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Effect of Different Litter Materials in Deep Litter System on Physiological Responses of Broiler Chickens

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Abstract: This study evaluated the effect of different litter materials on the physiological responses of broiler chickens reared under a deep litter system, with particular focus on thermal and respiratory indicators of welfare. Five litter types wood shavings, sawdust, rice husk, coconut husk, and Tectona grandis leaves were compared over an eight-week experimental period. Physiological parameters measured at weeks 3, 5, and 8 included breast surface temperature (°C), rectal temperature (°C), panting rate (breaths/min), and respiratory rate (beats/min). Results indicated that differences in breast surface temperature and panting rate among litter treatments were statistically non-significant ($P > 0.05$) across all weeks, suggesting comparable thermal regulation across materials. However, rectal temperature and respiratory rate at week 3 differed significantly ($P < 0.05$), with the highest mean observed in birds reared on coconut husk (41.55°C) and the lowest on Tectona grandis leaves (40.86°C). This variation implies that coconut husk may have temporarily elevated internal body temperature, possibly due to its heat retention characteristics, whereas Tectona grandis leaves promoted better thermal dissipation. All tested litter materials supported stable physiological responses however, Tectona grandis leaves demonstrated potential advantages in maintaining lower internal body temperature during early growth under deep litter systems.

Keywords: Litter materials, Physiological responses and Broiler chickens.

Introduction

Efficient thermal regulation and respiratory stability are critical factors influencing broiler chicken welfare and productivity, particularly in intensive deep-litter systems where environmental conditions can profoundly impact broiler physiology [4]. The choice of litter material plays a crucial role in maintaining optimal microclimatic conditions in poultry houses, influencing temperature regulation, gas exchange, and overall comfort [2]. While wood shavings and sawdust have traditionally been favored due to their availability, absorbency, and cushioning properties, rising costs, deforestation concerns [6]. Regional shortages have prompted the exploration of locally available and renewable alternatives [8]. Such litter materials include rice husk, coconut husk, and Tectona grandis (teak) leaves. These alternative materials exhibit distinct differences in texture, moisture absorption capacity, and thermal conductivity, which may, in turn, influence the physiological responses of broilers reared on them.

Although litter management is widely acknowledged as essential in broiler production, few comparative studies have examined the physiological effects of different organic litter materials [7]. Key physiological indicators, such as breast surface temperature, rectal temperature, panting rate, and respiratory rate, offer valuable insights into thermoregulatory efficiency and the stress or comfort levels of birds under various litter conditions [9]. Understanding these responses is essential for optimizing litter selection to reduce heat stress and promote welfare and growth performance.

This study was conducted to evaluate the effects of various litter materials on the physiological responses of broilers reared in deep litter systems. The findings are expected to contribute to sustainable, welfare-focused poultry management, particularly in regions seeking cost-effective and environmentally friendly litter materials.

Materials and Methods

Experimental site

The study was carried out at the poultry unit of the Teaching and Research Farm of the Department of Animal Science, University of Uyo, Akwa Ibom State, Nigeria. The Farm is located on (latitudes 4°59 and 5°04N and longitudes 7°53 and 8°00E) with a mean annual rainfall of 2,190mm (University of Uyo, Meteorological center).

Experimental Materials

Wood shavings, saw dust, Rice husk, coconut husk were sourced locally, from Timber market in Uyo, Rice mill in Ini and Ikot Abasi Local Government Areas of Akwa Ibom State, Nigeria respectively. Leaves of Tectona grandis were harvested in the university premises around the forestry arboretum. The wood shavings were thoroughly dried and packed into bags and stored. Coconut husks, leaves of Tectona grandis were further chopped and dried to reduce moisture content. All the litter materials were dried, packed in bags and stored at room temperature in airtight containers.

Experimental birds and Management

A total of 120 Arbor Arces unsexed day-old broiler chicks of mean weight 40.00±0.50g were purchased from a reputable distributor in Uyo, fed commercial mash, clean water ad libitum and reared on concrete floor of well ventilated, deep litter poultry housing. The birds were randomly allotted to five treatments of (spread height of 0.05m thick litter material) wood shavings (control), saw dust (T2), rice husk (T3), coconut husk (T4), and sun-dried chopped leaves of T. grandis (T5), (spread to a depth of 0.01m) with 8 birds each replicated three times in a completely randomized design. Before the arrival of the broiler chicks, the poultry house was washed with disinfectants and allowed to dry before the experimental litter materials, feeders, drinkers were provided in each of the pen. When the birds arrived, the day-old chicks were weighed using an electronic sensitive scale (5.0 kg scale -Mettler, ME204E model), to obtain the initial weight. Vitamins, minerals and antibiotics were added to their drinking water for (3-5) three to five days.

Experimental Design

The birds were randomly allotted to five (5) treatment groups (T) and each treatment was replicated three (3) times with eight (8) birds per replicate. The experiment was arranged in a completely randomized design of wood shavings (control), saw dust (T2), rice husk (T3), coconut husk (T4), and sun-dried chopped leaves of T. grandis (T5).

Evaluation of Physiological responses:

a). Respiratory rate (RR): This was determined by observing the number of flank movements of the bird per minute using a stopwatch for an hour.

b). Rectal temperature (RT): This was measured with the aid of a mini digital thermometer with ±0.1°C accuracy, the disinfected thermometer was inserted into the rectum of the birds for one minute using a stopwatch, and reading was taken once it beeped.

c). Panting rate (PR): Panting rate (PR) was taken as the number of flank movement per minute. Counts were taken as a cycle of in and out movement as described by [1].

d). Breast surface temperature (BST): Body surface temperature was measured three times a week. For measuring body surface temperature, two birds from each pen were randomly selected, and the temperatures of the breast were recorded using an infrared thermometer UT932 (for animal use).

Results and Discussion

As shown in Table 1, the physiological responses of broiler chickens reared on different litter materials varied across 3, 5 and 8, though most parameters did not differ significantly ($P > 0.05$). Breast surface temperature (BST) increased progressively with age across all treatments, ranging from 36.10°C to 37.50°C at week 3, 37.80°C to 38.80°C at week 5, and 37.21°C to 38.90°C at week 8. Despite these week related increases, differences among litter types were statistically non-significant ($P > 0.05$).

Rectal temperature (RT) demonstrated a significant ($p<0.05$) effect of litter material at week 3, with the highest mean value recorded in birds on coconut husk (41.55 °C) and the lowest on Tectona grandis leaves (40.86°C). No significant ($P > 0.05$) differences were detected at weeks 5 and 8. The elevated rectal temperature in birds reared on coconut husk may reflect its relatively higher thermal insulation and moisture retention properties, leading to mild heat stress, whereas the comparatively lower temperatures observed on Tectona grandis leaves could indicate better heat dissipation and aeration.

These outcomes are consistent with prior studies by (5) who reported that the thermal and respiratory physiology of broilers is primarily shaped by litter temperature, humidity, and ammonia accumulation rather than by the physical characteristics of the litter alone.

Panting rate (PR) decreased slightly from week 3 (34.03–38.09 breaths min^{-1}) to week 5 (31.00–35.67 breaths min^{-1}) across all groups, before rising marginally by week 8 (34.43–36.45 breaths min^{-1}). However, differences among litter types were not significant ($P > 0.05$).

Respiratory rate (RR) exhibited a significant ($p<0.05$) variation among litter types at week 3 with birds on wood shavings showing the highest mean rate (69.34 beats min^{-1}) and those on *Tectona grandis* leaves the lowest (65.09 beats min^{-1}). Subsequent weeks showed no significant ($P > 0.05$) litter effects. The significant early difference in respiratory rate highlights that *Tectona grandis* leaves may offer superior environmental moderation compared to conventional wood-based litters. This finding emphasizes the potential of locally available, biodegradable materials to enhance physiological comfort and welfare in broiler production [3].

Table 1: Effect of different Litter Materials in Deep Litter Systems on physiological responses of broiler chickens.

Physiological Parameters	Week	Wood shavings	Saw dust	Rice husk	Coconut husk	T. grandis leaves	SEM	P- value
Breast surface temperature (C)	3	36.10	36.54	36.89	37.11	37.50	0.24	0.88
Rectal temperature (ºC)	5	37.80	37.99	38.15	38.68	38.80	0.20	0.71
	8	38.90	38.56	37.89	38.42	37.21	0.30	0.93
	3	41.16b	41.05ab	40.96c	41.55a	40.86d	0.12	0.03
Panting rate (breath/min)	5	40.76	41.21	41.44	40.08	40.31	0.26	0.76
	8	41.08	40.04	40.41	41.23	41.93	0.33	0.94
	3	38.09	37.91	36.33	36.21	34.03	0.73	0.19
	5	33.41	35.67	32.75	31.98	31.00	0.79	0.25
	8	36.45	35.98	36.21	34.43	35.99	0.86	0.31
	3	69.34a	68.77b	68.07c	65.89cd	65.09d	0.83	0.04
Respiratory rate (beats/min)	5	66.75	64.98	65.01	64.01	65.34	0.44	0.19
	8	62.65	63.88	63.21	65.52	66.75	0.76	0.31

^{a,b,c} means with different superscripts are significantly different ($p<0.05$)

Conclusion

This study demonstrated that although most litter materials maintain comparable physiological stability in broilers, *Tectona grandis* leaves may offer superior thermoregulatory comfort during early growth.

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