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Haematobiochemical indices of growing pigs as influenced by bedding materials#

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Abstract

Haematological and serum biochemistry parameters are good indicators of the physiological status of animals, and their changes are important for assessing the response of an animal to various physiological situations. Thus, a study was conducted to evaluate the haematobiochemical profile of pigs reared on different bedding materials. Twenty-seven (27) crossbred weaned pigs weighing between 39 and 41 kg obtained from the pigsty of the Teaching and Research Farm, University of Ibadan, Nigeria, were replicated three times with nine pigs in each treatment. The three treatments used were concrete (T1), wood shavings (30 cm depth) (T2) and sand (20 cm depth) (T3). The experiment lasted for eight weeks. Feed was offered twice a day while water was supplied ad libitum. Five mL of blood was collected from three pigs per treatment for the analysis of haematological indices in anticoagulant-containing tubes, while tubes without anticoagulant were used for serum biochemistry. From the results obtained, packed cell volume (26.00%), haemoglobin (8.03g/dL), red blood cell (3.34 x 10^6/uL), and white blood cell (21866.70 x10^6/uL) were significantly ($p<0.05$) highest in pigs reared on a concrete floor compared to other flooring systems. Monocyte and eosinophil values did not differ significantly across treatments ($P>0.05$). No significant difference ($P>0.05$) was observed in mean corpuscular haemoglobin concentration and mean corpuscular haemoglobin. Total protein and globulin were significantly ($p<0.05$) highest (4.50g/dL, 2.33g/dL) in the sand floor. Alanine aminotransferase (ALT) was significantly highest in T3, while aspartate aminotransferase (AST) and alkaline phosphatase (ALP) were highest in T1. It can be concluded that sand can be used as an alternative bedding material for growing pigs without adversely affecting their haematological and serum parameters.

Keywords: Bedding, floor, grower pig**,** haematology, serum

In modern swine production systems, the choice of flooring material plays a pivotal role in the overall management and welfare of growing pigs. The type of flooring can significantly impact various aspects of pig health, behaviour and performance. Flooring is a critical component of swine housing, affecting pig comfort, hygiene and overall well-being. Concrete floors are a common choice in swine facilities (Thorup et al., 2007). However, concerns arise regarding the potential discomfort for pigs due to the hardness and lack of thermal insulation of concrete surfaces. Wood shavings, as a flooring material, aim to enhance pig welfare and mimic a more natural environment (Pederson et al*.,* 2014). Li et al. (2018) reported that sand flooring offers potential benefits, including improved thermal comfort and increased engagement in

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natural behaviour such as rooting. Sand's loose structure can contribute to joint and hoof health. The life of all flesh is in the blood, and its usefulness for assessing the health status, chemical evaluation for survey, physiological, pathological conditions, as well as in the diagnostic and prognostic evaluation of various types of diseases in animals cannot be overemphasised (Alade et al*.,* 2005). The blood also helps in distinguishing the normal state from a state of stress, which can be maturational, environmental or physical (Aderemi, 2004). Haematological assessment is a useful tool for the diagnosis of many diseases and investigation of the extent of damage in a host (Onyeyili et al., 1991). Evaluation of haematological parameters or attributes serves as an index of general physiology, nutrition and health status of animals. The haematological profile of pigs may be influenced by several physiological factors, especially age, sex, breed, nutrition and management and stress (Tambuwal et al*.,* 2002). Serum biochemical analysis is used to assess myocardial injury, liver and kidney dysfunction, and protein quality and amino acid requirements in animals (Harris et al*.,* 1982). Serum biochemistry is a reliable biochemical system which could reflect the condition of the organism and the changes happening to it under the influence of internal and external factors (Toghyani et al*.,* 2010). Therefore, this study was conducted to evaluate the impacts of different floor types on haematobiochemical profile of growing pigs

Materials and methods

The experiment was carried out at the piggery unit, Teaching and Research Farm University of Ibadan, Nigeria. The experimental area is situated on GPS coordinates (7.4432^{0}N, 3.9003^{0}E). University of Ibadan Animal Care and Use Research Ethics Committee approved experimental procedures before the commencement of the study. Twenty-seven (27) crossbred (Large White × Landrace) growing pigs were used for the study. The pigs were dewormed and fed daily at 4% of their body weight at the beginning of the experiment, with the quantity gradually increased as the animals aged. Water was provided ad libitum. The animals were housed and monitored for one week prior to the commencement of the experiment to allow for proper acclimatisation. Feeding was carried out twice daily at 8:00 am and 4:00 pm. The experiment lasted for eight weeks.

The concrete floors were made of gravel, sand, granite, and water (T1), while wood shavings collected from sawmills within Ibadan metropolis in dried form were spread on the cemented floor to make wood shavings floors (T2). Sand in dried form was spread on floor to make sand floor (T3). At the end of the experiment, blood samples were collected from two pigs per treatment via the anterior vena cava into a set of well-labelled sterile bottles containing EDTA (Ethylene Diamine Tetra Acetic Acid) for haematological analysis. Haemoglobin concentration was determined using the cyanmethemoglobin method (Cannan, 1958). Packed cell volume (PCV) and red blood cell (RBC) and white blood cell (WBC) count of the blood samples were determined using the Wintrobe haematocrit tube according to the method of Schalm *et al*. (1975). Another set of bottles without EDTA was also used to collect blood immediately covered and centrifuged. Serum was separated, decanted, and deep-frozen for biochemical analysis, as described by Ewuola & Egbunike (2008). Data were analysed using the analysis of variance (ANOVA) procedure of SAS (2020). The differences among treatments were compared using Duncan's Multiple Range Test (Duncan, 1955) when the treatment effect was observed, with significance taken at $p<0.05$.

Table 1: Gross composition of experimental diet

Ingredient	Percentage
Maize	45.00
Wheat Offal	36.75
Groundnut cake	12.00
Full - fat soya	3.00
Bone meal	1.50
Oyster shell	1.00
Premix	0.25
Salt	0.50
Total	**100.00**
Calculated Analysis	
CP%	17.13
Energy (Kcal/Kg ME)	2610.20
Ca%	0.99
P%	0.72
Lysine%	0.62
Methionine %	0.25
Fibre%	4.82

Results and discussion

The haematological parameters of pigs on different bedding materials are presented in Table 2. Packed cell volume (PCV) was significantly higher ($p<0.05$) in pigs raised on concrete floors (T1: 26.00%) compared to those on sand bedding (T3: 23.37%), while pigs on wood shavings (T2: 24.67%) did not differ significantly from either T1 or T3. Haemoglobin concentration (HB) was highest in T1 (8.03 g/dL), followed by T3 (7.40 g/dL), and lowest in T2 (7.07 g/dL); all values differed significantly ($p<0.05$). Red blood cell (RBC) count was significantly higher in T1 (3.34×10^6/µL) and T3 (3.26×10^6/µL) compared to T2 (2.96×10^6/µL). White blood cell (WBC) count differed significantly ($p<0.05$) among treatments, T1 (21,866.70/µL) was significantly higher ($p<0.05$) than T2 (19,990.00/µL) and T3 (17,342.00/µL). Platelet count was also significantly affected, being highest in T2 (298,000.00/µL), followed by T1 (273,333.00/µL), and lowest in T3 (248,333.00/µL). Lymphocyte count was significantly higher in T3 (32.00%) than in T2 (29.00%), whereas T1 (31.00%) did not differ from either group. Neutrophil count was significantly lower in T2 (28.33%) relative to T1 (35.00%) and T3 (33.00%), which were statistically similar. Monocyte and eosinophil

Table 2. Haematology of grower pigs reared on different bedding materials

Parameters	T1	T2	T3	SEM
PCV (%)	26.00[a]	24.67[ab]	23.37[b]	0.15
HB (g/dL)	8.03[a]	7.07[c]	7.40[b]	0.01
RBC (x10^6/uL)	3.34[a]	2.96[b]	3.26[a]	0.01
WBC (x10^6/uL)	21866.70[a]	19990.00[b]	17342.00[c]	61.69
Platelet	273333.00[b]	298000.00[a]	248333.00[c]	447.52
Lymphocyte (%)	31.00[ab]	29.00[b]	32.00[a]	0.11
Neutrophil (%)	35.00[a]	28.33[b]	33.00[a]	0.10
Monocyte (%)	3.67	2.67	2.67	0.06
Eosinophil (%)	3.67	3.33	3.33	0.06
MCV (fL)	77.79[ab]	84.91[a]	71.57[b]	0.33
MCHC (fL)	30.90	28.91	31.67	0.17
MCH (fL)	24.02	23.98	22.67	0.10

a,b Means on the same row with different superscripts are significant (p<0.05), SEM = Standard Error of Mean

values did not differ significantly across treatments (p>0.05). Mean corpuscular volume (MCV) was highest in T2 (84.91 fL) and significantly greater than T3 (71.57 fL), but similar to T1 (77.79 fL) was intermediate. No significant differences (p>0.05) were observed in mean corpuscular haemoglobin concentration (MCHC) and mean corpuscular haemoglobin (MCH).

The results of serum biochemical parameters of grower pigs raised on different bedding materials are shown in Table 3. Total protein (TP) was significantly higher (p<0.05) in pigs reared on sand bedding (T3: 4.50 g/dL) compared to those on concrete floors (T1: 3.77 g/dL) and wood shavings (T2: 3.80 g/dL), which did not differ from each other. Albumin (Alb) concentration was highest in T1 (2.43 g/dL) and significantly greater (p<0.05) than values recorded in T2 (2.07 g/dL) and T3 (2.17 g/dL). Globulin concentration differed significantly (p<0.05) among treatments, with the highest value in T3 (2.33 g/dL), followed by T2 (2.07 g/dL), and the lowest in T1 (1.33 g/dL). Consequently, the albumin-to-globulin ratio (A/G) was highest in T1 (1.96), compared to lower but statistically similar values in T2 (1.06) and T3 (1.09). Alanine aminotransferase (ALT) activity was significantly higher (p<0.05) in T3 (34.33 U/L) compared to T1 (31.00 U/L) and T2 (27.67 U/L). Aspartate aminotransferase (AST) was highest in T1 (50.00 U/L) compared to T2 (44.67 U/L) and T3 (42.33 U/L), which were not significantly different. Alkaline phosphatase (ALP) activity was significantly higher in T1 (91.67 U/L) than in T2 (87.00 U/L) but was similar to T3 (89.00 U/L). Blood urea nitrogen (BUN) and total bilirubin (T Bil) did not differ significantly (p>0.05) among treatments. Creatinine concentration was significantly lower (p<0.05) in T3 (0.63 mg/dL) compared with T1 (0.83 mg/dL) and T2 (0.83 mg/dL), which were similar.

This study showed that bedding materials significantly influenced pig haematological parameters, with concrete flooring associated with higher PCV, Hb, RBC, and WBC values compared to sand and wood shavings. These results are partly consistent with Ogunbode and Adepoju (2024), who found no significant differences in PCV or HB between floor types but reported better overall blood profiles in pigs on concrete. High PCV, Hb, RBC, and

Table 3. Serum biochemistry of grower pigs reared on different bedding materials

Parameters	T1	T2	T3	SEM
Total Protein TP(g/dL)	3.77[b]	3.80[b]	4.50[a]	0.03
Albumin Alb(g/dL)	2.43[a]	2.07[b]	2.17[b]	0.01
Globulin Glob(g/dL)	1.33[c]	2.07[b]	2.33[a]	0.01
Alb/Glob ratio	1.96[a]	1.06[b]	1.09[b]	0.02
Alanine aminotransferase ALT(U/L)	31.00[b]	27.67[c]	34.33[a]	0.14
Aspartate aminotransferase AST(U/L)	50.00[a]	44.67[b]	42.33[b]	0.14
Alkaline Phosphate ALP(U/L)	91.67[a]	87.00[b]	89.00[ab]	0.19
Blood Urea Nitrogen - BUN	10.57	11.40	10.83	0.04
Total Bilirubin T Bil	0.17	0.20	0.17	0.01
Creatinine(mg/dL)	0.83[a]	0.83[a]	0.63[b]	0.01

a,b Means on the same row with different superscripts are significant (p<0.05)

WBC improve the oxygen-carrying capacity of the cells, resulting in better availability of nutrients (Oleforuh-Okoleh et al., 2015). The lower PCV and HB values in pigs on sand bedding may reflect reduced erythropoietic activity, low protein intake, liver damage, and parasitic infection (Lindsay, 1977). Ugwuene (2011) reported that reduced red blood cell counts indicate reduced oxygen delivery to tissues and reduced carbon dioxide removal from the lungs. Platelet counts were significantly higher in pigs housed on wood shavings, whereas lymphocyte levels were elevated in those on sand, and neutrophil counts were increased in pigs maintained on concrete and sand. Platelet counts were highest on wood shavings, while lymphocytes were greater on sand, and neutrophils were elevated in pigs on concrete and sand. These variations indicate that bedding type influences immune balance. This study confirms that production environment shapes haematological outcomes as observed by Golinar et al*.,* (2025), who reported housing and system related effects on RBC, platelet, and erythrocyte indices. Overall, concrete flooring appeared to yield superior haematological responses, supporting earlier findings (Ogunbode and Adepoju, 2024), although specific differences among treatments suggest interactive effects of housing system, management, and production conditions (Golinar et al*.,* 2025). The white blood cell counts of lymphocytes and neutrophils indicate the pigs' immune potential. Although there were no significant differences among the floor types for monocytes, eosinophils, mean corpuscular haemoglobin concentration, and mean corpuscular haemoglobin, this might indicate similar haemoglobin content across groups. Serum biochemical responses of grower pigs were significantly influenced by bedding type. Total protein and globulin were highest in pigs on sand. A significantly higher total protein in T3 can be an indicator of better health and welfare of pigs on sand bedding. Blood biochemical variables such as total protein and albumin may be vital measures of the effects of stress on animals. The results of the present study are consistent with the findings of Antil et al. (2019), who observed that bedding material had a significant effect on plasma protein levels. Results of the present investigation are contrary to the findings of Keane et al. (2017), who compared straw with a concrete floor for total plasma albumen levels in finishing beef heifers and found no significant difference between treatment and control groups. Albumin and the albumin-to-globulin ratio were greater in pigs housed on concrete, indicating differential effects on protein metabolism. Enzyme activities also varied, with ALT elevated in pigs on sand and AST higher in those on concrete, though ALP remained relatively stable across treatments. These trends align with reports by Ogunbode and Adepoju (2024) that pigs on concrete maintained superior blood indices and with Golinar et al. (2025), who noted that housing conditions could alter serum enzyme values within normal ranges. In contrast, sand-supported pigs showed elevated globulin levels, possibly indicating stronger immune-related protein responses. Overall, bedding material influenced biochemical indices, with concrete promoting higher metabolic and mineral profiles, whereas sand favoured globulin production.

Conclusion

The study showed that sand can be used as an alternative bedding material in pig production without any deleterious effects on the haematology and serum indices of growing pigs

Conflict of interest

The authors declared no conflicts of interest concerning the research, authorship and publication of this article.

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