EFFECT OF LONG-DISTANCE ROAD TRANSPORTATION ON HAEMATOLOGICAL PARAMETERS IN NIGERIAN TRADE CATTLE

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ABSTRACT
Long-distance transportation of trade cattle can induce physiological stress, which is reflected in changes in blood and serum parameters. Haematological studies provide valuable insights into the relationships between blood characteristics and environmental factors. This study investigated the effects of long-distance road transportation on haematological parameters in trade cattle. Blood samples were collected from 6 cattle (3 males and 3 females) subjected to transportation and compared with 6 of those that were not transported (3 males and 3 females). The data were analysed using a completely randomized design (CRD), with each animal serving as a replicate. The results showed that transportation significantly ($p < 0.05$) affected haematological parameters, including increase in the values of haemoglobin (Hb), red blood cell count (RBC), packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), and white blood cell count (WBC). These changes indicate that the cattle experienced stress during transportation. Recovery from transportation stress was observed after 5-7 days of lairage, suggesting that this period is crucial for allowing cattle to recover from the stress of long-distance transportation.

Keywords: Trade cattle, Transportation, Physiological response, Haematology, Lairage, Nigeria

INTRODUCTION
Transportation of cattle is known to induce physiological stress, leading to changes in blood composition, heart rate, electrolytes, hormones, metabolites, and enzymes concentrations, as well as live-weight, meat, and skin quality (Fazio and Ferlazzo, 2003; Gregory, 2008). Haematological parameters can serve as indicators of physiological stress due to long-distance transportation in trade cattle. Haematology, the study of blood cellular components, is crucial in understanding the relationships between blood characteristics and the environment (Ovuru and Ekweozor, 2004). It aids in selecting genetically resistant animals and assessing their physiological, nutritional, and pathological status (Mmereole, 2008; Isaac *et al.,* 2013; Kubkomawa, 2016). Blood examination provides valuable information on an animal's health status, helping diagnose and prognose diseases (Olafedehan *et al.,* 2010). Changes in hematological parameters indicate an animal's response to physiological situations, making them essential in assessing stress levels (Khan and Zafar, 2005; Afolabi *et al.,* 2010). While haematological studies on Nigerian indigenous cattle have been conducted (Oladele *et al.,* 2001a & b; Kubkomawa, 2016), research on the effects of transport stress on haematological parameters is limited (Minka and Ayo, 2009).

The physiological responses of animals to adverse conditions, such as transportation, are related to their anatomical and physiological constitutions (Minka and Ayo, 2009; Van Engen and Coetzee, 2018). During transportation, animals are exposed to multiple stressors, activating the hypothalamic-pituitary-adrenal (HPA) axis and sympatho-adrenomedullary (SAM) system (Manteca *et al.,* 2013). Plasma levels of glucocorticoids are widely used as measures of stress (Knights and Smith, 2007; Ashenafi *et al.,* 2018). The aim is to determine the effects of transportation on the basic blood physiology of trade cattle. This will help to fill the gap of adopting standard welfare management by traders and transporters, such as proper handling, loading density, stoppages during transportation, and proper lairage rest after transportation.

MATERIALS AND METHODS
A total of 12 cattle (all adults) were used, consisting of N'dama, Bororo and Sokoto Gudali. 3 males and 3 females in the cattle market, and 3 males and 3 females in the university livestock unit, with the cattle at FUTO Livestock unit serving as control. Blood was collected once from the control animals while for the animals subjected to road transportation between 900km to 1400km of about 15 to 30

hours journey time, blood was collected immediately on arrival and thereafter, every other day until 7 days after arrival (day 1, 3, 5, 7). The animals were bled by venipuncture using hypodermic needle and syringe. About 3 mililiters of the blood was drawn into tubes containing ethylene diamine tetra acetate (EDTA) for haematological analysis. The experiment was therefore a completely randomized design (CRD) with each animal serving as a replicate.

RESULTS AND DISCUSSION

Table 1: Haematological changes in trade cattle subjected after road transportation in Nigeria

	Control	Arrival	Recovery groups			
Parameter		**Day 1**	**Day 3**	**Day 5**	**Day 7**	**SEM**
Hb(gm/dl)	11.30^{d}	16.22^{a}	14.35^{b}	12.28^{c}	11.47^{d}	0.37
PCV (%)	33.98^{e}	48.65^{a}	43.07^{b}	38.78^{c}	36.38^{d}	1.02
RBC($x10^{6}$/mm)	4.97^{c}	7.40^{a}	5.95^{b}	5.37^{c}	5.20^{c}	0.17
MCV (fl)	70.22^{bc}	83.50^{a}	73.03^{b}	68.15^{c}	68.25^{c}	1.17
MCH (pg)	11.63^{b}	14.42^{a}	13.85^{a}	12.25^{b}	11.95^{b}	0.23
MCHC (%)	21.00^{c}	25.70^{a}	22.60^{b}	21.15^{c}	20.92^{c}	0.36

Means in the same row with different superscript are significantly different at $p < 0.05$.
Hb = Haemoglobin concentration, PCV = Packed Cell Volume, RBC = Red Blood Cell Count, MCV = Mean Corpuscular Volume, MCH = Mean Corpuscular Haemoglobin, MCHC = Meam Corpuscular Haemoglobin concentration.

Table 1 highlighted variations in the haematological concentration of the control cattle and those subjected to long distance transportation during the post-transportation period.

Haemoglobin concentration

The results showed that there were significant ($p < 0.05$) differences in the values of haemoglobin concentration between the control animals, and the animals subjected to long distance transportation up to the 5th day post-transportation. The significantly higher values recorded by the transported animals on arrival indicate the presence of stress, since haemoglobin concentration has been commonly used as a physiological indicator of stress during the transportation (Van Engen and Coetzee, 2018; Alam *et al.,* 2018; Navarro *et al.,* 2019). The animals were however able to return to control values by the 7th day post transportation. These results agree with the reports of Navarro *et al.* (2019) that there was increase in the haemoglobin concentration of blood from cattle subjected to over 750 km road transportation immediately after offloading compared to the cattle not subjected to the same stressful journey conditions.

Packed Cell Volume (PCV)

Table 1 showed significantly ($p < 0.005$) higher PCV values in cattle subjected to transportation stress on arrival, and up to the seventh day post-transportation than the control indicating that the transport stress could not be ameliorated by the 7th day of lairage rest. The results agree with Schaefer *et al.* (1997), Alam *et al.* (2018), and Brunel *et al.* (2018) that higher values of PCV were seen on arrival in the transported animals when values were compared during loading, and unloading period, and attributed this to dehydration due to journey time, and handling.

Red Blood Cell (RBC)

The values in table 1 showed the mean red blood cell counts of the control cattle, and those subjected to transportation stress. The RBC count increased as a result of the long distance transportation with the value on arrival being the highest, and significantly ($p < 0.05$) higher than the control, and the resting days values. By the 5th day post-transportation, the RBC values became significantly similar ($p > 0.05$) to the control value, indicating that the effect of the transportation stress was reversed after the 3rd day of rest. Transportation stress has been reported by several studies to alter the normal values of RBC counts (Plyashenko and Sidorov, 1987; Nwe *et al.* 1996; Minka and Ayo, 2009 and 2011).

Mean Corpuscular Volume (MCV)

MCV is the measure of the actual volume of individual red cells expressed in femtoliter (fl). Several studies have shown that stress as related to transportation of livestock increases the value of MCV

(Knowles 1990; Warriss, 2003; Tarrant *et al.,* 1992; Shaefer *et al.,* 1997, Zulkifli *et al.,* 2019). The effects of transportation on mean corpuscular volume (MCV) of trade cattle are presented in table 4.9. Generally, the values recorded on arrival were significantly higher ($p < 0.05$) than the control values and the resting days' values, indicating that MCV value was elevated due to transportation stress. Such increase is considered an indicator of dehydration in cattle (Schaefer *et al.,* 1997; Navarro *et al.,* 2019).

Mean Corpuscular Haemoglobin (MCH)

Mean corpuscular hemoglobin is a measure of the Hb concentration of each red blood cell, and therefore a measure of the oxygen carrying efficiency of each RBC, since the major function of Hb is oxygen exchange. Table 4.9 shows that the MCH of the cattle on arrival, and three days post-transportation were significantly higher ($p < 0.05$) than the control, and 5 to 7 days post-transportation values. However, the control value was statistically similar ($p > 0.05$) to the 5th and 7th day post-transportation values. Brunel *et al.* (2018) observed increased value of MCH on arrival in cattle subjected to road transportation, and may be due to the amount of stress generated by a greater duration of transportation. These results also agree with the reports of Zulkifli *et al.* (2019) that the value of MCH in cattle subjected to road transportation stress returned to normal between the 4th and the 7th day after arrival. Alam *et al.* (2018) reported partial recovery after 24 hours.

Mean Corpuscular Haemoglobin Concentration (MCHC)

MCHC is the measure of the amount of Hb in a known PCV. It is calculated by dividing the Hb value with the PCV value. The results presented in table 4.9 show that transportation stress resulted in significant ($p < 0.05$) increase in the MCHC value of trade cattle on arrival. Brunel *et al.* (2018) also reported that MCHC are higher values in transported cattle than those at rest. This perhaps could be attributed to the amount of stress generated through transportation. The values became statistically similar to the control value by the 5th day post transportation, indicating a return to normal level. The results agree with Navarro *et al.* (2019) who reported that the MCHC value of control cattle not subjected to transportation stress to coincide with those subjected to road transportation stress after 4 – 7 days of lairage rest. The findings also corroborate Alam *et al.* (2018) which reported partial recovery after 24 hours of rest from arrival.

CONCLUSION

The long-distance transportation from the north to the south had significant effects on Hb, RBC count, PCV, MCV, MCH, MCHC, and WBC count of the trade cattle, with values being high on arrival but declining to control levels by the 5th to the 7th day of lairage rest. Trade cattle subjected to long distance road transportation should be allowed to rest for 5 – 7 days in lairage before slaughter.

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