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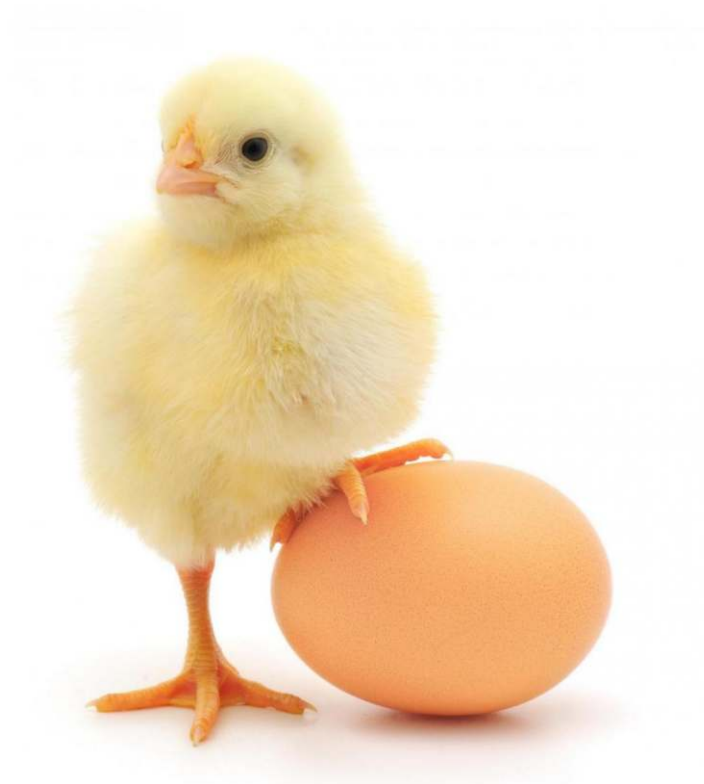

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Effect of Quality Feeds and Litter Materials on Broiler Performance under Hot Humid Climate

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Abstract: Eight hundred eighty seven straight run day old commercial broiler chicks (Cobb) were randomly housed into eight equally spaced compartments (1.13 sq ft/bird) and allotted to two different rations viz. Ration-I: R_1 (Broiler starter-I: 24.18% CP and 2999Kcal/Kg ME and Broiler finisher-I: 22.22% CP and 3108 Kcal/Kg ME) and Ration-II: R_2 (Broiler starter-II: 22.12% CP, 2879Kcal/Kg ME and Broiler finisher-II: 19.87% CP and 2941Kcal/Kg ME) and two litter materials viz. L_1 (Rice husk) and L_2 (Wheat straw+saw dust) used and form four combinations in two replications viz. L_1R_1, L_1R_2, L_2R_1 and L_2R_2. The body weight gain (g/bird) of experiment birds was recorded to be 1597.28±34.66, 1595.10±32.65, 1611.12±34.66 and 1581.26±32.65 under R_1, R_2, L_1 and L_2, respectively and influenced significantly by age only. Average weekly total feed intake (g/bird), FCR (Kg/Kg gain), average weekly water intake (ml/bird), water: feed intake ratio and performance efficiency factor were 512.50±6.54, 1.59±0.14, 1525.10±25.08, 2.80±0.08 and 212.10±27.18, respectively and influenced significantly by age. The feed cost (Rs/bird) was 26.23±0.07 and 26.43±0.06 with R_1 and R_2, which did not influenced either by feed or litter materials but influenced significantly by their interaction. However, feed cost per kg gain (Rs/Kg), feed cost per dressed weight (Rs/kg), total production cost (Rs) on Ration I was 16.32±1.88, 28.31±0.29 and 18692.15±36.98, respectively and were significantly higher than Ration II (15.22±1.66, 25.69±0.14 and 17642.76±17.05) where as net profit/bird (Rs. 4.46±0.08 and 8.45±0.68), return over feed cost (Rs. 9461.86±0.35 and 11347.96±2.65) and return as percent of feed cost (184.44±0.04 and 206.76±0.02) were significantly lower in Ration I than Ration II. The litter materials showed their significant effect on average weekly livability percentage and manurial value. Ambient temperature inside the house was significantly higher than out side the house and established significant negative relationship with Relative Humidity (RH), Temperature Humidity Index (THI) and feed intake and significant positive relationship with water and water: feed intake ratio. The broiler birds can be reared economically on rice husk as a liter material by feeding 2879 (BS)-2941 (BF) ME energy and 22.12% (BS)-19.87% (BF) protein ration to harvest significantly higher return over feed cost (206.76%)

Key words: Feed, litter materials, broiler, performance

Introduction

The net return per broiler is to a great extent dependent on the amount of the feed used to produce one kg of broiler and energy-protein ratio of diet. The birds reared below 20 percent CP and 2500 Kcal ME/Kg feed showed significantly lower body weight and body weight gain at six weeks of age (Temin *et al.*, 2000). Similarly, there is no additional beneficial gain if CP percentage maintained above 28 percent in starter ration (Temin *et al.*, 2000) and high energy level of 3350 Kcal ME/Kg feed (Hou *et al.*, 1991) but intermediate CP (21-24%) and energy level (2700-3100 Kcal ME/Kg) feed proved the best (Rajni *et al.*, 1998) in the broiler ration. Similarly broiler attained 2235 and 2171 kg body weight with 1.65 and 1.87 FCR on wheat straw and mixture of wheat straw and saw dust (Ogman, 2000). Hence the experiment was initiated to study the feasibility of using locally available two different litter materials and quality feeds under hot-humid climate.

Materials and Methods

The growth trail was lasted on eight hundred eighty seven straight strait run day old commercial broiler chicks (Cobb) for 35 days in which they were randomly housed into equally spaced (125 sq ft/compartment and 1.13 sq. ft/bird) eight compartments (110-111 birds/compartment) and offered two different rations (Table 1) Viz. R_1 (Broiler starter-I: 24.18% CP and 2999Kcal/Kg ME with 124:1 energy: protein ratio and Finisher-I: 22.22% CP and 3108Kcal/Kg ME with 140:1 energy: protein ratio) and R_2 (Broiler starter-II: 22.12% CP, 2879Kcal/Kg ME with 130:1 energy: protein ratio and Finisher-II: 19.87% CP and 2941Kcal/Kg ME with 148:1 energy: protein ratio) on two litter materials viz. L_1 (rice husk) and L_2 (wheat straw+saw dust) in two ration regime x litter material combinations viz. L_1R_1, L_1R_2, L_2R_1 and L_2R_2 in two replications. All the parameters recorded on weekly basis and each week considered as period.

Table 1: Composition (kg/100kg) of the Experimental rations

Sr.No.	Ingredients	Ration I Starter	Ration I Finisher	Ration II Starter	Ration II Finisher
1	Maize	50.62	54.60	49.91	52.12
2	Rice Polish	-	-	7.50	10.00
3	SBDOM	28.70	25.50	28.00	25.10
4	Maize Gluten Meal	4.00	4.00	1.80	-
5	Protoliv	8.00	6.50	6.00	5.40
6	Vegetable oil	3.00	4.10	1.10	2.00
7	Shell Grit	1.30	1.10	1.30	1.10
8	DCP	1.00	0.80	1.00	0.80
9	Mineral Mixture	2.50	2.50	2.50	2.50
10	Salt	0.30	0.30	0.30	0.30
11	L-Lysine	-	0.06	-	0.13
12	DL-Methionine	0.15	0.12	0.17	0.13
13	Vitamin AB_2D_3K	0.01	0.01	0.01	0.01
14	B-complex	0.01	0.01	0.01	0.01
15	UTPP	0.20	0.20	0.20	0.20
16	Coccidiostat	0.05	0.05	0.05	0.05
17	Neftin-200	0.03	0.03	0.03	0.03
18	Meritiv-100 (B_{12})	0.02	0.02	0.02	0.02
19	Liver Tonic	0.03	0.03	0.03	0.03
20	Choline Chloride	0.08	0.08	0.08	0.08
Total		100.00	100.00	100.00	100.00
Feed Cost (Rs/Kg)		10.71	10.89	9.69	9.77
CP Percent (g/kg)		24.18	22.22	22.12	19.87
Metabolic Energy (Kcal)		2999	3108	2879	2941
Energy: Protein ratio		124:1	140:1	130:1	148:1

The birds weighed in group of five in ten batches (50 birds per compartment) every week. The different periods P_1, P_2, P_3, P_4 and P_5 indicated the 1st, 2nd, 3rd, 4th and 5th week of age. The birds were offered water thrice in a day in plastic waterer and offered feed twice in a day in line feeders. The waterers were washed daily morning with universal barn cleaner in prescribed concentration. Water and feed consumption were measured daily. The temperature and relative humidity (Digital Thermo-hygrometer: J411TH) and light intensity (Digital Luxmeter: Mastech-MS6610) were measured daily twice at 7.30 a.m. and 2.30 p.m. throughout the experiment. The THI was calculated through formula (THI = Td - (0.55-0.55 RH) - (Td-58) (Oliver *et al.*, 1979) The litter materials were stirred daily from 2nd week onward in order to maintain moisture% and ammonia concentration in optimum level. The chemical analysis of the K (Flame photometer method), P (Spectrophotometer method), N (Kjeldah method) and coccidial oocyst (McMaster technique) were carried out. After thirty five days of experiment, six birds from each ration x litter material treatment combinations were slaughter by Halal method for evaluating different carcass traits. The data were analyzed under three factorial completely randomized design, completely randomized design and t- test (Snedecor and Cochran, 1994).

Results and Discussion

Body weight: The average body weight gain of experimental birds on two different rations and two different litter materials are presented in Table 2 and depicted in Fig. 1. The body weight and body weight gain of experimental birds fattened on R_1 and R_2 did not differ. Ferguson *et al.* (1998) also reported non significant difference in body weight when broiler fed either high (26.4%) or medium (24.13%) level of protein. where as the body weight of birds during present experiment was in accordance with the findings of Rajni *et al.* (1998). Gonzale (1984) fed (140:1 and 160:1 E: P ratio) R_1 and (120:1 and 180:1 E: P ratio) R_2 ration to broilers and observed E: P ratio affect ($p<0.05$) the growth rate as this was not the case with the present study implies that E: P ratio is not wide enough to show its significant effect. The rice husk and wheat straw+saw dust did not influence the body weight of broiler during first week but influenced there after ($p<0.05$).

The bird reared on L_2R_1 and L_1R_2 replication showed the lowest and the highest body weight ($p<0.05$), respectively during the experiment. The bird reared on the L_1R_1 treatment combination differed ($p<0.05$) in body weight from the bird reared on L_2R_2 treatment combination during 2nd and 5th week of the experiment only. However, the body weights of broiler reared either on L_1R_2 or L_2R_2 were at par. This promising result of

Table 2: Mean (±s.e.) Performance of broiler on different litter materials and rations

		Rice husk (L_1)		Wheat straw+ saw dust (L_2)	
Sr.No	Parameter	R1	R2	R1	R2
1	Body weight (g)				
	0 day	48.98±1.74	49.76±1.72	48.94±1.72	49.44±1.95
	35th day	1675.45±16.93	1645.60±12.60	1612.20±10.89	1643.90±12.06
	Average	1660.53±21.10 [b]		1628.05±16.25[a]	
2	Gain (g) +	1626.47±48.03	1595.74±46.14	1568.06±48.21	1594.46±46.23
3	Feed intake +				
	g/bird	2513.10±6.92	2536.10±6.82	2552.84±6.65	2648.30±6.77
	Kg/Kg gain	1.53±0.17	1.58±0.21	1.61±0.14	1.63±0.25
4	Water intake +				
	ml/bird	7649.68±16.55	7431.49±25.35	7696.20±16.48	7727.74±24.24
	Water: feed	3.97±0.11	3.76±0.09	4.02±0.08	3.79±0.09
5.	Manurial value				
	Moisture (%)	27.50±4.78	34.50±2.70	34.50±2.70	31.25±3.63
	Oocyst (g/litter)	450.00±227.70	725.00±362.90	725.00±362.90	0.00±0.00
	N (%)	1.42±0.09	1.39±0.05	1.44±0.06	1.51±0.08
	P (%)	0.0658±0.01	0.0532±0.01	0.0627±0.01	0.0821±0.01
	K (%)	0.421±0.02[a]	0.424±0.02[a]	0.505±0.01[b]	0.550±0.03[b]
7	Liveability (%)+	97.77±0.14	97.89±0.21	98.17±0.11	97.43±0.15
8	PEF (%)+	223.43±29.43	217.04±28.18	200.61±27.87	207.33±24.02
9	Dressing (%)	59.63±0.51	60.00±0.77	63.30±0.52	61.29±0.28

+Age effect ($p<0.05$); Mean with different superscripts (a and b) in column (litter materials) in same row differ significantly ($P<0.05$) did not influenced either by rations or litter materials

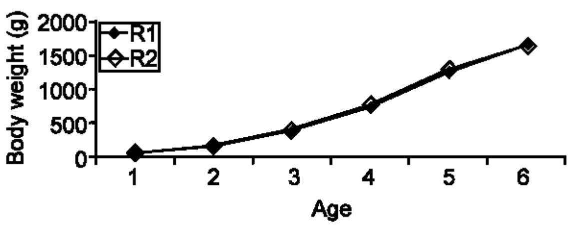

Fig. 1: Average Weekly Body Weight (g/bird)

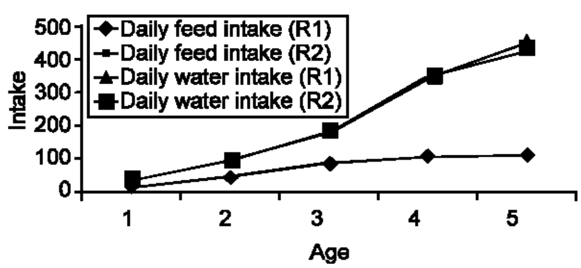

Fig. 2: Daily feed and water intake

body weight of broiler reared on rice husk (L_1) proved its suitability as a litter material for broiler rearing. The non significant effect of litter materials on body weight observed when broilers were reared on saw dust (1709g), rice husk (1602g), sugarcane bagasse (1610g) and wheat straw (628g), respectively (Monira *et al*., 2003) which correspond the present finding. However, Davasgaium (1998) and Ogman (2000) observed higher body weight of broiler when reared on chopped wheat straw (2235g), saw dust (2171g), mixture of saw dust with wheat straw (2136g), whole wheat straw (2040g), bagasse (2178g), wood shavings (2262g), mixture of bagasse and wood shavings (2261g) as compared to present finding while Anisuzzaman *et al*. (1995) recorded lower body weight when broilers were reared on saw dust (1520g), paddy straw (1466g) and sand (1393g) but they observed higher body weight of broilers reared on rice husk (1634g) which supports the present findings of the experiment and they proved rice husk as the best litter materials among all four litter materials which again supported by Haque and Chowdhury (1994). The body weight and body weight gain did not influence by either of feed or litter or period interaction effect implies independent effect of ration, litter and periods on body weight. Irrespective of rations, the birds grew linearly with same magnitude by 79.18 (11.31g/d), 232.56 (33.22g/d), 368.45 (52.63g/d) and 506.78g (72.82g/d) during P_1, P_2, P_3 and P_4 period and grew at decreasing rate 406.15g (58.02g/d) during P_5 period which may be due to decrease in percent water intake or space per bird was inadequate as compared to other periods. The increments of body weight and body weight gain during different periods differed ($p<0.05$). The body weight recorded on R_2 (low energy and low protein) during P_1, P_2, P_3, P_4 and P_5 was 6.95, 7.08, 4.63, 3.02 and 0.05 percent higher ($p>0.05$) than birds reared on R_1 (high energy and high protein). This may be due to little more feed and water intake by the birds of R_2 than R_1 (Fig. 1 and 2) indicated birds reared either on R_1 or R_2 grew linearly with same magnitude up to end of experiment.

Feed intake: The total and daily feed intake is depicted in Table 2 and Fig. 2, respectively. The daily feed intake (g/day) and weekly feed consumption (g/bird) observed higher ($p<0.05$) with R_2 than R_1. The high daily feed intake (Forbes and Shariatmadari, 1996) was observed (165.10g) than the present findings. Similarly, Summer (1995) also observed high total feed intake at the end of 5th week (1046 g) as compared to our present findings (778.10 g). The total feed consumption of 2845-3010g (Reddy *et al.*, 1998), 2864-3109g (Bandy *et al.*, 2003) and 3605.90-3828.84g (Mikulec *et al.*, 2004) during six weeks of growing period at various levels of crude protein (21-23%) observed by different workers. The birds reared on L_2R_2 replication showed higher ($p<0.05$) total feed consumption (2648.30g) than those birds reared on L_1R_1 (2513.10), L_2R_1 (2552.84g) and L_1R_2 (2536.10g). Similarly, The maximum daily feed intake (g/day) was observed in the L_2R_2 (75.18g), followed by L_2R_1 (72.40g), L_1R_2 (72.29g) and L_1R_1 (71.54g). The weekly feed consumption (g/bird) increased by decreasing rate between P_1 to P_2 (70%), P_2 to P_3 (45%), P_3 to P_4 (14.47%) and P_4 to P_5 (7.50%), respectively. The feed consumption by the experimental birds kept either on L_1R_1, L_2R_1, L_1R_2 and L_2R_2 differed ($p<0.05$) upto the end of P_3 but did not differ in P_4 and P_5. The birds reared on high protein and high energy ration showed better FCR than birds reared on low protein low energy (Temin *et al.*, 2000). The rations or litter materials failed to produce their significant effect on FCR. The FCR of birds reared on L_1 was ($p>0.05$) better (L_1R_1: 1.53 and L_1R_2: 1.58) than the birds reared on L_2 (L_2R_1: 1.61 and L_2R_2: 1.63). Haque and Chowdhruy, 1994; Anisuzzaman *et al.*, 1995 concluded that rice husk was the best among all litter materials used in the experiment. Similarly, Ogman, 2000 proved mixture of saw dust+wheat straw can be used effectively as litter material than bird reared only on wood shavings. The research workers (Singh and Sharma, 2000; Monira *et al.*, 2003) observed non significant effect of litter materials on FCR and they have also observed higher FCR (2-2.5) on various litter materials than the present finding except Ogman (2000) who observed 1.64 FCR which support our present findings. The lowest FCR in the present study may be either due to adequate quality water supply (Greenburg *et al.*, 2001) or supply of quality feed (Temin *et al.*, 2000). The FCR of experimental birds reared either on L_1 or L_2 did not influenced by age up to P_2. The FCR of birds reared on L_2R_2, L_1R_1 and L_1R_2 influenced by period ($p<0.05$) except FCR of birds reared on L_2R_1. The lowest FCR of experimental bird observed during 4th week of experiment. Again in the same P_4 period bird reared either on L_1R_2 or L_1R_1 showed the lowest FCR than bird reared on L_2R_2 or L_2R_1. The highest FCR observed during P_5 may be due to sudden drop in body weight gain as compared to feed consumption, this was again due to higher inside house temperature (85.61°F) which was the highest ever temperature of the experimental periods or the floor space which was provided (1.13 sq.ft/bird) may be inadequate though it was more than the recommended floor space of one sq.ft/bird (Austic and Neshiem, 1990) for the broiler birds. The FCR of experimental birds reared on all four combinations did not influenced by Ration or litter materials or interaction effect of rations, litter materials and periods.

The weekly total water intake (ml/bird) and daily water: feed intake ratios are presented in Table 2 and daily water intake (ml/day) are depicted in Fig. 2 and showed similar trends (R_1: 7672.00 and R_2: 7579.62).The birds reared on L_2 showed marginally higher water intake (L_2R_2- 218.50 and L_2R_1- 217.56 ml/day) than birds reared on L_1 (L_1R_1- 216.10 and L_1R_2- 209.85 ml/day). The litter did not produced its effect. The daily water intake (ml/day), total water intake (ml/bird) and water: feed intake ratio was ($p<0.05$) affected by age. The water intake was increased linearly at the decreasing rate between P_1 to P_2 (60.45%), P_2 to P_3 (47.42%), P_3 to P_4 (47.54%) and P_4 to P_5 (22.62). This may be due to higher THI value (101.56 to 106.73) and THI has negative correlation ($p<0.05$) with water intake (-0.5676). The sudden drop in percent of water intake between P_4 and P_5 as compared to other periods inspite of sudden drop in RH (12.57%) and THI (92.38) during P_5 may be due to inadequate floor spaced. The water intake observed in the present experiment was quite higher because of ($p<0.05$) positive relationship between water intake and temperature (0.4769). The findings of Summer, 1995 and Tabler (2003) are in accordance with present findings. The water to feed intake ratio of experimental birds. The water to feed intake ratio were higher ($p<0.05$) in P_1 than observed between P_2 and P_3, this may be due to high ambient temperature during P_1 (84.78°F). Similarly ($p<0.05$) negative relationship with RH (-0.5600) and THI (-0.5440) and ($p<0.05$) positive relationship with temperature (0.6046). The water to feed intake ratio increased drastically by 38.10 percent and 15.68 percent between P_3 to P_4 and P_4 to P_5 may be due to again high ambient temperature and during P_4 (84.51°F) and P5 (85.61°F), respectively which leads to age effect ($p<0.05$). The water to feed intake ratio investigated by Tabler, 2003 was quite lower than the value observed in the present experiment while Kukde and Thakur (1992) observed water to feed intake ratio (2.52) in rainy and (3.18) in summer season which are in accordance with present findings.

Microclimate: The weekly microclimatic values are presented in Table 3 and correlation coefficients of microclimatic elements with productive parameters of broilers are presented in Table 4 and depicted in Fig. 3. The observed values of ambient temperature, relative humidity percent and THI inside the house were higher ($p<0.05$) than out side the house this may be due to low wind speed. The microclimate within the house did not differ from period to period. There was continuously drop

Table 3: Mean (± s. e.) Microclimate during experiment

Week (Period)	Temperature (°F)		RH (%)		THI		Rainfall (mm)
	Inside	Outside	Inside	Outside	Inside	Outside	
1	84.78±0.9	78.35±0.3	80.38±0.9	79.93±0.9	101.90±0.6	101.40±0.5	5.10
2	83.76±0.3	77.44±0.3	80.74±0.7	74.86±1.1	101.56±0.1	98.63±0.61	0.00
3	82.41±0.6	77.73±0.4	89.93±2.6	84.44±4.1	106.73±1.5	103.89±2.2	125.00
4	84.51±0.5	79.53±0.2	85.14±1.7	80.02±1.9	104.19±1.0	101.46±1.0	15.60
5	85.61±0.9	76.64±0.9	64.29±3.4	63.32±2.4	92.38±1.97	92.27±1.32	0.00
Mean	84.21±0.4	77.93±0.4	80.10±1.8	76.51±3.2	101.35±1.0	99.53±1.8	4.16±0.

Table 4: Mean Correlation coefficients of microclimate with productive Parameters

Item	T°F	RH (%)	THI	FI	W: F	Body Wt	FCR
T°F	1.00	-	-	-	-	-	-
RH (%)	0.49*	1.00	-	-	-	-	-
THI	0.46*	0.99*	1.00	-	-	-	-
FI	0.20	-0.37*	-0.36*	1.00	-	-	-
W: F	0.60*	-0.56*	-0.54*	0.55*	1.00	-	-
Body Wt.	0.43	-0.47	-	-	-	1.00	-
FCR	0.28	-0.67	-	-	-	0.65	1.00

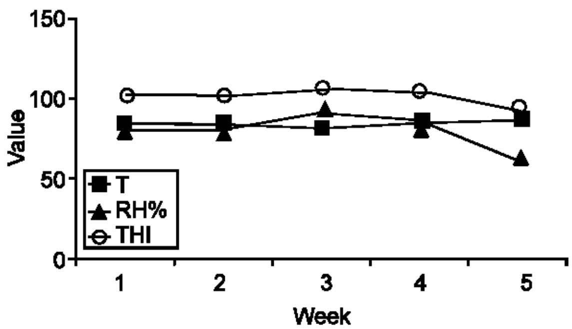

Fig. 3: Microclimate during experiment

in ambient temperature of house from P_1 (84.78°F) to P_3 (82.41°F) but increased during P_4 (84.51°F) and P_5 (85.61°F). The drop in temperature between P_1 to P_2 was marginal (1.20%) but sever (9.83%) from P_1 to P_3 may be due to no rain fall during P_2 but maximum rain fall (125 mm) observed during the P_3 of experiment hence RH (%) marginally increased (0.4%) between P_1 (80.38%) to P_2 (80.74%) but drastically increased from P_1 (80.38%) to P_3 (89.93%) but again drop marginally (5.63%) between P_3 to P_4 because of little rain fall during P_4 (15.60mm) but there was severe drop in RH% (32.43%) between P_4 to P_5 and P_3 to P_5 (39.88%) as compared to P_3 because of no rain fall during P_5 or this was due to negative correlation ($p<0.05$) between temperature and relative humidity percent (-0.4928) and temperature and temperature-humidity index (-0.4584) but correlation ($p<0.05$) between relative humidity percent and temperature-humidity index (0.9967) intern the highest temperature-humidity index during P_3 (106.73) and minimum (92.38) during P_5.

The correlation coefficients ($p>0.05$) between temperature to feed intake, body weight and FCR implies that temperature did not influenced feed intake, body weight and FCR but positively correlated ($p<0.05$) with water intake and water to feed intake ratio. The relative humidity positively correlated ($p<0.05$). With temperature-humidity index (0.9967), but negatively correlated with feed intake (-0.3686), water intake (-0.5792) and water to feed intake ratio (-0.5600) As positive significant ($p<0.05$) correlation between temperature and water intake (0.4769) and water to feed intake ratio (0.6046) and negative significant ($p<0.05$) correlation between relative humidity (%) and temperature-humidity index with feed intake (-0.3656 and -0.3614), water intake (-0.5792 and -0.5676) and water to feed intake ratio (-0.5600 and -0.5440) intern increase in the rate of water during P_5. The feed intake (0.2071) and body weight (0.4347) were non significantly ($p>0.05$) positively correlated with temperature but Homindan *et al.*, 1997 observed negative correlation between temperature and feed intake and temperature and body weight. The final body weight gain found in the present experiment was 1596.19 g/bird with the average temperature of 84.21° F (29°C) which was higher than the body weight gain (1141.50 g) reported by Simmons *et al.* (2003) on 35th at 28°C where as May and Lott (2000) observed 790g body weight on 21st day at 29°C strongly confirm the present findings. The maximum growth was achieved in the temperature range 27.30°C to 30.58°C in dry period and 26.28°C to 31.93°C in the humid period (Sharma and Gangwar, 1985) which strongly confirmed the present findings. Different light intensity (6-180 lux) did not affect the body weight, feed intake and water intake of birds (Donald *et al.*, 2000). Yahav (2000) found body weight (1400-1473g) at 70-75 percent relative humidity, which was lower than the present findings and FCR (1.36) at 53 percent relative humidity reported by Bruzual *et al.* (2000) was also lower than the FCR (1.59) of present findings at 64-90 percent relative humidity.

Manurial value: The manurial values of different litter materials with different ration combinations are presented in Table 2. There was (p>0.05) difference in moisture percentage in different litter materials of ration×litter combinations. The average moisture percentage was maximum in L_2R_1 (34.50%) and least in L_1R_1 (27.50%) with average of 29.75 percent. The average moisture percentage of rice husk (27.88%) and wheat straw+saw dust (32.88%) was higher than value observed by Monira *et al.* (2003) but lower than the values reported by Swain and Sundaram (2000). The moisture percentage in L_2 (wheat straw+saw dust) and L_1 (rice husk) varied from 20-42 and 17-43 percent, respectively during.

The highest moisture percent was observed during P_4 and P_5 may be due to more water intake during this period. Inspite of addition of fresh rice husk (15 Kg/week) and wheat straw+saw dust (12.5 Kg/week) with daily stirring of litter materials in all pens after second week, the higher moisture percentage observed in both the litter materials than the recommended value which is nearly 25 percent indicated still more addition of litter material required to maintain moisture percent below recommended value. The average coccidial oocyst count in present experiment was 493/g litter material which was very low than the value reported by Babu *et al.*, 1993 (1158.33) but it was strongly supported by the findings of Monira *et al.*, 2003 (495/g litter material). The coccidial oocyst in L_1 (rice husk) was 625/g litter material which was higher than the value found by Monira *et al.*, 2003 (558.50/g) but lower than value recorded by Babu *et al.*, 1993 (1158.33/g). Similarly in L_2 (wheat straw+saw dust), the average coccidial oocyst was (363/g litter material) which was very low than value found by Monira *et al.*, 2003 (608.40/g) under hot humid condition. The average value of nitrogen percentage in litter material was 1.44%. The average value of nitrogen percentage was lower than the value recorded by Babu *et al.*, 1993; Monira *et al.*, 2003 (2.87%) this may be due to evaporation of volatile nitrogen on account of daily stirring of litter materials where as in L_1 (rice husk) and in L_2 (wheat straw+saw dust) it was 1.41 and 1.48 percent, respectively. The nitrogen percent in rice husk was also lower than the value observed by Monira *et al.*, 2003 (3.04%). The similar trend was seen for wheat straw+saw dust by Monira *et al.*, 2003 (3.55%) at 27.8°C temperature with 76.73 percent relative humidity. The average potassium percent was 0.48 percent which was lower than the value recorded by Babu *et al.*, 1993 (0.773%) but higher than the value (0.168%) recorded by Monira *et al.*, 2003. The value of potassium percent differed (p<0.05) between L_1 (0.42%) and L_2 (0.52%). The potassium percentage of L_1 (0.42%) was lower than the potassium percentage investigated by Babu *et al.*, 1993 (0.77%) but value for L_2 was higher than the value recorded by Monira *et al.*, 2003 (0.21%). The average value of phosphorus percentage of experiment was 0.66 percent which was lower than the value reported by Monira *et al.*, 2003 (1.06%). The L_2 showed 0.72 percent phosphorus that was lower than the value observed by Monira *et al.*, 2003 (1.25%). Similarly, L_1 showed 0.59 percent phosphorus, which was quite lower than the value obtained by Monira *et al.*, 2003 (1.07%). All the manurial value parameters were non significantly affected either by ration or litter material or period, which was also confirmed Monira *et al.*, 2003 except potassium percentage which was affected (p<0.05) by litter materials.

Carcass trait: The carcass traits of the experimental birds are presented in Table 2. The dressing percentage on live weight basis varied from 59.63 percent (L_1R_1) to 63.30 percent (L_2R_1) but they did not influenced by either rations or litter materials. The dressing percent of present experiment was quite lower than the dressing percent observed by Bandy *et al.*, 2003 (85.02%) may be due to difference in slaughter age but higher than the value observed by Chhonker *et al.*, 1994 (57.20%) while findings of Singh *et al.*, 2001 (65-72%) supported the present findings. The weight of skin and feather of birds reared on L_1 under R_1 treatment showed significantly (p<0.05) lower weight than birds reared on L_2 but reverse trend was observed in R_2 treatment. The weight of filled as well as empty digestive tract weight of liver, weight of heart, weight of gizzard and weight of abdominal fat did not influence either by rations or litter treatment. The research worker (Renden *et al.*, 1992) also reported non significant effect of feeding as well as litter treatment on carcass trait.

Liveability: The average liveability percentage (Table 2) of experiment was 98.02 percent. The liveability percent was little higher for birds reared on R_1 (98.37%) than those birds reared on R_2 (97.66%). The livability percent was low for birds reared on L_1 (97.83%) than those birds reared on L_2 (98.20). The liveability percentage of birds reared on Rice husk and wheat straw+saw dust were higher than the value found by Singh and Sharma, 2000 (96.00 and 95.00%, respectively). The higher liveability percent observed under L_2 (98.20%) than the L_1 (97.83). The liveability percentage under R_2 feeding (97.66%) was less than R_1 feeding (98.37%). The average liveability percentage (98.02%) of present experiment was higher than the value recorded by Singh and Sharma, 2000 (96.40%) and Donald *et al.*, 2000 (96.16%).

Performance efficiency index: The performance efficiency factors under present investigation are presented in Table 2. The performance efficiency factor did not influence either by rations or litter materials

Table 5: Mean (±s. e.) economics statement on different rations

Sr. No.	Particulars	Ration- I	Ration-II	t test
1	No. Of Chicks	443	444	NS
2	Total Chick Cost (Rs)	3761.07	3769.56	NS
3	Total Feed Consumed (Kg)	1038.58±3.28	1043.00±0.89	NS
4	Total Feed Cost (Rs.)	11206.28±35.40^{B}	10348.39±31.20^{A}	*
5	Litter Cost (Rs)	448.10±0.00	448.10±0.00	NS
6	Medicinal Cost (Rs.)	761.64±0.00	761.64±0.00	NS
7	Electricity Cost (Rs)	1640.00±0.00	1640.00±0.00	NS
8	Labour Cost (50 Rs/Day)	875.00±0.00	875.00±0.00	NS
9	Total rearing Cost of experiment	18692.15±36.98^{B}	17642.76±17.05^{A}	*
10	Total rearing Cost of experiment/chick	42.19±36.98^{B}	39.74±17.05^{A}	*
11	Final Live Weight (g/bird)	1643.83±26.55	1644.75±16.91	NS
12	Total Live Wt. Obtained (Kg.)	705.16±2.75^{A}	730.27±1.87^{B}	*
13	Feed cost (Rs/kg gain)	16.32±1.88	15.22±1.66	NS
14	Feed cost (Rs/kg dressed wt)	28.31±0.29^{B}	25.69±0.14^{A}	*
15	Total receipt from meat (Rs 29/Kg.)	20449.62±78.97^{A}	21177.82±54.52^{B}	*
16	Selling Of Build-Up Litter Materials (Rs.)	218.50±0.00	218.50±0.00	NS
17	Total Income (Rs.)	20668.14±79.73^{A}	21396.35±54.42^{B}	*
18	Net Profit (Rs)	1975.99±75.76^{A}	3753.56±65.46^{B}	*
19	Net Profit/Bird (Rs)	4.46±0.68^{A}	8.45±0.68^{B}	*
21	Return over feed cost (Rs)	9461.86±0.35^{A}	11347.96±2.65^{B}	*
22	Return as percent of feed cost	184.44±0.04^{A}	206.76±0.02^{B}	*

Mean with different superscript (A and B) in row differ significantly at $p < 0.05$

implies that entire flock performed equally on both the rations and the litter materials. However broiler reared on L_2R_1 (200.61) and L_2R_2 (207.33) showed non significantly lower performance efficiency factor as compared to birds reared on L_1R_1 (223.43) and L_1R_2 (217.04). This may be due to higher FCR and low body weight of birds reared on wheat straw+saw dust than on rice husk. The performance efficiency factor of experimental birds increased linearly upto 4th week of experiment at different rate significantly ($p<0.05$) may be due to low FCR (1.41-1.68) and higher body weight gain (49.48-1257.10 g), where as performance efficiency factor decreased during 5th week due to higher FCR (2.02) and low body weight gain (58.02 g/day) between P_4 and P_5. The performance efficiency factor of birds irrespective of the litter materials observed non significantly higher in R_2 than the birds reared on R_1 upto P_4. Greenburg *et al.*, 2001 reported higher performance efficiency factor of birds reared on Cell vet ™ water purifier (246.73-342.23) inspite of higher mortality and low FCR than value observed in present experiment (1.52-1.90) may be due to higher body weight gain (1786-2936 g) observed at different locations during experiment.

Economics: Income expenditure statements on rations of experimental birds are presented in Table 5. The feed cost (Rs./bird) was observed to be 26.33 (26.23-26.43) during the present experiment, which did not influenced by the rations. Whereas feed cost (Rs./Kg gain) came to 15.77. (16.32-15.22) differed ($p<0.05$) between the rations. The feed cost (Rs./bird) and feed cost (Rs./Kg gain) influenced ($p<0.05$) by age and by combined effect of ration and litter materials. The feed cost observed at different ages differed ($p<0.05$) from one other. The combined effect of ration and litter materials did not show any significant effect on feed cost (Rs./bird) upto P_2 but there after showed effect ($p<0.05$) upto the end of experiment. However ration and litter materials combinedly showed effect ($p<0.05$) on feed cost (Rs./Kg gain) through out the experiment. The feed cost (Rs./bird) increased from P_1 to P_5 at decreasing rate as seen in daily feed intake. The feed cost (Rs./Kg gain) ranged from 14.62 (P_4) to 17.30 (P_5). The lowest FCR during P_4 (1.42) as compared to P_5 (1.92) in turn the lowest feed cost (Rs./Kg gain) during P_4 (14.62) than P_5 (17.30). The feed cost (Rs./Kg gain) observed less by Rs. 1.10 in R_2 than R_1 because of the lower cost of feed. The total rearing cost of experimental birds and total production cost (Rs./bird) were observed lower ($p<0.05$) for the birds reared on R_2 (17642.76 and 39.74) than R_1 (18692.15 and 42.19) where as total live weight, total receipt from meat, total income, net return and net profit/bird observed higher ($p<0.05$) for birds reared on R_2 than R_1. The birds reared on R_2 gave Rs.1777.57 and Rs. 3.99 more net profit and net profit/bird respectively than the birds reared on R_1. This proved economic superiority of R_2 over R_1. The return over feed cost and return as percent of feed cost investigated under present study was more for birds reared on ration - II (Rs.11347.96 and 206.76%) than the birds reared on ration-I (Rs. 9461.86 and 184.44%) where as feed cost (Rs./Kg dressed weight) was less in R_2 (Rs.25.69) than R_1 (Rs.28.31). The net profit and feed cost (Rs./Kg gain) investigated under present study were in accordance with, Bandy *et al.*, 2003; Tyagi *et al.*, 2003 where as Das and Ghosh, 2000 observed lower value for feed cost (Rs./kg dressed weight) and total production cost (Rs) than observed under present investigation. The income expenditure statement irrespective of ration showed lower total rearing cost of experimental birds when reared on wheat straw+saw dust (Rs. 17964.17) than rice husk (Rs.18430.35) but the final live weight, total receipt from meat, total income as well as net return was higher ($p<0.05$) from birds reared on rice husk than birds reared on wheat straw+saw dust. The bird reared on L_1R_2 gave maximum net profit/bird (Rs 8.19) than bird reared L_2R_2 (Rs 7.33), L_1R_1 (Rs 5.15), L_2R_1 (Rs 4.89) indicate L_1R_2 gave 67.48, 59.02 and 11.73 percent more net profit (Rs/bird) than the birds reared on L_2R_1, L_1R_1 and L_2R_2, respectively. This proved that rice husk and ration-II was highly economical for broiler rearing.

Conclusion: The broiler birds can be reared economically on rice husk liter material by feeding 2879 (BS)-2941 (BF) ME energy and 22.12% (BS)-19.87% (BF) protein ration to harvest significantly higher return over feed cost (206.76%).

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