

## **Impact of different beddings on the growth performance, haematological indices and carcass characteristics of broiler chickens**

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**Target Audience:** *Poultry Farm Managers, Broiler processors Animal Scientists*

### **Abstract**

*The growing demand for wood shavings has created a reason for alternative bedding materials in the poultry industry. As a result, a 56-day study was conducted to investigate the effect of different beddings on growth performance, haematological indices and carcass characteristics of broiler chickens. 180 day-old chicks were randomly assigned to one of four different bedding materials: WS: wood shaving, SP: shredded paper, RWM: raised wire mesh, and CCC: crushed corn cobs. In a completely randomized design, the birds were replicated three times with 15 birds each. Throughout the study, birds were given free access to feed and water. Data on growth performance and haematological indices were collected. After 56d, two birds from each replicate were slaughtered for carcass evaluation. The bedding materials used had a significant ( $P < 0.05$ ) influence on the broiler chicken's FCR, average daily weight gain (ADWG), and feed intake (ADFI). Birds raised on WS had the highest ADWG (37.36 g/day), while birds raised on SP and CCC had the lowest values but similar values of 36.42 and 35.20 g/day respectively. The ADFI values of broiler chickens decreased ( $P < 0.05$ ) across the treatment groups. Birds reared on CCC had the best FCR (2.50) values. Except for the packed cell volume (PCV) and haemoglobin values, there was no significant ( $P > 0.05$ ) effects of bedding materials on broiler chicken's haematological indices. PCV values of birds raised on RWM (28.01%) and CCC (28.00%) were similar but higher ( $P < 0.05$ ) than those raised on SP (26.70%) and WS (24.00%) respectively. Litter materials had a significant impact on broiler chicken's carcass characteristics. Birds raised on RWM had the highest dressing percentage (71.78 %), while birds raised on CCC had the lowest (69.00%) values. The birds raised on CCC had significantly higher relative weights of shank, liver, and heart than other treatment groups. It was concluded that CCC could replace WS as a bedding material for broiler chickens in hot humid climates.*

**Keywords:** *Wood shaving, Shredded paper Poultry, raised wire mesh, Evisceration, Feed intake*

### **Description of Problem**

Bedding materials are primarily used in broiler production to prevent direct contact of the bird with the floor and to promote absorption of faecal moisture in order to keep the floor reasonably dry, ensure birds' comfortability (1) and thus preventing the excess production of ammonia and harmful pathogens (2). It also provides birds with a suitable medium for feeding, watering, and

other management practices (3). The significance of good bedding materials for broiler rearing on conventional floor systems has been recognized and emphasized. In poor management, broilers do not perform to their genetic potential because the quality of the environment is highly dependent on bedding materials. The poultry industry consumes a large amount of processed solid wood residues and other litter material.

Litters collect droppings and absorb moisture from poultry droppings as well as respiratory processes. Broiler growth performance and carcass quality can be significantly influenced by bedding type (4). The materials used as bedding can also have a significant impact on carcass quality and bird's performance as well as on their biochemical characteristics. Some specific procedures must be adhered, to properly maintain the litter and maximize the health and productivity of the birds raised on it (2). Litter type influences litter consumption and litter bacteria (5; 6), which may affect broiler chick body weight and immunity. Particle size, moisture content and build up, caking rate, and other physical characteristics of the material used are all factors that can affect the efficiency of a type of litter. The bedding material has a significant impact on broiler performance and carcass quality (5). Some bedding materials have been claimed to promote high humidity levels and may also increase the occurrence of lesions, primarily on chicken breasts, hocks and footpads (7). Litters should be easily accessible, have a high moisture absorption capacity, be non-toxic, inexpensive, and porous. Different types of bedding materials are used with varying degrees of success in different countries. Sawdust, rice husks, sugarcane pulp, sugarcane bagasse, chopped straw, paper mill by-products, sand, wood shavings, corn cobs, oat hulls, dried leaves, coffee husks raised wire mesh, and shredded paper are all common bedding materials used in poultry houses around the world (3; 8). An ideal bedding material should be dry and have a high water holding capacity, but it should also be able to quickly release absorbed moisture for venting to the atmosphere (9). Wood shavings are traditionally used as a bedding material in broiler chicken production in Nigeria. However, competition for wood shavings for

other uses has become fierce. Wood-based bedding materials are now being recycled to make other wood products. As a result, farmers will be unable to obtain enough high-quality bedding materials for their poultry production. This has significantly contributed to Nigeria's high cost of broiler chicken production. Traditional wood-based bedding materials (Wood shavings) will become less available as competition for their use grows. Due to limited supplies, high costs, and the scarcity of suitable bedding materials, alternative litter materials such as peanut hulls, rice husks, corn cobs, coffee husks, and various grasses have been sought after (10;11). The current study was therefore designed to investigate the effects of alternative materials on broiler chicken growth performance, haematological indices, and carcass yield in a hot humid climate.

## **Materials and Methods**

### **Experimental Site**

This study was conducted for 8 weeks at the Teaching and Research Farm of the Federal College of Animal Health and Production Technology, Moor Plantation Apata, Ibadan. The area lies within the rain forest ecological zone and falls within longitude ( $7^{\circ} 27^{\prime}$ ) and latitude ( $3^{\circ} 25^{\prime}$ ) at altitude 200 – 300m above the sea level with an annual rainfall of about 1250mm. The temperature and relative humidity ranges from  $30 - 35^{\circ} \text{C}$  and 76 – 84% respectively (12).

### **Experimental birds and management**

The litter materials used in this study were wood shavings, shredded paper, raised wire mesh and crushed corn cobs. Wood shavings were obtained from sawmills, maize cobs were obtained from maize farmers and then crushed roughly, shredded paper are obtained from old newspaper processed into chips. The litter materials

were air-dried and spread evenly to a depth of about 5 cm in each replicate. A total of one hundred and eighty day-old mixed sex broiler chicks were purchased from a reputable hatchery in Nigeria. The chicks were acclimatized for one week and randomly assigned to four treatment groups of different bedding materials and replicated

three (3) times with 15 birds each. The birds were fed *ad libitum* with standard starter mash for the first 28 days and thereafter with finisher mash until day 56. Diets were formulated to meet (13) nutrient recommendations for each feeding phase as shown in Table 1.

**Table 1: Gross composition of the experimental diets at starter and finisher phase**

Ingredients (%)	Starter	Finisher
Maize	55.00	57.00
Wheat bran	0.00	10.00
Groundnut Cake	18.00	0.00
Soybean meal	20.00	25.00
Fish meal	3.00	2.40
Lysine	0.10	0.10
Methionine	0.10	0.10
Oyster shell	1.00	1.90
Bone meal	2.30	3.00
Broiler premix	0.25	0.25
<b>Total</b>	<b>100.00</b>	<b>100.00</b>
Calculated Analysis		
Crude protein (%)	24.16	19.46
Crude fibre	3.33	3.64
Metabolized energy (kcal/kg)	2843	2930

### Experimental Design

A total of one hundred and eighty (180) birds used for this study were randomly allotted into four treatment groups of three replicates containing 15 birds in a completely randomized design.

### Chemical Analysis

An aliquot of daily feed samples (concentrates) was collected, oven dried, ground and sieved through a 2-mm sieve and stored in airtight container for proximate (14) (13). Nitrogen free extract (NFE) was determined by subtracting sum of (% Moisture + % Crude Protein + % Ether extract + % Crude fibre + % Ash) from 100.

$$\text{NFE} = (100 - (\%M + \%CP + \%EE + \%CF + \%Ash))$$

### Data Collection

#### Growth Performance

The growth of birds in different treatment groups was monitored by taking their pre-experimental body weights, followed by weighing on a weekly basis. The body weight of birds was measured using a sensitive scale. Feed offered daily per bird was recorded and refusal was weighed and recorded to compute feed intake on daily basis.

$$\text{Feed intake(g)} = \text{Total feed supplied(g)} - \text{Left over/Remnat(g)}$$

$$\text{Weight gain (Kg)} = \text{Final Weight gain(Kg)} - \text{Initial Weight gain(kg)}$$

$$\text{Average Body Weight} = \frac{\text{Total Weight of Birds in a Replicate}}{\text{Total number of birds}}$$

$$\text{Feed Conversion Ratio (FCR)} = \frac{\text{Feed intake (Kg)}}{\text{Weight gain (Kg)}}$$

### Haematological Parameters

At 56 d, approximately 3 mL of blood sample was collected from two randomly selected experimental birds per replicate via the wing web using hypodermic needle and syringes. The blood sample collected was released into the sample bottles containing Ethyl Diamine Tetra Acetic Acid (EDTA) as anticoagulant and the bottles were gently shaken to ensure proper mixing of the blood with EDTA to prevent coagulation. The Packed cell volume (PCV) was determined using the wintrobe haematocrit method described by (15). White blood cell (WBC) and Red blood cell (RBC) were determined using haemocytometer after appropriate dilution (16), Haemoglobin (17).

### Carcass Evaluation

Also, at 56 d, two (2) birds were randomly selected per replicate for carcass evaluation. The birds were selected, weighed, slaughtered, bled and processed to obtain the dressed weight, eviscerated weight while the organs and cut-up parts are expressed as percentage of the live weight

### Statistical Analysis

All the data collected were subjected to analysis of variance (ANOVA) using statistics model Procedure (18). Significant means among the variable were separated using Duncan multiple range test of the same statistical package.

### Results and Discussion

Presented in **Table 2** is impact of different beddings on the growth performance of broiler chicken. Different bedding materials employed here in this study significantly ( $P < 0.05$ ) influenced the performance characteristics of broiler chicken except the final weight. Birds raised on WS (37.36 g/day) recorded the highest average daily weight values followed by birds reared on RWM (36.68 g/day) significantly higher than SP (36.42g/day) and CC (35.20g/day) respectively which were statistically similar. The average daily feed intake and feed conversion ratio of the experimental birds decreased across the treatment groups. Birds reared on CC recorded the best FCR (2.50).

**Table 2: Impact of different beddings on performance characteristics of Broiler chicken**

Parameters	WS	SP	RWM	CCC	SEM
Initial weight (g)	156.67	166.67	163.33	166.67	3.50
Final weight (g)	1972.22	1930.00	1937.50	1861.11	43.67
Body weight gain (g)	1815.55 <sup>a</sup>	1763.33 <sup>c</sup>	1774.17 <sup>b</sup>	1694.44 <sup>c</sup>	49.59
Av. Daily weight gain (g/day)	37.36 <sup>a</sup>	36.42 <sup>c</sup>	36.68 <sup>b</sup>	35.20 <sup>c</sup>	0.80
Av. Daily feed intake (g/day)	107.36 <sup>a</sup>	97.76 <sup>b</sup>	95.80 <sup>b</sup>	87.92 <sup>c</sup>	4.29
Feed conversion ratio	2.87 <sup>a</sup>	2.68 <sup>b</sup>	2.68 <sup>b</sup>	2.50 <sup>c</sup>	0.09

<sup>a, b, c</sup> means in the same row with different superscripts are significantly different. ( $p < 0.05$ )

SEM: Standard Error of Mean, WS: Wood Shaving; SP: Shredded Paper; RWM: Raised Wire Mesh; CC: Corn Cobs

Indicated in **Table 3** is impact of different beddings on the haematological indices of broiler chicken. The litter materials employed had no significant influence on the haematological indices of broiler chicken

except the PCV and Haemoglobin. PCV values of birds raised on RWM (28.01%) and CCC (28.00%) were similar but higher ( $P < 0.05$ ) than those raised on SP (26.70%) and WS (24.00%) respectively.

**Table 3: Impact of different beddings on haematological indices of Broiler chicken**

Parameters	WS	SP	RWM	CCC	SEM
PCV (%)	24.00 <sup>b</sup>	26.70 <sup>ab</sup>	28.01 <sup>a</sup>	28.00 <sup>a</sup>	0.49
Hb (g/100mL)	7.65 <sup>b</sup>	5.90 <sup>b</sup>	9.50 <sup>a</sup>	8.00 <sup>a</sup>	1.25
RBC (mm x 10 <sup>3</sup> )	2.00	2.50	3.01	3.11	0.11
WBC (mm x 10 <sup>3</sup> )	15.00	18.42	16.97	21.01	1.45
Lymphocytes (%)	57.67	65.00	69.00	61.23	2.98
Heterophils (%)	34.23	30.67	24.01	35.10	2.63
Eosinophils (%)	2.67	2.30	4.00	2.33	0.19
Basophils (%)	0.32	0.33	0.10	0.13	0.12
Neutrophils (%)	58.01	63.20	43.01	24.32	1.27

<sup>a,b,c</sup> Means in the same row with different superscripts are significantly different ( $P < 0.05$ )

SEM: Standard Error of Mean. WS: Wood Shaving; SP: Shredded Paper; RWM: Raised Wire Mesh; CCC: Crushed Corn Cobs

**Table 4** shows impact of different beddings on the carcass characteristics of broiler chicken. There was a significant effect of bedding materials on the carcass characteristic of broiler chickens except the live weight, head, lungs and gizzard. Birds

raised on RWM had the highest dressing percentage (71.78 %), while birds raised on CC had the lowest (69.00%) values. The relative weight of shank, liver, and heart of the birds raised on CC were higher ( $P < 0.05$ ) when compared with other treatment groups.

**Table 4: Impact of different beddings on the carcass yield of broiler**

Parameters	WS	SP	RWM	CCC	SEM
Live weight (g)	2050.00	2200.00	1766.67	1933.33	94.17
De-feathered weight (g)	91.87 <sup>b</sup>	89.37 <sup>d</sup>	94.23 <sup>a</sup>	91.53 <sup>c</sup>	0.90
Eviscerated weight (g)	7724 <sup>d</sup>	78.80 <sup>c</sup>	88.32 <sup>a</sup>	79.43 <sup>b</sup>	1.14
Dressing percentage	70.50 <sup>b</sup>	70.39 <sup>b</sup>	71.78 <sup>a</sup>	69.00 <sup>c</sup>	0.84
Cut Part (% Live Weight)					
Leg	12.21 <sup>a</sup>	3.47 <sup>d</sup>	3.97 <sup>c</sup>	4.31 <sup>b</sup>	0.14
Shank	1.51 <sup>c</sup>	1.46 <sup>d</sup>	1.87 <sup>b</sup>	2.14 <sup>a</sup>	0.07
Drumstick	14.24 <sup>a</sup>	13.88 <sup>b</sup>	13.71 <sup>c</sup>	12.05 <sup>d</sup>	0.35
Head	5.44	5.25	5.84	6.11	0.16
Wing	5.73 <sup>c</sup>	7.07 <sup>a</sup>	6.89 <sup>d</sup>	7.04 <sup>b</sup>	0.16
Thigh	7.73 <sup>a</sup>	5.87 <sup>c</sup>	6.48 <sup>b</sup>	4.76 <sup>d</sup>	0.35
Organ Weight (% Live Weight)					
Gizzard	2.42	2.00	2.37	2.41	0.09
Spleen	0.22 <sup>d</sup>	0.31 <sup>c</sup>	0.41 <sup>a</sup>	0.39 <sup>b</sup>	0.05
Liver	3.01 <sup>d</sup>	3.47 <sup>b</sup>	2.93 <sup>c</sup>	3.83 <sup>a</sup>	0.15
Lung	0.91	1.03	0.95	1.11	0.07
Heart	0.70 <sup>c</sup>	0.02 <sup>d</sup>	0.95 <sup>b</sup>	1.02 <sup>a</sup>	0.06

<sup>a,b,c</sup> Means on the same row with different superscripts are significantly different ( $P < 0.05$ )

SEM: Standard Error of Mean. WS: Wood Shaving; SP: Shredded Paper; RWM: Raised Wire Mesh; CCC: Crushed Corn Cobs

## **Discussion**

The primary function of bedding materials is to aid in moisture absorption, thereby preventing the excessive production of ammonia and harmful pathogens (2). This is all based on the litter management practices employed, particularly by farmers, to ensure dry litters on the farm at all times. As a result, different bedding materials have been reported to have a significant impact on broiler performance (5). There is a scarcity of data on the effects of maize cobs as broiler chicken bedding materials. In this study, the litter materials had no effect on the final weight gain of the experimental birds. The similarity in the final body weights of the birds in this study confirmed the observation of (19), who compared pine shavings and chopped Bermuda grass hay as bedding material for turkey hens. Several studies have found that using alternative bedding materials had no effect on the body weights of the experimental birds (20; 21; 22), which contradicts the current study. The broiler chicken body weight gain values obtained varied significantly across treatment groups, with birds reared on CCC having the lowest body weight gain in comparison to other litter materials. This study supported the findings of (23), who found that different bedding materials had a significant effect on poultry bird body weight gain. This study's findings were consistent with those of previous researchers (24; 25), who found that birds reared on other litter materials gained significantly less weight than birds reared on WS. The observed differences in body weight gain may be attributed to different litter types used, which affect bird consumption and litter bacteria infestations (26), thereby affecting body weight and immunity of broiler chick. (5) reported that certain types of litter materials have a positive effect on body weight gain. This indicates that there

are numerous factors that can influence the efficiency of a type of litter, such as particle size, moisture content and build up, caking rate, and other physical properties of the material used. Birds raised on CCC had the lowest feed intake and the best FCR values. The feed conversion ratio of broiler chickens was significantly influenced by litter materials across the treatment groups. This is consistent with the findings of numerous researchers (20; 27) who discovered that bedding materials had an effect on the feed conversion ratio of broiler chickens. The birds raised on CCC had the highest FCR. These findings supported the observation of the previous researchers (20) that when birds are reared on alternative bedding materials, their performance is either equal to or worse than that of birds reared on WS.

Haematological variables can also be used to assess bird health (28). Except for packed cell volume (PCV) and haemoglobin (Hb), which are indicative of the bedding materials used, similar haematological values were obtained from broiler chickens reared on different bedding materials and those in the control group. The experimental birds' PCV and Hb values varied significantly across treatment groups, with birds raised on RWM and CCC recording similar values but significantly higher when compared to other treatment groups. The composition and nature of the bedding materials could explain the inconsistency of results across studies. (29) found that RBC and WBC values in broiler chickens were unaffected, which is consistent with the current findings.

The type of bedding material has been shown to have a significant impact on broiler chicken carcass quality (5). The bedding materials had a significant impact on the carcass characteristics of broiler chickens. The findings of this study contradicted the observation of (20; 27) who found no

significant effect of bedding material type on broiler chicken carcass characteristics. This study also discovered that bedding material types had a significant impact on eviscerated weight, dressing percentage, relative weight of legs, shanks, drumstick, wing, thigh, spleen, liver, and heart. Birds raised on RWM had the highest dressing percentage (71.78%), while those raised on CCC had the lowest (69.00%) values. Birds raised on CCC had significantly higher relative weights of shank, liver, and heart compared to other treatment groups. Many factors, including particle size, moisture content and build up, rate of caking, and other physical characteristics of the litter materials used, have been reported to influence the efficiency of a type of bedding materials (30). The findings of this study corroborated the observation of (31), who discovered that litter types had an effect on the carcass traits of broilers.

### Conclusion and Applications

1. The findings of this study suggested that the four beddings are suitable for raising broilers because none of the beddings had an adverse effect on the broiler chickens' growth performance, carcass characteristics, or haematological parameters.
2. However, corn cobs performed slightly better and could replace WS as a bedding material for broiler rearing among the available beddings in terms of feed conversion ratio, daily feed intake, packed cell volume and haemoglobin.

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