 18.86, 17.93, 16.28, 11.31, 16.84 and 15.97 respectively. Similarly the net profit per kg live weight fetched were Rs. 4.68, 8.84, 8.66, 7.81, 5.62, 7.89 and 7.71 for A, B, C, D, E, F and G groups, respectively. Therefore it is concluded that the mixture of soybean straw with groundnut hulls used for bedding material of broilers was more economical and profitable. It is recommended that the combination of soybean straw with groundnut hulls may be used as a superior bedding material with 50% combination on volume basis.

**Keywords:** Economics of broiler production, Growth performance, Litter material

The deep litter system is the most popular system of housing in poultry production throughout the world. Common litter

materials include wood shavings, sawdust, peanut hulls, shredded sugar cane and straw. A characteristic optimal litter has

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to include some important characters like: low moisture, pH and ammonia production, firm in the hand, not wet and sticky, highly absorbent, soft and give off moisture readily and doesn't pack down easily. In addition, it has to be cheap, available and free of molds, preservatives and pesticides (Reece *et al.*, 1979; Elliott and Collins, 1982 and Carr *et al.*, 1990). There is direct correlation between litter quality and health, performance, carcass quality and welfare of poultry (Malone and Chaloupka, 1983). Low supplies, high cost and unavailability of suitable materials have encouraged the search for alternative litter materials (El-Deek *et al.*, 2011). Burning of huge quantities of paddy straw and wheat straw leads to emission of obnoxious gases thus, causing adverse impacts on health of human, animal and bird population. This practice can be discouraged through its utilization as an alternate litter material to commonly use rice husk which is now available at costly prices because of its use in different industries, raising the cost of broiler production. In the recent past, rice husk has become an extensively used material by many other industries due to its potential as a fuel leading to increase in its price. It is therefore important to find out suitable and cheap alternate bedding materials and their combination to curtail the cost of poultry production. In this context the use of crop residues as poultry litter seems to be promising. Hence, the objectives of present experimental design were to investigate effects of use of different litter material combinations on growth

performance, economics of broiler production and bedding characteristic like moisture % and pH etc.

## MATERIALS AND METHODS

**Experimental design and diet:** For the present study, 420 healthy day old commercial straight run broiler chicks of Vencobb<sup>400</sup> strain were procured from M/s Venkateshwara Hatcheries Private Limited, Pune having uniform body weight and the experiment was carried out for a period of 42 days (6 weeks) from 7<sup>th</sup> March to 19<sup>th</sup> April 2015 in the Department of Poultry Science, College of Veterinary and Animal Sciences, MAFSU, Parbhani. Brooding was continued up to 1 week of age as experiment was conducted in summer. Before arrival of broiler chicks the pens, waterers, feeders, brooders and floor were cleaned, washed, disinfected and fumigated. The birds were housed under deep litter system with different litter materials such as rice husk, saw dust, groundnut hulls, wheat straw, soybean straw. Ideal feeding, watering and floor space were provided to all the treatment groups throughout the experimental period as per standards. The experimental chicks were housed in seven different pens. Each pen was partitioned for treatment group to have 3 replications, accommodating 20 birds in each. The experimental birds were vaccinated against Ranikhet disease on 4<sup>th</sup> day, Gumboro disease/IBD on 15 day and booster dose of Gumboro /IBD was carried out on 24<sup>th</sup> day and against Ranikhet (strain)

disease given on 29<sup>th</sup> day. Different litter materials such as rice husk, groundnut hulls, wheat straw and soybean straw were procured from Balsa Dairy, VNMAU, Parbhani and saw dust was procured from MIDC, Parbhani and used during entire experiment for the groups A, B, C, D, E, F and G respectively, throughout the experiment with different 1:1 (50%) combinations of different litter material on volume by volume basis. The litter material as per the treatment group was spread in each pen and for first two days it was covered by pasting the newspaper on the floor and chicks were reared on respective litter material from 3<sup>rd</sup> day onward till the completion of experiment. No litter materials were added, removed or replaced during course of trial, although some stirring of litter material occurred. The feed ingredients used in the present experiment were purchased from local market and rations were prepared as per BIS (2007) at Feed Mixing Plant, College of Veterinary and Animal Sciences, MAFSU, Parbhani. The pre-starter ration was offered for first eight days, starter ration was offered from 9<sup>th</sup> day up to end of 21<sup>st</sup> day of age and finisher ration was offered thereafter up to 42<sup>nd</sup> day of age. The weighed amount of ration was offered every day in the morning to all the treatment groups. The birds were offered *ad libitum* fresh and clean drinking water throughout the experiment.

**Observations recorded:** The live body weights of all birds were recorded replicate wise at weekly interval and from these data

the average weekly body weight and weight gain per bird were calculated for various treatment groups. The daily mortality was recorded. It was expressed as percentage mortality at the end of the experiment for corresponding treatment group. The litter moisture (AOAC, 1990) was determined on a weekly basis through 42 days of age as per the method described by Brake *et al.* (1992). The litter pH was measured according to the method described by Brake *et al.* (1992). The upper 10 cm of the litter was collected at each sample position and transported back to the laboratory for determination of pH. Cake formation score was measured according to the method described by Andrews (1972) and Carter *et al.* (1979). The litter was taken in the hand from four different sites of group and pressed in the fist. After pressing litter sample in the fist, compaction of litter was observed and expressed as per the scale given below. On a scale of 1 to 5, each pen for the amount of litter cake formation was determined, where 1 = no litter cake to 5 = total pen coverage of caked litter. The other growth performance parameters found to be non-significant.

**Statistical analysis:** All the data obtained were subjected to statistical analysis as per Snedecor and Cochran (1989) using Randomized Block Design.

## RESULTS

**Live weights:** The mean weekly live weights (g) differ significantly ( $P < 0.01$ )

between different groups (Table 1). Highly significant influence of litter material on body weight for treatment group B and F was seen. Similarly, highly significant effect of litter material on live weight of treatment groups C, D and G compared to control indicate that other combinations like wheat straw with soybean straw, saw dust with

soybean straw, saw dust with wheat straw are better options compared to control.

**Mortality:** The mean percent weekly mortality of groups A, B, C, D, E, F & G are 1.11, 0, 3.33, 0.55, 1.94, 0.27 and 0 percent respectively. The highest mortality percent was recorded for broiler raised on

**Table 1. Average weekly live weights (g) of broilers with different combination of litter materials**

Weeks	Treatment groups						
	A	B	C	D	E	F	G
I	164.09	167.69	172.17	170.49	164.10	167.70	172.18
II	411.07	417.60	432.40	427.88	411.08	417.61	438.71
III	780.44	805.68	807.94	806.22	780.48	805.69	807.95
IV	1137.64	1136.50	1147.46	1157.47	1137.65	1136.50	1147.47
V	1587.31	1639.89	1614.79	1623.59	1587.31	1639.88	1614.79
VI	2058.19	2180.66	2117.30	2130.73	2058.19	2180.67	2117.30
Mean	1023.12 <sup>c</sup>	1058.03 <sup>a</sup>	1048.67 <sup>b</sup>	1052.73 <sup>b</sup>	1023.13 <sup>c</sup>	1058.08 <sup>a</sup>	1049.73 <sup>b</sup>

Means connected with similar superscript in the same row do not differ significantly

**Table 2. Average weekly moisture (%) of litter with different combination of litter materials**

Weeks	Treatment groups						
	A	B	C	D	E	F	G
I	17.543	19.979	23.590	21.712	19.086	23.302	20.881
II	18.826	20.608	24.047	22.112	20.341	25.232	22.361
III	20.644	21.866	24.710	23.060	21.658	26.151	22.462
IV	21.186	21.526	26.881	23.588	22.297	26.560	22.563
V	22.953	23.335	26.406	24.413	24.298	26.333	23.829
VI	23.311	23.767	29.110	25.778	25.662	27.350	24.532
Mean	20.743 <sup>c</sup>	21.846 <sup>c</sup>	25.790 <sup>a</sup>	23.443 <sup>b</sup>	22.223 <sup>b</sup>	25.821 <sup>a</sup>	22.771 <sup>b</sup>

Means connected with similar superscript in the same row do not differ significantly

**Table 3. Average weekly pH of litter with different combination of litter materials**

Weeks	Treatment groups						
	A	B	C	D	E	F	G
I	6.128	6.330	6.847	6.175	6.245	6.231	6.184
II	6.221	6.258	6.949	6.255	6.329	6.238	6.255
III	6.314	6.338	7.122	6.421	6.340	6.448	6.580
IV	6.387	6.378	7.012	6.427	6.418	6.427	6.733
V	6.508	6.584	7.008	6.724	6.514	6.593	6.669
VI	6.672	6.861	7.147	6.841	6.851	6.829	7.014
Mean	6.371 <sup>b</sup>	6.458 <sup>b</sup>	7.014 <sup>a</sup>	6.473 <sup>b</sup>	6.445 <sup>b</sup>	6.461 <sup>b</sup>	6.572 <sup>b</sup>

Means connected with similar superscript in the same row do not differ significantly

**Table 4. Average weekly cake formation score of litter with different combination of litter materials**

Weeks	Treatment groups						
	A	B	C	D	E	F	G
I	1	2	3	2	2	2	2
II	1	3	4	3	3	3	2
III	1	4	5	4	4	3	3
IV	2	4	5	4	4	4	4
V	3	5	5	5	5	4	4
VI	3	5	5	5	5	4	4
Mean	1.8	3.8	4.5	3.8	3.8	3.3	3.2

**Table 5. Economics of broiler production with use different combination of litter material**

Sr. No.	Economics Particulars	Treatment groups						
		A	B	C	D	E	F	G
1	Cost of day old chick (Rs)	18	18	18	18	18	18	18
2	Feed consumption (g)							
i)	Pre starter	296.29	298.32	292.10	300.10	297.81	299.12	299.42
ii)	Starter	994.29	992.12	989.87	995.79	997.81	990.31	994.98
ii)	Finisher	2657.45	2705.19	2571.00	2590.13	2654.33	2711.97	2561.00
	Total	3948.03	3995.63	3853.61	3886.02	3949.95	4001.40	3855.40

**Table 5. Economics of broiler production with use different combination of litte material (Cont..)**

Sr. No.	Economics Particulars	Treatment groups						
		A	B	C	D	E	F	G
3	Rate of feed (Rs/kg)							
i)	Pre starter	26.32	26.32	26.32	26.32	26.32	26.32	26.32
ii)	Starter	26.44	26.44	26.44	26.44	26.44	26.44	26.44
iii)	Finisher	25.59	25.59	25.59	25.59	25.59	25.59	25.59
4	Cost of feed consumed (per bird Rs.)							
i)	Pre starter	7.79	7.84	7.68	7.89	7.81	7.86	7.86
ii)	Starter	26.28	26.22	26.14	26.30	26.33	26.17	26.28
iii)	Finisher	67.99	69.22	65.79	66.27	67.91	69.37	65.53
	Total cost of feed consumed per bird (Rs.)	102.06	103.28	99.61	100.46	102.05	103.4	99.67
5	Other miscellaneous cost* (Rs) {5(e) + 6}	7.20	4.90	5.150	6.90	5.25	6.80	7.05
a)	Average rate of litter material (Rs/kg)	4.00	1 and 2	1 and 1	3 and 1	3 and 1	2 and 3	3 and 1
b)	Litter utilized (kg)	48.00	30 & 12	39 & 30	48 & 30	12 & 39	12 & 48	48 & 39
c)	Litter cost (Rs)	192.00	30+24	39+30	144+30	36+39	24+144	144+39
d)	Total cost of litter (Rs)	192	54	69	174	75	168	183
e)	Cost of litter per bird (Rs)	3.20	0.90	1.15	2.90	1.25	2.80	3.05
6	Miscellaneous cost like vaccine, medicine, lime, electric bulb etc. (Rs)	4	4	4	4	4	4	4
7	Total cost of production (1+4+5)	127.26	126.18	122.76	125.36	125.3	128.2	124.72
8	Average cumulative weight gain (g) at the end of sixth week	2010.19	2133.66	2069.96	2083.06	2009.87	2133.66	2069.97
9	Return obtained @ Rs.68 per kg live weight	136.68	145.04	140.69	141.64	136.61	145.04	140.69
10	Net profit/ bird (Rs)	9.42	18.86	17.93	16.28	11.31	16.84	15.97
11	Net profit/ kg (Rs)	4.68	8.84	8.66	7.81	5.62	7.89	7.71

combinations of soybean straw with wheat straw (C), followed by groundnut hulls with wheat straw (E) and rice husk (A). From the mortality point of view, it can be inferred that the combination of soybean straw with groundnut hulls and sawdust with wheat straw can serve as best alternative litter materials.

**Moisture:** The mean litter moisture percent at 1<sup>st</sup> week of age were 17.54, 19.98, 23.59, 21.71, 19.08, 23.30 and 20.88 percent respectively for treatment groups A, B, C, D, E, F and G respectively (Table 2). The moisture percentages in different litter materials were highly significant ( $P < 0.01$ ) at different litter ages. This study also indicated that litter materials like soybean straw, wheat straw, saw dust and groundnut hulls in combination can successfully be used as a litter material without any adverse effects. However, treatment group B (soybean straw with groundnut hulls) was also alternate, cheaper litter material without any apparent effects on moisture percent.

**pH:** The weekly mean litter pH values at 4<sup>th</sup> week of age were 6.38, 6.37, 7.01, 6.427, 6.41, 6.42 and 6.73 for treatment groups A, B, C, D, E, F and G respectively (Table 3). In the present study there were no significant differences in pH values among the various treatment groups except treatment group C where, it was significantly higher (7.01) and this range was at the level of bird's comfort demand.

**Cake formation score:** The weekly mean litter cake formation score at 1<sup>st</sup> week of

age were 1, 2, 3, 2, 2, 2 and 2 for treatment groups A, B, C, D, E, F and G respectively (Table 4). It was observed that the cake formation score was due to high litter moisture which was a major contributing factor (Mayne *et al.*, 2007).

**Economics:** The economics of broiler production were calculated from different treatment groups which were presented in Table 5. The cost of day old chicks, feed, medication, vaccination, litter and other overheads were considered while calculating the cost of production. The cost of pre-starter, starter and finisher ration for all control and treatment groups are presented in Table 5. The prices of pre-starter, starter and finisher ration were Rs.26.32, 26.44 and 25.59 per kg for all treatment groups having different combination of feed ingredients. The total cost of feeding observed were Rs. 102.06, 103.28, 99.61, 100.46, 102.05, 103.4 and 99.67 for treatment groups A, B, C, D, E, F and G respectively. The total cost of feed for group C was lower than others treatment groups. The cost of litter for rearing one bird were Rs.3.2, 0.9, 1.15, 2.9, 1.25, 2.8 and 3.05 for treatment groups A, B, C, D, E, F and G respectively. The total sale price fetched from the birds sold on live weight basis from different treatment groups were Rs.119.44 (F) followed by Rs.119.44 (B), Rs.116.64 (D), Rs.115.86 (D), Rs.115.86 (C), Rs.112.56 (A) and Rs.112.50 (E). The net profit obtained per bird after selling the birds @ Rs. 68/- per kg on live weight basis was higher Rs. 18.86 for treatment group B, followed by Rs 17.93 (C), 16.84 (F), 16.28 (D), 15.97 (G), 11.31 (E) and

9.42 (A). The net profit/kg on live weight basis observed for different treatment groups were Rs. 8.84 (B), Rs.8.66 (C), Rs.7.89 (F), Rs.7.81 (D), Rs.7.71 (G), Rs.5.62 (E) and Rs.4.68 (A) respectively. It may be concluded that use of different combination of litter materials significantly ( $P < 0.01$ ) enhanced the net income per bird. It was concluded that the combination of soybean straw and groundnut hulls was found to be safe and economical substitute as a litter as compared to rice husk. It is recommended that the combination of soybean straw with groundnut hulls may be used as a superior bedding material with 50% combination on volume basis. On contrary, it is also recommended that poultry farmers should not use the combination of soybean straw with wheat straw as a litter material during rearing of broilers. Therefore, use of different combination of litter materials was more beneficial from the point of view of bird's performance, survivability and improved profitability compared to rice husk alone.

## DISCUSSION

**Live weights:** The results of present study were in agreement with the findings of Asaniyan *et al.* (2007) and El-Deek *et al.* (2011) who concluded that using mixture of newspaper and shaving woods or barley straw as a bedding materials in broiler house improved the broiler performance. In contrast to the present study, Benabdeljelil and Ayachi (1996); Lien *et al.* (1998); Senaratna *et al.* (2007); Navneet *et al.* (2011); Onu *et al.* (2011); Farghly (2012)

and Karousa *et al.* (2012) revealed non-significant effect of litter type on body weight.

**Mortality:** The mortality percent observed in the present study range from 0 to 3.33% in different litter combinations which is quite lower and also in agreement with the various authors reported as 3.03% (Khan *et al.*, 2009), 2.77% to 3.33% (Karousa *et al.*, 2012), 2.47% to 4.85% (Mahmood *et al.*, 2014). However, Farghly (2012) reported higher mortality 6.33% to 8.33% in local turkey with different litter material combinations.

**Moisture:** The results in the present study are in accordance with Benabdeljelil and Ayachi (1996), they indicated that alternate materials rice husk, sawdust, wood shavings, and rice hulls solely or in combination can successfully be used as a poultry litter without any adverse effect on litter moisture. Similar reports were also observed by Lien *et al.* (1998); Senaratna *et al.* (2007); Hafeez *et al.* (2009); El-Deek *et al.* (2011) and Karousa *et al.* (2012) in broilers and Farghly (2012) in local turkey birds.

**pH:** The findings of the present study are in agreement with Meluzzi *et al.* (2008); Senaratna *et al.* (2007) and El-Deek *et al.* (2011) in broilers and Farghly (2012) in local turkey birds.

**Cake formation score:** Grimes *et al.* (2002) found no difference in the incidence of litter caking and condition by litter type which was in contrast to the present study.

Hence it was recommended that effective and timely removal of cake should be essential component of litter management programme.

**Economics:** The present findings are in close agreement with that reported by Hafeez *et al.* (2009) and Khan *et al.* (2009). The significant ( $P < 0.01$ ) influence of different litter materials combination on broiler production concluded that the combination of different litter materials exhibited higher net profit per kg live

weight compared to that of rice husk (Control Group), except groundnut hulls and wheat straw.

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## REFERENCES

- AOAC. 1990. Association of Analytical Chemist, Official Methods of Analysis, 15th ed., Collegiate Press, Washington, D. C. – 20044: 957
- Andrews LD, 1972. Cage rearing of broilers. *Poult. Sci*, 51: 1194-1197
- Asaniyan EK, Agbede JO and Laseinde EAO, 2007. Impact assessment of different litter depths on the performance of broiler chickens raised on sand and wood shaving litters. *WJZ*, 2 (2): 67-72
- Benabdeljelil K and Ayachi A, 1996. Evaluation of alternative litter materials for poultry. *J Appl Poult Res*, 5: 203-209
- Brake JD, Boyle CR, Chamblee TN, Schultz CD and Peebles ED, 1992. Evaluation of the chemical and physical properties of hardwood bard used as a broiler litter material. *Poult Sci*, 71: 467-72
- BIS, 2007. Indian standards. Poultry Feed Specification, 5<sup>th</sup> revision, pp 3-5
- Carr LE, Wheaton FW and Douglass LW, 1990. Empirical models to determine ammonia concentrations from broiler chicken litter. *Trans ASAE*, 33: 1337-1342
- Carter TA, Allison RC, Mills WC and West JR, 1979. Wood chips for poultry litter. *Poult Sci*, 58: 994-997
- El-Deek, AA, Al-Harathi MA, Khalifah MM, Elbanoby MM and Alharby T, 2011. Impact of newspaper as bedding material in arid land on broiler performance. *EPSJ*, 31(4): 715-725
- Elliott HA and Collins NE, 1982. Factors Affecting ammonia release in broiler houses. *Trans ASAE*, 413- 418; 424
- Farghly MFA, 2012. Evaluation of clover and corn stalks straw as alternative litter materials to wheat straw for raising local turkey. *Egyptian J Anim Prod*, 49(2): 161-172
- Grimes J, 2004. Alternative litter material for growing Poultry. *North Carolina Poultry Industry Newsletter*, pp 1-4
- Grimes JL, Smith J and Williams CM, 2002.

- Some alternative litter materials used for growing broilers and turkeys. *Worlds Poult Sci J*, 58: 515-526
- Hafeez A, Suhail SM, Durrani FR, Dawood J and Ahmad I *et al.*, 2009. Effect of different types of locally available litter materials on the performance of broiler chicks. *Sarhad J Agric*, 25(4): 581-586
- Karousa MM, Meneeh IS, Ahmed SA, Ahmed EA and Youseif HA, 2012. Effect of litter materials on broiler behavior and performance. *BVMJ*, 23(1): 142-149
- Khan AA, Bhat GA and Banday MT, 2009. Effect of different litter materials on performance of commercial broilers in temperate agro-climatic conditions of Kashmir valley in summer season. *Indian J Anim Res*, 43 (2): 153-154
- Lien RJ, Hess JB, Conner DE, Wood CW and Shelby A, 1998. Peanut hulls as a litter source for broiler breeder replacement pullets. *Poult Sci*, 77: 41-46
- Malone GW and Chaloupka GW, 1983. Influence of litter type and size on broiler performance. 2. Processed newspaper litter particle size and management. *Poult Sci*, 62: 1747-1750
- Mayne RK, Else RW and Hocking PM, 2007. Higher litter moisture is sufficient to cause footpad dermatitis in growing turkeys. *Br Poult Sci*, 48: 538-545
- Meluzzi A, Fabbri C, Folegatti E and Sirri F, 2008. Effect of less intensive rearing conditions on litter characteristics, growth performance, carcass injuries and meat quality of broilers. *Br Poult sci*, 49: 509-515
- Mahmoud MSH, Soliman FNK, EL-Deen MB and Sebai AE, 2014. Effect of different types of litter on broiler performance. *Italian Sci Rev*, 4(13): 654-656
- Navneet K, Nagra SS, Daljeet K and Hanah Paddy SS, 2011. Straw as an alternate bedding material for broiler chicks. *JWPR*, 2(3): 48-53
- Onu PN, Madubuiké FN, Nwakpu PE and Anyaehie AI, 2011. Performance and carcass characteristics of broilers raised on three different litter materials. *Agri Biol J*, 2011, 2(10): 1347-1350
- Reece FN, Bates BJ and Lott BD, 1979. Ammonia control in broiler houses. *Poult Sci*, 58: 754-755
- Senaratna D, Atapattu NSBM and Belpagodagamage DU, 2007. Saw dust and refuse tea as alternative litter materials for broilers. *Trop Agricult Res*, 19: 283-289
- Snedecor GW and Cochran WG, 1989. *Statistical Methods*, 8<sup>th</sup> ed., Oxford and IBH Publishing Company, New Delhi