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Effect of Different Litter Materials on Behavior, Stress and Incidence of Mortality and Morbidity Rate on Broiler Chickens

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ABSTRACT

The goal of the current study was to find out effect of different litter materials on behavior, stress and incidence of mortality and morbidity rate on broiler chickens. The Poultry Unit of Livestock Farm Complex of the College of Veterinary Science and Animal Husbandry, ANDUAT Kumarganj, Ayodhya, UP, served as the study's location. For a total of 42 days (6 weeks), the experiment was conducted on 240-day-old Vencobb400 straight run commercial broiler chicks. After being weighed, the chicks were divided at random into three treatment groups: Group 1 (Control – Rice husk) is denoted by (Tc), Group 2 (50 % Rice husk + 50 % Paddy straw) is denoted by (T_1), and Group 3 (Wood saving) is denoted by (T_2). Each treatment group consisted of two replicates, each with 40 chicks. The experiment's findings indicate that T_1, or the treatment groups that received both paddy straw and rice hulls, had lower feeding rates and duration. However, throughout the course of the weeks, there were no significant differences in the frequency or percentage of time spent engaging in certain behaviors across the three groups. At age 6, the H/L ratio was higher in the Tc group (0.37a ± 0.008) than in the T_1 group (0.33b ± 0.456) or T_2 group (0.35a ± 0.120). According to this study, birds in the T_1 group experienced the least amount of stress compared to other treatment groups. The broiler chick mortality rate was 6.25% in the wood-saving litter (T_2) and 3.75% in the T_1 group, followed by 5% in the Tc group.

Keywords Litter materials, Behavior, Stress, Broiler chicken.

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INTRODUCTION

One of the most significant aspects of a farmer's economy is poultry. In the shortest amount of time, it gives a huge number of rural populations new income and employment prospects. From household poultry

farming to scientific poultry farming that involves commercial egg and meat production, India's poultry output has seen tremendous expansion. According to Iisa Augustine and Ruchira Shukla (2015), the poultry business is the part of the livestock industry that is expanding the quickest both internationally and in India. According to Livestock census 2019, the number of chickens in the country has climbed by 16.81% since the most recent census, reaching 851.81 million. However, in previous census 2012 it was 729.21 million in numbers (20th Livestock Census 2019).

Particle size, moisture content and buildup, rate of caking, and other physical properties of the material employed are some factors that might affect how effective a type of litter is rice husk, paddy straw, wood shavings, sawdust, peanut hulls, shredded sugar cane, straw, and other organic materials that are dry, absorbent, and reasonably priced are frequently used as bedding. Sometimes, sand is used as bedding.

The most typical materials utilized as litter in many regions' commercial grill manufacture are wood shavings and sawdust. The hunt for substitute litter materials has been prompted by low supply, high costs, and the lack of acceptable resources. The bedding materials aid in moisture absorption, which reduces the growth of dangerous germs and ammonia. Good litter should absorb moisture from bodily wastes like blotting paper while giving birds a dry, cosy surface to dust themselves in and rest upon. As a result, it should be quick to dry, soft and compressible, absorbent, and buoyant. Gupta *et al.* (2020) find that final body weight, body weight gain, FCR were better in Tmix i.e. combinations of paddy straw with rice hulls treatment groups than wood saving groups and the control group. But feed intake was higher in Tc groups. Singh *et al.* (2018b) observed that body weight of chicks raised under sand and rice hull litter did not differ significantly, however the average daily feed intake of chicks under rice hulls was significantly higher than that of under sand litter. The performance index of the earlier study period was significantly higher in paddy straw+ rice hulls followed by sand and rice hulls respectively. Litter can make up as much as 4% of a chicken's diet. Since some litter will be consumed by birds, the base material must be devoid of any pollutants that might be absorbed into the chicken's edible tissues. The same holds true for the materials used to make litter, which must be devoid of toxins like metals or pesticides as well as other elements like chemicals, pathogens, and moulds that could harm the health of the birds. In this situation, using crop and wood waste as poultry litter seemed viable. Therefore, it was intended for the current experimental design to investigate how different litter materials affected broiler chicken behavior, stress levels, and rates of mortality and morbidity.

MATERIALS AND METHODS

The study was carried out at College of Veterinary Science and Animal Husbandry, ANDUAT Kumarganj, Ayodhya, UP. The experiment was carried out on 240 day old Vencobb 400 straight run commercial broiler chicks reared in deep litter system with pakka floor for a period of 42 days (6 weeks). Chicks were weighed and distributed randomly into three treatment groups that is Group 1st (Control – Rice husk) indicated by (Tc), Group 2nd (50 % Rice husk + 50% Paddy straw) indicated by (T_1) and Group 3rd (Wood saving) indicated by (T_2) with two replicates of 40 chicks each.

Measurement of behavioral activity

Scan sampling method

The period occurrences scan sampling method or one zero sampling are other names for this (Altman 1974). All of the behavior parameters in the current investigation were recorded using this technique. This strategy involved recording the events that took place over a specific time frame. The recorder of the Lumia 730 camera was used to capture the behavioral studies of the birds. Different colored inks were used to make it easier to identify the birds, and an instantaneous sampling technique was utilized to capture the behavior of the chicks because continuous recording was typically impossible because too much behavior occurred too frequently. 20 minutes were recorded for each replication of each litter treatment during the daily 120-minute period between 7:00 and 9:00 (IST), beginning on the first day. On a nominal and

Table 1. Description of each behavior in experiment.

Behavior	Description of behavior
Feeding	Beak in or above the feeder
Drinking	Beak in or above the drinker
Resting	Resting the abdomen on the litter but holding head raised
Dozing	Sleep lightly or for a short period of time
Head and litter scratching	Pecking or scratching in the litter

ordinal scale, the behaviors of birds in response to different litter sources were investigated. These behaviors included preening, scratching, wing flapping, feeding, drinking, resting, pecking, avoiding, pushing, dust bathing, leg stretching, neck stretching, and threats/flights. Data was gathered on a nominal scale to calculate the total number of birds that displayed a specific behavioral activity in response to different litter sources at a particular time. The average amount of time spent by birds in a particular activity was measured, nevertheless, using an ordinal scale.

Observations of behaviors

The five behavioral activities in the broiler chickens were recorded in the present study. The list of activities of behaviors has been given in Table 1.

Heterophills/ lymphocyte ratio

In order to assess the stress, blood samples from 18 randomly chosen birds from each group were taken during the third and sixth weeks of the study. To determine the H: L ratio, the smear was stained with May-Grunwald-Giemsa stain.

Mortality and morbidity

It was noted the daily death and morbidity. At the conclusion of the experiment, it was expressed as a percentage for the corresponding treatment group.

Statistical analysis

Utilizing IBM SPSS Statistics® (20) software, experimental data were submitted to analysis of variance (ANOVA) to determine the effects of various litter materials on the growth performance of broiler chickens. By using a *Duncan alpha* comparison, the means were tested for statistically significant differences at the 5% level.

RESULTS AND DISCUSSION

The experiment examined the impact of various litter materials on behavior, stress, incidence of mortality and morbidity rate, and broiler chicken mortality and morbidity rates. It was conducted on 240 day old Vencobb 400 straight run commercial broiler chicks, who were randomly allocated into three treatment groups. Results for several types of litter are displayed as follows.

Table 2. Frequency of different behavioral activities by birds on different litter treatments.

Behavioral activities	Tts	Age in weeks 1	2	3	4	5	6
Feeding	T_C	1.52±0.10	1.34±0.10	1.22a±0.10	0.94±0.07	1.03ab±0.07	1.06ab±0.08
	T_1	1.37±0.10	1.22±0.10	1.81b±0.12	1.22±0.10	1.49b±0.11	1.50b±0.10
	T_2	1.45±0.09	1.20±0.11	1.26ab±0.13	1.25±0.12	1.41a±0.10	1.75a±0.10
Drinking	T_C	0.31±0.04	0.41±0.06	0.18±0.04	0.31±0.05	0.46±0.06	0.31±0.06
	T_1	0.27±0.04	0.41±0.05	0.17±0.04	0.15±0.04	0.43±0.06	0.48±0.07
	T_2	0.30±0.05	0.25±0.05	0.21±0.05	0.15±0.04	0.29±0.05	0.43±0.06
Resting	T_C	1.90±0.07	1.79±0.08	1.73±0.07	1.85±0.08	1.90±0.08	1.85±0.09
	T_1	1.86±0.07	1.70±0.07	1.94±0.08	1.80±0.08	1.82±0.08	1.99±0.09
	T_2	1.80±0.07	1.74±0.08	1.89±0.07	1.99±0.09	1.84±0.08	1.89±0.08
Dozing	T_C	1.52±0.10	1.35±0.10	1.21a±0.10	0.95±0.07	1.03a±0.07	1.06±0.08
	T_1	1.37±0.10	1.22±0.10	1.81c±0.12	1.22±0.10	1.50c±0.11	1.50±0.10
	T_2	1.45±0.09	1.20±0.11	1.26b±0.13	1.25±0.12	1.41c±0.10	1.75±0.10
Head and litter scratching	T_C	0.18±0.03	0.22±0.03	0.13±0.03	0.18±0.03	0.11±0.02	0.18±0.03
	T_1	0.12±0.02	0.21±0.03	0.15±0.03	0.22±0.03	0.19±0.03	0.25±0.04
	T_2	0.15±0.03	0.16±0.03	0.16±0.03	0.21±0.03	0.14±0.03	0.16±0.03

Means with different superscripts in a row differ significantly ($p<0.05$).

Table 3. Percent duration of time spent in different behavioral activities by birds on different litter treatments.

Behavioural activities	Tts.	Age in weeks 1	2	3	4	5	6
Feeding	T_C	24.26±1.37	22.62±1.49	18.13^{a}±1.30	14.04^{ab}±1.01	15.67^{ab}±1.09	16.35^{ab}±1.16
	T_1	21.77±1.52	21.27±1.56	30.37^{b}±1.71	22.08^{b}±1.65	24.32^{b}±1.57	26.02^{a}±1.50
	T_2	22.67±1.34	18.72±1.62	20.11^{ab}±1.96	19.78^{a}±1.79	25.96^{a}±1.64	28.48^{b}±1.39
Drinking	T_C	1.49±0.24	1.87^{a}±0.28	0.66^{c}±0.17	1.44±0.27	1.84±0.27	1.05±0.20
	T_1	1.26±0.21	2.15^{b}±0.32	0.66^{a}±0.18	0.65±0.17	1.76±0.26	1.76±0.27
	T_2	1.42±0.25	0.86^{ab}±0.18	0.70^{b}±0.17	0.66±0.19	1.23±0.23	1.58±0.26
Resting	T_C	61.44±1.66	60.38±1.59	64.65^{c}±1.63	66.38±1.70	61.50±1.80	61.39±1.78
	T_1	62.55±1.69	61.12±1.67	53.54^{a}±1.69	63.95±1.79	58.89±1.77	57.41±1.70
	T_2	58.13±1.61	64.62±1.77	64.77^{b}±2.07	64.88±1.83	58.93±1.88	53.48±1.56
Dozing	T_C	14.48a±0.76	15.93±0.91	17.66^{b}±0.93	18.04^{b}±1.06	22.16^{b}±1.22	21.24^{b}±1.00
	T_1	13.45b±0.90	13.44±0.95	14.44^{ab}±0.76	10.99^{a}±0.76	13.64^{a}±0.89	12.40^{a}±0.66
	T_2	16.59^{a}±0.95	13.54±1.00	13.27^{a}±0.97	12.89±1.09	12.84±0.81	14.30±0.81
Head and litter scratching	T_C	0.76^{a}±0.15	0.65±0.13	0.39±0.11	0.55±0.12	0.32±0.10	0.42±0.10
	T_1	0.21^{b}±0.06	0.67±0.13	0.49±0.13	0.64±0.13	0.61±0.14	0.79±0.15
	T_2	0.65^{ab}±0.14	0.50±0.12	0.50±0.12	0.70±0.15	0.46±0.12	0.57±0.14

Means with different superscripts in a row differ significantly ($p<0.05$).

Broiler behavior

The information on the frequency and length of the broiler birds' behavioral activity is shown in Tables 2-3, respectively.

Feeding behavior

During 3rd week frequency of feeding behavior differed significantly ($p<0.05$) in T_1 (1.81±0.12) over Tc (1.22±0.10) group, however during 5th week feeding behavior differed significantly ($p<0.05$) in T_1 (1.49±0.11), and T_2 (1.41±0.10) group over Tc (1.03±0.07) group in 6th week the similar pattern has shown. However, the frequency of feeding in T_1, T_2 and Tc groups was significantly ($p<0.05$) different from Tc groups. In comparison to the first, second, and fourth weeks, eating behavior was considerably more frequent ($p<0.05$) in the third, fifth, and sixth weeks. In the T_2 group, feeding behavior was considerably more frequent in the sixth week compared to the second, third, and fourth weeks, but no other weeks showed a significant difference ($p<0.05$) aside from the sixth week. However, the percentage of time spent on feeding during the third week was considerably ($p<0.05$) different in the T_1 group compared to the Tc group, and the fourth week was significantly ($p<0.05$) different in the T_1, T_2 group. However, the percentage of time spent on feeding in the fifth and sixth weeks differs considerably ($p<0.05$) between the T_1, and T_2 groups and the Tc group. The amount of time that was spent on feeding overall in groups T_1, T_2 was significantly ($p<0.05$) different from the Tc group. The amount of time spent on feeding in the Tc group was noticeably longer in the first and second weeks. In different litter groups, the percentage of time spent in feeding each week was not significant ($p<0.05$). In the current study, rice husk litter required more time and feedings more frequently than mix litter or wood-saving litter. Birds reared on (WS+ sand) showed considerably higher eating behavior, BW, and BWG than birds reared on straw and (straw + sand), according to Ramadan *et al.* (2013). When litters were utilized independently (WS, straw, or sand), bedding types had no discernible impact ($p<0.05$) on feeding behavior. On sand and wood shavings, standing and walking reduced while sitting increased. On the other hand, birds reared on beddings made of straw and (straw + sand) showed noticeably greater standing and walking behaviours and less sitting behavior. It has been determined that different forms of bedding have an impact on broiler chicken behavior.

Drinking behavior

The frequency of drinking behavior over the course of a week did not differ significantly ($p<0.05$) between groups or within groups. In the second week, the percentage of time spent drinking was substantially ($p<0.05$) greater in the T_1 (2.15±0.32) than the Tc

(1.87±0.28) groups, while in the third week, the percentage of time spent drinking was significantly ($p<0.05$) higher in the T_2 (0.70±0.17) than the other groups. In the T_1 (2.15±0.32) group, the% duration time spent on drinking was significantly ($p<0.05$) higher in the second week as compared to the third and fourth week, and no significant ($p<0.05$) difference was found in the first, second, fifth, and sixth week within group, the% duration time spent on drinking behavior was non-significant ($p<0.05$) in the Tc, and T_2 groups.

Resting behavior

The frequency of resting behavior displayed by the various treatment groups did not change substantially ($p<0.05$), but the percentage of time spent on resting behavior was significantly ($p<0.05$) found to be lower in the T_1 (53.54±1.69) group as compared to other treatment groups on the third week. Additionally, no change in the percentage of a bird's life that was spent engaging in resting behavior was discovered ($p>0.05$). Between the various treatment groups, there was no discernible difference in the total frequency or percentage of time spent engaging in resting behavior ($p>0.05$). The difference in the way broiler chickens rested while using various litters revealed that they spent the most time using mix litter (61.56±0.69), followed by rice husk (60.73±0.74) and wood shavings (58.13±0.70).

Dozing behavior

In the third week, the frequency of dozing behavior displayed by the T_1 (1.81±0.12) group was significantly ($p<0.05$) higher than that of the control, Tc (1.21±0.10), and T_2 (1.26±0.13) groups. In contrast, in the fifth and sixth weeks of the birds' lives, the frequency of dozing behavior was significantly ($p<0.05$) lower in the control group compared to T_1 and T_2 groups. There was no significant ($p<0.05$) difference between the various treatment groups in the first, second, or fourth week. In the Tc group, group sleeping was more frequent in the first three weeks of the bird's life than in the following three. In the T_1 group, the incidence of drowsiness increased considerably ($p<0.05$) in the third week compared to the first, second, and fourth weeks. In the T_2 group, the frequency of drowsiness was determined to be non-significant ($p<0.05$). In the T_1 group (13.45±0.90), the percentage of time spent dozing was considerably ($p<0.05$) higher than in the T_2 and Tc groups in the first week of the bird's existence. However, there was no significant difference ($p<0.05$) between the groups in the second week. Tc differed significantly ($p<0.05$) from T_2 in the third week. The percentage of length time spent dozing was substantially higher in the control group compared to other treatment groups in the fourth, fifth, and sixth weeks ($p<0.05$). Within groups at various weeks, there was no difference that was judged to be significant ($p<0.05$). It was discovered that as birds get older, the duration of their napping behavior increases in the control group.

Head and litter scratching

No significant ($p<0.05$) difference was found between Tc and T_2 in the first week, and no significant ($p<0.05$) difference was found between various treatments in the subsequent weeks. Instead, the percentage of time spent on head and litter scratching behavior of birds was significantly ($p<0.05$) higher in the control group (0.76±0.15) as compared to T_1 (0.21±0.06) groups. However, Singh *et al.* (2018a) find that behavioral activities like drinking, dust bathing, stretching, standing and perching in sand litter, dust-bathing, peaking, stretching, walking, lying and perching in rice hulls and peaking, stretching and standing in straw+rice hulls were seemed to be significantly differed in morning, noon and evening hour interval.

Heterophils/ lymphocytes ratio (H/L ratio)

At 3 and 6 weeks of age, the lymphocyte (%) did not change between treatment groups ($p<0.05$) (Table 4). At the third week of life, the H/L ratio did not significantly differ from one another. At the sixth week of life, the H/L ratio was higher in the Tc group (0.37±0.008) than in the T_1 group (0.33±0.456) or T_2 group (0.35±0.120). According to Gross and Siegel (1983), when birds are under stress, the proportion of heterophil cells in the blood increases while the proportion of lymphocytes drops. According to Siegel and Gross (2000), the H/L ratio varied between 0.6 and 1.2 over prolonged periods of greater levels of stress. A illness in progress is typically indicated by

Table 4. Heterophil : Lymphocyte of the experimental broiler birds under different litter treatments.

Parameters (%)	Weeks	Light treatments		
		T_C	T_1	T_2
Lymphocyte	3rd	63.5±0.456	66.5±1.008	66.0±0.234
	6th	70.5±0.008	68.0±0.123	71.0±1.22
Heterophil	3rd	25.5±0.008	24.5±0.568	22.5±0.988
	6th	26.0^{a}±0.117	22.5^{c}±0.647	24.5^{b}±0.113
H/L ratio	3rd	0.4±0.011	0.4±0.189	0.4±0.006
	6th	0.37^{a}±0.008	0.33^{b}±0.456	0.35^{a}±0.120

Means with different superscripts differ significantly ($p<0.05$).

a H/L ratio exceeding 1.3.

Mortality and morbidity

Mortality and morbidity rates were significantly same. The data shown in Table 5 showed a variation in mortality. These findings suggested that mortality varied between treatment groups. The broiler chicken mortality rate ranged from 6.25% in the wood saving group (T_2) to 3.75% in the T_1 group, and 5% in the Tc group, where 80 birds were maintained in each treatment group. The mortality percent observed in the present study range from 3.75 to 6.25% in different litter combinations which is quite higher and also in agreement with the various authors reported as Khan *et al.* (2009) 3.03, Karousa *et al.* (2012) 2.77 to 3.33, Mehmood *et al*. (2013) 2.47 to 4.85% respectively. However, Farghly (2012) reported higher mortality 6.33 to 8.33% in local turkey with different litter material combinations. Chakravati *et al.* (2019) concluded that alum at a concentration of 0.095 kg/bird can be safely used for broiler litter treatment without any detrimental effects and is economical. There was no apparent significant incidence of disease in all the three different litter materials during the whole observation period.

Table 5. Mortality rate of broiler chicks.

Age in weeks	Mortality of broiler chicks		
	T_c	T_1	T_2
1st	0	1	1
2nd	1	0	0
3rd	0	1	1
4th	2	1	0
5th	1	0	2
6th	0	0	1
Total (80 birds in each)	4	3	5
Mortality (%)	5%	3.75%	6.25%

CONCLUSION

According to research on the impact of various litter materials on broiler chicken behavior, stress levels, and the incidence of mortality and morbidity rates, T_1 treatment groups that combine paddy straw and rice husk, exhibits a lower feeding rate and duration. However, throughout the course of the weeks, there were no significant differences in the frequency or percentage of time spent engaging in certain behaviors across the three groups. At age 6, the H/L ratio was higher in the Tc group (0.37a±0.008) than in the T_1 group (0.33^{b}±0.456) than T_2 group (0.35^{a}±0.120). According to this study, birds in the T_1 group experienced the least amount of stress compared to other treatment groups. The broiler chick mortality rate was 6.25% in the wood-saving litter (T_2) and 3.75% in the T_1 group, followed by 5% in the Tc group.

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