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Assessment of Haematological and Serum Biochemical Responses of In-Gilts under Different Flooring Systems

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Abstract

The study evaluated the effects of different bedding materials on the haematological and serum biochemical indices of in-gilts reared under intensive systems of management. The experiment was conducted to determine the suitability of selected bedding systems in improving the physiological health and welfare status of pigs. Twenty-four (24) in-gilts pigs were used for the study. The treatments were replicated three times each with six animals in each treatment. The blood samples were collected at the end of the experiment for haematological and serum indices analysis. Three different bedding materials were used for the experiment, viz, concrete, wood shavings (30 cm depth) and sand (20 cm depth). The concrete floor was made from gravel, granite, sharp sand and water, while wood shavings were obtained in dried form from sawmills within Ibadan metropolis and dirts, pebbles, iron metals, nails and broken bottles were removed and spread on the cemented floor to make the wood shaving floor. Gutter sand in dried form were collected from drainage and sieved to remove debrils and harmful materials and spread at a depth of 20 cm on a cemented floor to make sand floor. The results revealed significant ($p<0.05$) differences across the different floor types for haematological and serumand serum biochemical indices evaluated.

Keywords: *Animal welfare, blood parameters, floor types, in-gilts, physiological response*

1.0 INTRODUCTION

Livestock sector plays an important role in providing nutritious food, rich in animal protein and in providing family incomes and employment to millions of the people in Nigeria. Among the various livestock species, pig is one of the most important meat producing animals around the world. Rearing of pig is an important operation which needs great deal of management, skill, application of scientific management practices and constant care and management (Saikia *et al.*, 2018). To have more gains from pig farming, it is essential that the housing of the pigs should be scientific. The housing of swine should provide enough rest, fresh feed and water, better facilities for disease prevention, treatment

and management and ensure enough safety during inclement weather condition. The swine housing system is shifting from the pasture production to the confinement system. Bedding materials are essential components of modern pig housing systems because they improve welfare, comfort, health, behavior and productivity of pigs. Common bedding materials used in pig production include straw, wood shavings, sawdust, sand and rice husk. These bedding materials are locally available in Nigeria and are usually handled as waste. Dry bedding materials control ammonia levels, provides a healthy environment and reduce stress. The quality of bedding materials is a major concern in pig production not only because it affects the healthy and productivity (Garces *et al.*, 2013) but it may act as potential reservoir and transmission vehicle for pathogens and potential pathogens (Gilaneh *et al*., 2016). Ogunbode *et al.*, 2026 reported that blood is an important materials for the evaluation of health status in animals and act as a pathological reflector of exposure of animal to toxicant and other conditions (Olafadehan *et al.*, 2010). Haematological studies are of ecological and physiological interest in helping to understand the relationship of blood characteristics to the environment. Toogun *et al.*, 2007 opined that evaluation of haematological indices is also useful in the diagnosis of many diseases and investigation of damage to the blood. Hence, the present study was planned to study the effects of bedding materials on haematological indices and serum biochemical of in-gilts.

2.0 MATERIALS AND METHODS

2.1 Experimental Site

The experiment was carried out at the piggery unit of the Teaching and Research Farm of the University of Ibadan, Ibadan, Oyo State, Nigeria (GPS Coordinates: 7.4432^0N, 3.9003^0E).

2.2 Experimental Housing

The experimental pigs were housed in a well-ventilated piggery designed to provide adequate space for movement, resting and feeding. Each experimental pen measured approximately3.0m length by 2.5m width giving a floor area of $7.5m^2$ per pen. The pens were separated by bricks partitions to prevent mixing of animals from different treatment groups. The ambient temperature and relative humidity of the pig house were monitored throughout the experimental period. Temperature was measured using a digital thermometer while relative humidity was determined using a digital hygrometer .The sanitation of the experimental house was maintained throughout the study. The pens, feeders and drinkers were cleaned on daily basis to reduce the accumulation of faeces, urines and other contaminant.

2.3 Procurement of Bedding Materials and Pigs

The bedding materials used were T1: Concrete floor, T2: Wood shavings floor (30 cm deep) and T3: Sand floor (20 cm deep).The concrete floor was made of cement, granite, gravel, sharp sand and water. The wood shaving was gotten in dried form from sawmills within Ibadan metropolis and pebbles, dirts, metals, iron, broken bottles and nails were removed and spread on a cemented floor at a depth of 30 cm to make wood shaving floor. Sand from gutter were collected and sieved to have fine sand and spread on a cemented floor at a depth of 20 cm to make sand floor. The wood shavings and sand beddings were removed every two weeks to prevent caking and build up of ammonia. Twenty-four (24) in-gilts pigs between the weight range of 62 kg to 69 kg were used for the study and fed according to their nutrient requirement while water was supplied *ad libitum*. The pigs were allowed seven (7) days acclimatization and the animals were fed twice daily. The experiment lasted for 120 days.

2.3 Experimental Design

Twenty-four (24) in-gilts were randomly assigned to three treatments diets with six pigs per treatment in a completely randomized design (CRD). Standard routine management practices were employed during the experiment.

2.4 Data Collection

2.4.1 Determination of Blood Parameters

Blood samples were collected at the end of feeding trial through the anterior vena cava vein using a sterile syringe and needle. Blood sample per pig was collected into two sets of labelled sterilized bottles. One set contained anti-coagulant (EDTA – Ethyl-Diamine Tetra Acetic Acid powder), while the other set did not. The set of bottles containing anticoagulant was used to determined the values of haematological indices such as size of haemoglobin (Hb), packed cell

volume (PCV), red blood cell (RBC), white blood cell (WBC), and platelets. Values obtained were used to calculate Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin Concentration (MCHC).

Mean Corpuscular Volume (MCV) = PCV X 10 / RBC

Mean Corpuscular Haemoglobin (MCH) = Hb x 10 / RBC

Mean Corpuscular Haemoglobin Concentration (MCHC) = Hb x 100 / PCV.

The set of bottles without anti-coagulant was used to determine the serological indices such as total protein, albumin, globulin and total bilirubin while liver functions were determined using a commercial diagnostic reagent kit by following manufacturer's instructions.

2.5 Statistical Analysis

Data on blood indices were subjected to one-way analysis of variance. (SAS 2023) and the means were separated using Duncan Multiple Range Test (Duncan, 1955).

3.0 RESULTS

The haematological indices of in-gilts reared on different floor types are presented in Table 2. Packed cell volume (PCV) was significantly higher ($p<0.05$) in in-gilts on wood shavings (T2: 38.33%) and sand bedding (T3:37.67%) compared with those on concrete floors (T1:35.00%). Haemoglobin concentration (Hb) followed a similar pattern, being significantly greater in T2 (12.30 g/dL) and T3 (12.20 g/dL) compared to T1 (11.27 g/dL). Red blood cell (RBC) counts were also higher in T2 (6.34 x 10^6/uL) and T3 (6.03 x 10^6uL) than in T1 (5.52 x106/uL). White blood cell (WBC) counts differed significantly among treatments ($p<0.05$), with the T3 (10,633.30/uL) significantly higher than T1 (8,766.70/uL) and T2 (7,400.00/uL). Platelet counts were significantly greater in T2 (141,000.00/uL) and T3 (148,667.00/uL) compared to T1 (113,333.00/uL). Lymphocyte values were significantly higher in T2 (46.00%) than in T1 (41.67%) and T3 (39.67%). Neutrophil counts was significantly highest in T3 (53.67%) compared to T1 (51.33%) and T2 (46.00%).Monocyte counts was significantly higher in T1 (4.33%) compared with T2 (3.00%) and T3 (3.00%). Eosinophil counts were significantly higher in T2 (5.00%) compared to T1 (2.67%) and T3 (3.67%). No significant differences ($p>0.05$) were observed in mean corpuscular volume (MCV), mean corpuscular haemoglobin concentration (MCHC) and mean corpuscular haemoglobin (MCH) values.

The serum biochemical value of in-gilts reared on different bedding materials are presented in Table 3.Total protein (TP) was significantly higher ($p<0.05$) in in-gilts on concrete floors (T1:8.83g/dL) compared to those on wood shavings (T2: 7.60g/dL) and sand bedding (T3:7.77 g/dL), which did not differ significantly. Albumin (Alb) followed a similar pattern, with the highest value recorded in T1 (3.57g/dL) compared to lower but statistically similar values in T2 (2.87g/dL) and T3 (3.00g/dL). Globulin concentration was significantly higher in T1 (5.27g/dL) than in T2 (4.87g/dL) and T3 (4.77g/dL). The albumin-to-globulin ratio (A/G) was significantly greater in T1 (0.68) compared with T2 (0.59) but similar to T3 (0.63). Serum enzyme activities showed marked differences among treatments. Alanine aminotransferase (ALT) and aspartate aminotransferase (AST) were significantly higher in T1 (55.33U/L and 62.67U/L respectively) than in T2 (32.67U/L and 46.33U/L) and T3 (31.67U/L and 45.00U/L).Alkaline phosphatase (ALP) activity was significantly higher in T1 (295.67U/L) compared to T2 (229.00U/L) and T3 (208.67U/L). Blood urea nitrogen (BUN) was significantly higher in T1 (27.47mg/dL) compared with T2 (25.63mg/dL) and T3 (24.67mg/dL).Total bilirubin (T.Bil) followed the same trend with T1 (0.63mg/dL) having a significantly higher value compared to T2 (0.30mg/dL) and T3 (0.33mg/dL). Serum creatinine concentration was significantly higher in T1 (2.27mg/dL) and T2 (1.63mg/dL) compared with T3 (1.30mg/dL).

Table 1: Haematology of In-gilts reared on Different Bedding Materials

	T1	T2	T3	SEM
PCV (%)	35.00^b	38.33^a	37.67^a	0.10
HB(g/dL)	11.27^b	12.30^a	12.20^a	0.03
RBC (x10^6/uL)	5.52^b	6.34^a	6.03^a	0.02

WBC (x10^6/uL)	8766.70^b	7400.00^c	10633.30^a	27.72
Platelet	113333.00^b	141000.00^a	148667.00^a	511.86
Lymphocyte (%)	41.67^b	46.00^a	39.67^b	0.12
Neutrophil (%)	51.33^b	46.00^c	53.67^a	0.05
Monocyte (%)	4.33^a	3.00^b	3.00^b	0.04
Eosinophil (%)	2.67^b	5.00^a	3.67^b	0.05
MCV	63.42	60.48	62.50	0.18
MCHC	32.20	32.09	32.39	0.08
MCH	20.43	19.40	20.24	0.08

a,b.c Means on the same row with different superscripts are significantly ($p<0.05$) different
PCV: Packed Cell Volume
HB: Haemoglobin
RBC: Red Blood Cell
WBC: White Blood Cell
MCV: Mean Corpuscular Volume
MCHC: Mean Corpuscular Haemoglobin Concentration
MCH: Mean Corpuscular Haemoglobin

Table 2: Serum Biochemistry of In-gilts reared on Different Bedding Materials

	T1	**T2**	**T3**	**SEM**
TP(g/dL)	8.83^a	7.60^b	7.77^b	0.01
Alb(g/dl)	3.57^a	2.87^b	3.00^b	0.01
Glob(g/dL)	5.27^a	4.87^b	4.77^b	0.02
Alb/Glob	0.68^a	0.59^b	0.63^{ab}	0.00
ALT(U/L)	55.33^a	32.67^b	31.67^b	0.09
AST(U/L)	62.67^a	46.33^b	45.00^b	0.10
ALP(U/L)	295.67^b	229.00^b	208.67^c	0.50
BUN(mg/dL)	27.47^a	25.63^b	24.67^b	0.05
T Bil(mg/dL)	0.63^a	0.30^b	0.33^b	0.01
Creatinine(md/dL)	2.27^a	1.63^a	1.30^c	0.01

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

TP: Total protein
ALB: Albumin
GLOB: Globulin
ALB/GLO: Albumin/Globulin ratio
ALT: Alanine aminotransferase
AST: Aspartate aminotransferase
ALP: Alkaline Phosphatase
BUN: Blood Urea Nitrogen
T.BIL: Total Bilirubin

4.0 DISCUSSIONS

The haematological results showed that in-gilts reared on wood shavings and sand bedding had higher packed cell volume, haemoglobin and red blood cell counts compared with those on concrete floors, suggesting improved oxygen-carrying capacity and reduced stress in enriched environments. Similar observations were reported by Choe *et al* 2020 who linked enriched housing to better haematological stability in gestating sows. Platelet counts were also elevated in T2 and T3, consistent with improved circulatory health and reduced chronic stress (Martelli *et al*., 2010). Leukocyte distribution varied with bedding type, with higher white blood cell and neutrophil counts in sand-bedded in-gilts, indicating stronger immune responsiveness (Van der Meer *et al.*, 2016), while wood shavings promoted higher lymphocyte values,(46.00%) reflecting reduced stress. Elevated monocytes in in-gilts on concrete floors align with Yeom *et al.*, (2012), who reported stress-induced shifts in leukocyte profiles. Higher eosinophil counts in wood shavings may reflect allergenic or parasitic responses,(5.00%) consistent with Plundrich

et al., (2020). No significant differences in mean corpuscular volume, mean corpuscular haemoglobin concentration and mean corpuscular haemoglobin suggest that bedding influenced blood cell counts rather than morphology.

The serum biochemical profile of in –gilts showed consistently higher total protein, albumin, globulin, liver enzymes (ALT,AST,ALP), nitrogenous wastes (BUN, creatinine and total bilirubin) in in-gilts reared on concrete floors (T1) compared with those on wood shavings (T2) and sand (T3). Higher total protein in-gilts reared on concrete floor indicated adequate protein utilization or mild dehydration and lower values in pigs on wood shavings and sand floors might suggested reduced protein intake, impaired synthesis or altered protein metabolism. Higher albumin and globulin values in in-gilts reared on concrete floor indicated greater immunological stimulation. Aspartate aminotransferase (AST) is an enzyme associated with the liver and also present in skeletal muscle and other tissue. A higher aspartate aminotransferase concentrations in pigs on concrete could be associated with increased physical activity, muscle stress or tissue injury. These patterns i.e. elevated protein fraction and liver enzymes can reflect differences in nutritional status, hepatic metabolic activity or low-grade inflammatory stimulation and are comparable to reports that nutritional and management factors alter serum proteins and enzyme activities in in-gilts (Weng, 2019). The absolute values also fall within the broader clinical ranges reported for modern sows, although the T1 values for some analytes (e.g. TP, ALT/AST) were toward the upper end of published reference intervals (Heath, *et al.,* 1991). An elevated alanine aminotransferase concentration in pigs could indicate increased hepatic cellular stress or injury. A higher alkaline phosphatase could be interpreted as evidence of liver dysfunction and associated with differences in activity and skeletal development depending on the age and physiological status of the animal. A higher alkaline phosphatase in concrete floor could be interpreted as evidence of liver dysfunction and associated with differences in activity and skeletal development depending on the age and physiological status of the animal. Higher blood urea nitrogen in concrete floor indicate increased protein catabolism, greater dietary protein breakdown or reduced renal clearance while lower values in wood shavings and sand floors could be as a result of lower protein utilization or dietary protein intake. Relatively higher creatinine concentrations in in-gilts on concrete floor suggested reduced renal clearance or differences in muscle metabolism whereas stable values generally indicate adequate kidney functions. Housing-related stressors and management (including bedding/hygiene) have previously been associated with altered immune and endocrine markers in pregnant sows, which could underlie shifts in protein and enzyme measures observed here (Grun *et al.,* 2013)

5.0 CONCLUSION

Concrete floor supported improved haematological and serum biochemical values by increasing the blood parameters values

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