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Metabolic Response to Loadtime Stress During Transportation of Cattle in Nigeria

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Abstract: The effects of loadtime stress on changes in some biochemical and cellular composition of blood were evaluated in 24 matured bulls comprising 12 each of White Fulani and Sokoto Gudali breeds of cattle. The animals were stocked (3.09 m^2 h^{-1}), in a trailer pulled by Iveco Truck and transported for 42 h covering a distance of 1024 km. The animals were bled before (preload), immediately after loading (postload) and holdtime periods of 0, 6 and 12 h after transit to assess the cause effect on stress response in cattle. There was significant effect of loadtime ($p<0.05$) on all the variables measured in the present study. Plasma glucose concentration (7.92 mg dL^{-1}) at 6 h holdtime period suggests that stress was more severe at this time period. The Neutrophil:Lymphosite (N:L) ratio was however higher ($p<0.05$) at all time periods of holding than at preload and postload time periods indicating a prolonged effect of stress on the animals immune system at holdtime periods. Interaction between loadtime and bread was significant ($p<0.05$) for all measurements except plasma protein and calcium concentration. Loadtime stress increased plasma glucose and Urea N concentrations in both breeds with the magnitude of the increase being higher ($p<0.05$) in White Fulani cattle. However, loadtime stress decreased plasma protein and calcium concentrations in both breeds with the magnitude of the decrease being lower ($p<0.05$) in Sokoto Gudali cattle. The result indicate that Sokoto Gudali was less stressed and more loadtime tolerant than White Fulani cattle. Also, the higher ($p<0.05$) magnitude of the increase in N: L ratio due to the interaction effect of stress was sustained more in White Fulani than Sokoto Gudali cattle. The above changes in all variables measured were evidence of internal catabolism in the animal body indicating tissue dehydration and weak host defensive mechanism. As a result, fatigue and strong depression, just immediately after the transport (0 h hold time) occur and the animals could be seen lying down. Since, loadtime stress is inevitable whenever animals are transported by road, efficient management practices are necessary during the procedures of loading and unloading to reduce injuries, suffering stress and economic losses in food animals.

Key words: Preload, postload, holdtime, white fulani and sokoto gudali

INTRODUCTION

Loading or confinement of animals reared predominantly in West African under the free grazing system into a vehicle has been reported as an unusual exercise that constitute a break in the dynamic stereotypy of the animal (Ayo and Oladele, 1996). This is because the very process of loading animals into the vehicle is often accompanied by excessive noise, chasing of animals with sticks, pushing and kicking of animals, long standing, while waiting for the vehicle or its departure. Gracey (1986) also noted that poor ramp design, too narrow doors unnecessary projections and improper positioning of loading spots contributed to injuries, suffering and stress in food animal. Severe preslaughter stress has been reported to adversely affect meat quality (Apple *et al*., 1995; Warner *et al*., 1986).

Meanwhile, researchers have used several metabolic indicators to assess stress level in animals. Plasma glucose concentration have been used as reliable indicator of longtime physical stress in cattle (Knet and Ewbank, 1986; Sanbouri, 1991; Tarrant *et al*., 1992; Nwe *et al*., 1996). Stress in cattle due to feed deprivation during transportation have been reported to cause protein breakdown that increases plasma urea N (Kouakou *et al*., 1999; Kannan *et al*., 2000). The effect of various stressors on differential leucocyte profile have been demonstrated (Philips *et al*., 1989; Tarrant *et al*., 1992; Kegley *et al*., 1997; Schaefer *et al*., 1997). Metabolic response to various stress factors

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has been studied in many animal species but the data on metabolic response to load time stress in cattle are very limited. This experiment was therefore designed to evaluate the stress response to load time procedures and to assess the time-cause effect on stress response in cattle during hold time periods. It is also, to determine the magnitude of change in some biochemical and cellular composition of the blood due to physical and psychic exertion that might occur in White Fulani and Sokoto Gudali cattle at load time periods.

MATERIALS AND METHODS

A total number of 24 matured bulls of about 3-7 years old, belonging to White Fulani (WF) and Sokoto Gudali (SG) breeds of cattle served as subjects of this study conducted during the hot humid raining season of the year.

The animals are horned and were raised for meat purpose. They were generally raised on free range pastures, groundnut and cowpea hays with sorghum and millet grain supplements. Water was also offered ad libitum to the cattle.

The animals were kept in an open field prior to transportation without shelter except for trees that provided shade for the animals and some huts used for keeping grain supplements and stockers personal belongings. This experiment was conducted during the hot humid rainy season (June) simulating commercial situation in Nigeria. Care was also taken not to include any animal showing signs of ill-health.

The animals were transported from Gwobawa in Sokoto State to Ojoo in Lagos state in an open trailer pulled by an Iveco truck. The trailer has a total cabin space of $12.12 \times 2.4 \times 2.4$ m^3 with a metal scaffold attached to the top. Shade was provided for the animation necessary by mats made from cured straws spread over the scaffold.

Thermometers and Hygrometers were also attached to the scaffold at 2 different locations to measure the average temperature (°C) and relative humidity (%) at the loading and unloading spots. Prior to the loading procedures, the transport trailer was packed at a loading spot 20 m from a smaller enclosure (measurement area). Mean, while the animals were moved into the enclosure an hour before the commencement of blood collection. Each animal was gently apprehended and bled before loading into the vehicle (preloading). The handling and loading procedures of animals into the trailer were completed within 2 h. They were loaded by hired local stock handlers who used rope to tie the horns, neck or forelegs and pulled each animal into the vehicle. The stock handlers also used clubs, whips and legs to push and kick the animals individually with commanding noise into the vehicle through the loading ramp that was inclined at 30°. The stocking density per animal was about 3.09 m^2 h^{-1} irrespective of the shape, size and horn status of the animals. Immediately after loading each animal was again bled by 21 g needle and blood sample collected (post load) to evaluate the stress response due to the procedures of loading.

The trailer started the journey and traveled from Gwobawa in Sokoto State to Ojoo in Lagos state Nigeria covering a distance of 1024 km within 42 h. After transportation, animals were made to disembark from the vehicle through a ramp inclined at about 30° and held in an open lairage for 12 h without food but with ad libitum access to water. During hold time period/animals were measured with floor space allowance of 4.5 m^2 h^{-1}. Blood samples were collected at either 6-12 h after transportation to assess the time-cause effect on stress response by the animals.

Ambient temperature, relative humidity and time at Gwobawa in Sokoto state on the day of departure and at Ojoo in Lagos State on the day of arrival were recorded using a thermometer, hygrometer and a clock, respectively. Each cattle was restrained and easily handled for blood collection. A total of 8 mL of blood from each animal was collected by jugular vein puncture using 3 different tubes containing different test reagents. The 2 mL of blood was discharged into sterile tube containing Floride Oxalate (to test for glucose). Another, 3 mL of blood was discharged into tubes containing lithium heparin to test for protein and calcium. The remaining 3 mL of blood was discharged into sterile bottle containing dipotassium EDTA to analyze leucocyte count. Differential leucocyte profile and Neutrophil: Lymphocyte (N:L) ratio were also assessed. These samples were stored in ice pack at 4°C and analyzed within 3 h.

Data were analyzed by Analysis of Variance procedure using the statistical analysis system (SAS, 1990). The mean effect in the model were breed (White Fulani vs Sokoto Gudali) treatment (preload time, post land time, unload time, 6 and 12 h hold time period) the breed×treatment interactions effect and the difference between means at a probability of <0.05 was considered significant (Ott, 1993).

RESULTS

Load time as a strong stress factor caused varying changes in the biochemical and cellular composition of the blood as it exerted the body system of cattle in the present study.

Plasma glucose concentration was significantly influenced by main effect of load time ($p<0.05$) increasing to higher levels at post load time and hold time periods of 0, 6 and 12 h (Fig. 1). Load time had a significant effect ($p<0.05$) on plasma, protein and calcium concentrations. Protein level was higher at pre load time period, low at post load and lower ($p<0.05$) at 0, 6 and 12 h hold time periods (Fig. 2). Plasma urea N concentration was also influenced by load time procedures ($p<0.05$) and was higher at 12 h of holding than at any other load time period (Fig. 3). However, the concentration of Urea-N at all the periods under study was higher than the preload time level. Overall mean calcium concentration decreased to lower levels at post load time and hold time periods of 0, 6 and 12 h (Fig. 4). Leucocyte count was also influenced by load time and was higher ($p<0.05$) at 12 h of holding than at any other time period (Fig. 5). However, the counts of Leucocyte at other periods under study were not significantly different. There were significant effects ($p<0.05$) of load time on differential Leucocyte count.

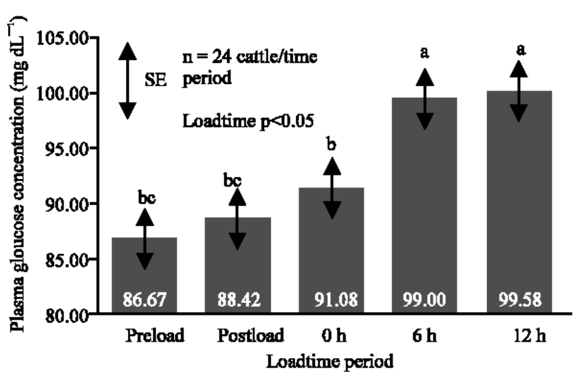

Fig. 1: Main effect of load time stress on plasma glucose concentration in cattle transported 42 h and held in lairage for 12 h

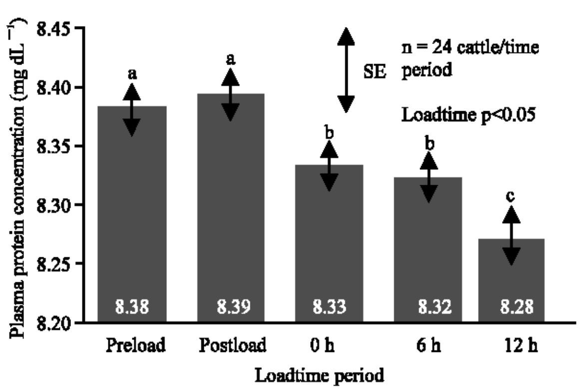

Fig. 2: Main effect of load time stress on plasma protein concentration in cattle transported 42 h and held in lairage for 12 h

Overall mean Neutrophil count (%) increased to higher levels (Fig. 6), while leucocyte count (%) decreased to lower levels (Fig. 7) at postload and holdtime periods of 0, 6 and 12 h. The mean eosinophil count (%) increased at

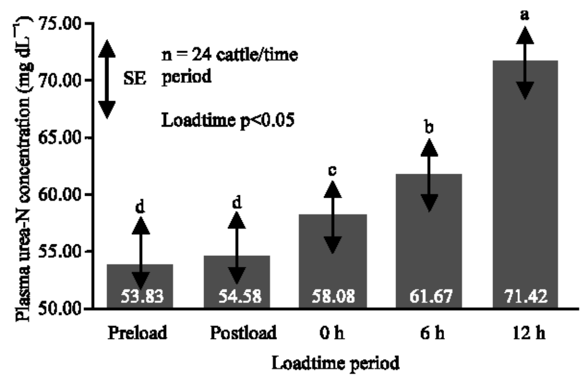

Fig. 3: Main effect of load time stress on plasma urea-N concentration in cattle transported 42 h and held in lairage for 12 h

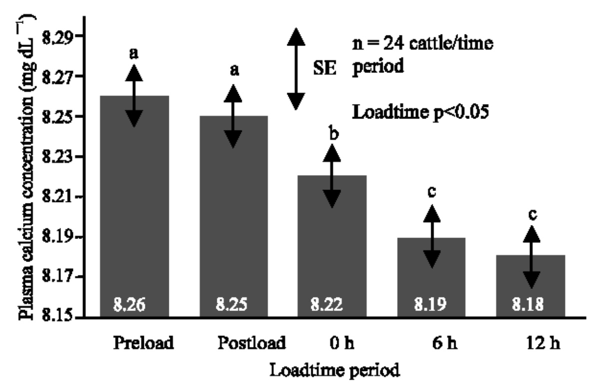

Fig. 4: Main effect of load time stress on plasma calcium concentration in cattle transported 42 h and held in lairage for 12 h

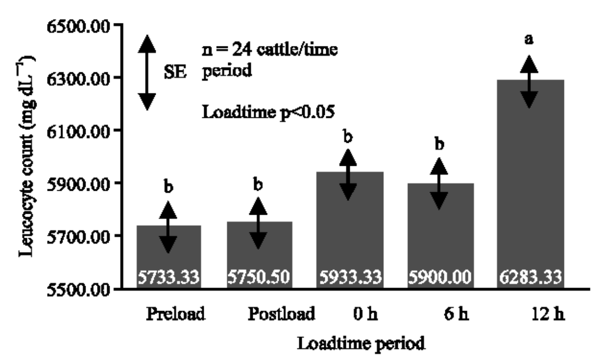

Fig. 5: Main effect of load time stress on Leucocytecount in cattle transported 42 h and held in lairage for 12 h

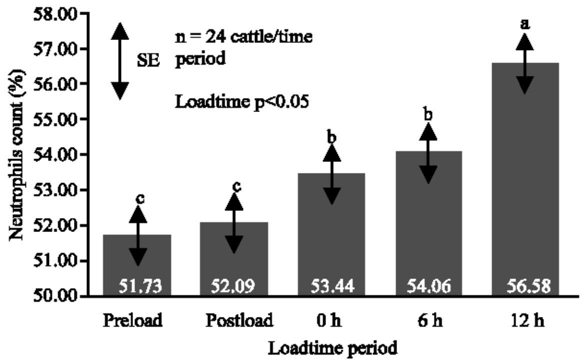

Fig. 6: Main effect of load time stress on Neutrophil count in cattle transported 42 h and held in lairage for 12 h

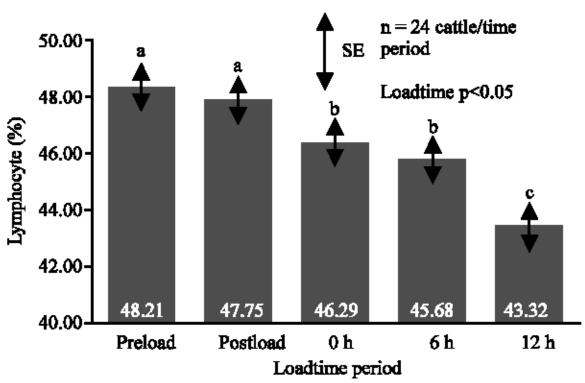

Fig. 7: Main effect of load time stress on Lymphocyte in cattle transported 42 h and held in lairage for 12 h

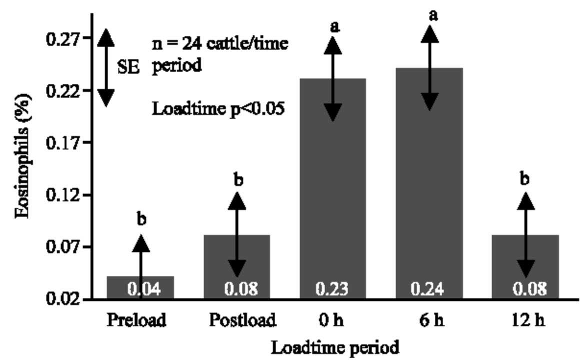

Fig. 8: Main effect of load time stress on Eosinophil in cattle transported 42 h and held in lairage for 12 h

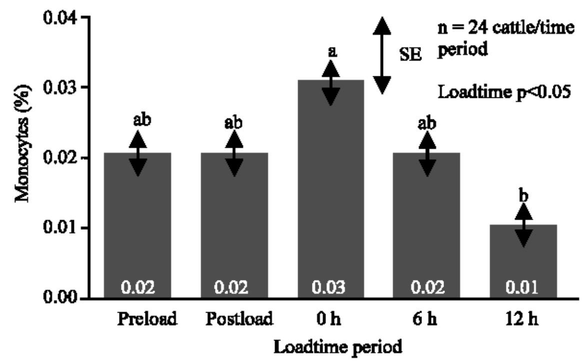

Fig. 9: Main effect of load time stress on Monocyte in cattle transported 42 h and held in lairage for 12 h

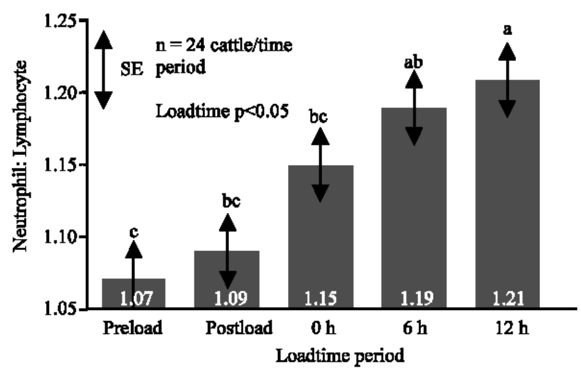

Fig. 10: Main effect of load time stress on Neutrophil to Lymphocyte ratio in cattle transported 42 h and held in lairage for 12 h

postload and peaked at 6 h holdtime period and decreased thereafter (Fig. 8). Monocyte count (%) also increased and peaked at 0 h (unloadtime) and decreased thereafter (Fig. 9). The main effect of loadtime of N:L ratio is shown in (Fig. 10). N:L ratio was significantly influenced by loadtime ($p<0.05$) increasing to higher ratio at postload and holdtime periods of 0, 6 and 12 h.

The main effect of breed on the variable measured is presented in Table 1. Breed effect was significant for all variables except plasma protein, calcium concentration and monocyte count (%). Sokoto Gudali had higher ($p<0.05$) glucose concentration, neutrophil count and N:L ratio, while it had lower ($p<0.05$) Urea-N concentration, leucocyte lymphocyte and eosinophil counts than white Fulani cattle.

The mean of treatment×breed interaction effects on all variables measured are presented in Table 2 and 3. Treatment×breed interaction effects were significant for all the variables except for plasma protein and calcium concentration, which decreased at loadtime periods due to stress by the same magnitude in both breeds of cattle. interaction between loadtime periods and breed were significantly affected ($p<0.05$) with Sokoto Gudali having higher plasma glucose concentrations at the preload, postload and unloadtimes and lower concentrations at the 6 and 12 h of loading.

Table 1: The main effect of breed on some biochemical and cellular composition of the blood of white fulani and sokoto gudali breeds of cattle when subjected to loadtime stress

Breed	Plasma glucose (mg dL^{-1})	Plasma protein (mg dL^{-1})	Plasma urea-N (mg dL^{-1})	Plasma calcium (mg dL^{-1})	Leucocyte (mg dL^{-1})	Neutrophil (%)	Lymphocyte (%)	Eosinmophil (%)	Monocyte (%)	N:L
While fulani	90.87^{b}	8.28	66.47^{a}	8.17	6123.33^{a}	50.13^{b}	49.25^{a}	0.58^{a}	0.04	1.26^{b}
Sokoto gudali	95.03^{a}	8.35	56.00^{b}	8.27	5716.67^{b}	55.67^{a}	44.07^{b}	0.40^{b}	0.03	1.37
SEM	3.68	0.10	2.62	0.11	310.05	2.19	2.09	0.06	0.01	0.09

^{a,b}means followed by different superscript in the same column differ significantly ($p<0.05$)

Table 2: Changes in means of some biochemical composition in the blood of white fulani and sokoto gudali breeds of cattle when subjected to loadtime stress

Measurement	Breed	Preload	Postload	0 h	6 h	12 h	SEM
Plasma glucose	WF	79.50^{c}	82.33^{c}	87.67^{b}	102.17^{a}	102.67^{a}	4.56
(mg dL^{-1})	SG	93.83	94.50	95.50	95.83	96.50	
Plasma protein	WF	8.35	8.35	8.29	8.28	8.23	0.13
(mg dL^{-1})	SG	8.44	8.42	8.37	8.36	8.33	
Plasma urea-N	WF	55.3^{d}	56.67^{d}	62.33^{c}	67.33^{b}	78.16^{a}	3.50
(mg dL^{-1})	SG	51.83^{d}	52.50^{d}	53.83^{cd}	56.00^{b}	64.67^{a}	
Plasma calcium	WF	8.25	8.24	8.20	8.15	8.13	0.12
(mg dL^{-1})	SG	8.27	8.26	8.24	8.23	8.23	

^{a,b,c,d}means followed by different superscripts in the same row differ significantly ($p<0.05$); WF = White Fulani; SG = Sokoto Gudali

Table 3: Changes in means of some cellular composition in the blood of white fulani and sokoto gudali breeds of cattle when subjected to loadtime stress

Measurement	Breed	Preload	Postload	0 h	6 h	12 h	SEM
Leucocyte	WF	5883.33^{cd}	5750.00^{cd}	6183.33^{bc}	5666.67^{d}	6833.33^{a}	410.50
(mg dL^{-1})	SG	5583.33	5750.00	5683.33	5833.33	5733.33	
Neutrophil (%)	WF	51.84^{c}	52.26^{bc}	55.63^{ab}	55.79^{a}	57.10^{a}	2.84
	SG	51.37	51.83	52.25	52.33	51.06	
Lymphocyte (%)	WF	48.16^{a}	46.99^{a}	44.15^{bc}	44.03^{bc}	42.82^{c}	2.53
	SG	48.50	48.01	47.43	47.33	48.82	
Eosnophil (%)	WF	0.07^{b}	0.13^{b}	0.30^{a}	0.33^{a}	0.11^{b}	0.06
	SG	0.03^{c}	0.08^{bc}	0.16^{a}	0.15^{a}	0.05^{c}	
Monocyte (%)	WF	0.01	0.03	0.01	0.01	0.00	0.03
	SG	0.04^{ab}	0.07^{a}	0.05^{b}	0.03^{b}	0.02^{b}	
N:L	WF	1.08^{c}	1.10^{b}	1.20^{ab}	1.27^{a}	1.33^{a}	0.13
	SG	1.07	1.08	1.10	1.11	1.09	

^{a,b,c,d}means followed by different superscripts in the same row differ significantly ($p<0.05$); WF = White Fulani; SG = Sokoto Gudali

Plasma Urea-N increased with white Fulani having higher concentration than Sokoto Gudali cattle at all time periods. Interaction effects were significant for leucocyte count under study. The percentages of neutrophils and lymphocyte decreased at lower values due to loadtime stress in white Fulani than in Sokoto Gudali Cattle. The N:L ratios were higher at all the periods of holding than prior to the beginning of transportation. Mean, while white Fulani had higher N:L ratio and eosnophil count than Sokoto Gudali cattle (at all time periods under study) when subjected to loadtime stress.

DISCUSSION

Loadtime stress had been reported to cause an elevation in plasma glucose concentration (Knet and Ewbank, 1986; Kannan *et al*., 2000), probably due to breakdown of glycogen in the liver and muscle into the liver systemic circulation (Murrey *et al*., 1990). In the present study, plasma glucose increased from a preload concentration (86.67 mg dL^{-1}) by 1.7 mg dL^{-1} due to loading procedures alone and additional increase by 2.66, 7.92 and 0.58 mg dL^{-1} at holdtime periods of 0, 6 and 12 h (Table 4) due to transport and unload time stress.

Table 4: The magnitude of the increase/decrease in some biochemical and cellular composition in the blood of cattle when subjected to loadtime stress

		Holding		
Measurement	Loading	0 h	6 h	12 h
Biochemical				
Plasma glucose (mg dL^{-1})	+1.75	+2.66	+2.92	+0.58
Plasma protein (mg dL^{-1})	+0.01	-0.06	-0.01	0.04
Plasma urea-N (mg dL^{-1})	+0.75	+3.50	+3.59	+9.75
Plasma calcium (mg dL^{-1})	-0.01	-0.03	-0.03	-0.01
Cellular composition				
Leukocyte (mg dL^{-1})	+16.67	+183.33	-33.33	+383.33
Neutrophils (%)	+0.36	+1.35	+0.22	+1.08
Lymphocyte (%)	+0.46	-1.46	-0.61	-2.36
Eosinophils (%)	+0.04	+0.15	+0.01	-0.16
Monocytes (%)	0.00	+0.01	-0.01	-0.01
N: L	+0.01	+0.06	+0.04	+0.02

(+) Increase; (-) Decrease

Excessive noise, chasing of animals with stick, long standing, while waiting for the vehicle or its departure, pushing and kicking could be responsible for the moderate increase in plasma glucose obtained at postload time. In addition the magnitude of the increase in glucose concentration due to unload time stress could also be ascribed to sharp bends, ascending and descending hills, poor ramp designs, to narrow doors; unnecessary projections, improper positioning of loading spot and the staggering effect of unrestrained animals from 1 side of the vehicle to the other, while the vehicle was coming to a halt (Gracey, 1986). The result in the present study therefore indicate that energy was expended as a result of the magnitude of the physical, psychic and vestibular exertion that occurred during loadtime procedures (Fazio and Ferlazzo, 2003). In an attempt to make up for the energy loss at loadtime periods, glucose was probably mobilized from glycogen in the liver (Murry *et al.*, 1990)

Even though plasma cortisol concentration was not measure in the present study, it has been observed that a 20 min van journey increased only plasma cortisol concentration but that a 2 h van journey increased both cortisol and glucose concentrations in goat (Sanbouri, 1992). The authors also noted that as a response to stress, elevation of glucose concentration was preceded by an elevation of cortisol concentration. Therefore, plasma glucose concentration might be useful as an indicator of the intensity of stress (Sanbouri, 1991). The higher magnitude of the increase in plasma glucose concentration (7.92 mg dL^{-1}) at 6 h holdtime period suggest that the intensity of stress was maximum at this time period.

It is postulated that the higher ($p<0.05$) magnitude in the increase in glucose concentration (2.83, 5.34 or 14.50 mg dL^{-1}) was due to greater mobilization of glycogen reserves in White Fulani cattle at postload and loadtime periods of 0 and 6 h, respectively. Thus, the higher ($p<0.05$) magnitude of the increase in glucose concentration indicate that White Fulani expended more energy than Sokoto Gudali cattle when subjected loadtime stress. In addition the lower magnitude of the increase (0.67, 1.00, 0.33 and 0.67) in glucose concentration in Sokoto Gudali cattle (Table 5) again suggest that this breed was less stressed and therefore, loadtime tolerant than White Fulani cattle during loadtime periods.

Transport with fasting elicits mobilization of body nutrient and reduces body conditions and body weight (Becker *et al.*, 1989; Von Borell, 2001). In the present study, loadtime stress in combination with fasting associated with transport decreased plasma protein concentration at lower level (Fig. 2) and increased plasma Urea-N at higher levels (Fig. 3). Similar effect has been reported by Cole *et al.* (1986) and Kouakou *et al.* (1999). The authors also noted that stress in calves and goats due to feed deprivation caused protein breakdown that increased plasma Urea N concentration. Also, the decreases in plasma protein concentration at lower levels may partially explain the decrease in plasma calcium concentration observed in the present study. Stephens (1980) and Cole *et al.* (1987) reported that total plasma calcium was affected by the total plasma protein

Table 5: The magnitude of the increased/decreased in some Biochemical and cellular compositing in the blood of white fulani and sokoto gudali breeds of cattle when subjected to loadtime stress

			Holding		
Measurement	Breed	Loading	0 h	6 h	12 h
Biochemical					
Plasma glucose	WF	+2.83	+5.34	+14.50	+0.50
(mg dL^{-1})	SG	+0.67	+1.00	+0.33	0.67
Plasma protein	WF	-0.01	-0.06	-0.01	-0.08
(mg dL^{-1})	SG	-0.01	-0.04	-0.01	0.00
Plasma Urea-N	WF	+0.84	+5.66	+5.00	+10.84
(mg dL^{-1})	SG	0.67	+1.33	+2.17	+8.64
Plasma Calcium	WF	-0.09	-0.05	0.00	0.00
(mg dL^{-1})	SG	+0.07	0.00	-0.07	-0.02
Cellular composition					
Leukocyte	WF	-133.33	+433.33	-516.66	+1166.66
(mg dL^{-1})	SG	+166.67	-66.67	+150.00	-10.00
Neutrophils (%)	WF	+1.02	+2.27	+1.16	+1.31
	SG	+0.46	+0.42	+0.08	+3.73
Lymphocyte (%)	WF	-1.17	-2.84	-0.12	-1.21
	SG	-0.49	0.58	-0.10	+1.49
Eosinophils (%)	WF	+0.06	+0.17	+0.03	-0.22
	SG	+0.05	+0.08	-0.01	-0.01
Monocytes (%)	WF	+0.02	-0.02	0.00	-0.01
	SG	+0.03	-0.02	-0.02	-0.01
N:L	WF	+0.02	+0.10	+0.07	+0.06
	SG	+0.01	+0.02	+0.01	-0.02

(+) Increase; (-) Decrease; WF = White Fulani; SG = Sokoto Gudali

concentration was approximately 45-50% of the total plasma calcium was bound to plasma proteins. Accordingly, plasma calcium concentration decreases with hypoproteinaemia as a consequence of the possible reduced feed intake associated with transportation.

The magnitude of the increase in plasma Urea-N and the magnitude of the decrease in plasma protein and calcium concentrations in both breeds with the changes being in White Fulani than in Sokoto Gudali cattle (Table 5) might be attributed to the level of gasto-intestinal fill prior to the commencement of the journey (Philips *et al.*, 1991). Of particular importance in evaluating prolonged effect of stress are the number of leucocytes, including neutrophils, lymphocytes, eosinofhits and monocytes in the blood. In the present study, neutrophill (%) increased from the baseline value (51.73%) by the magnitude of 0.36, 1.35, 0.22 and 1.08%, while lymphocyte (%) decreased from preload value (48.21%) by the magnitude of 0.46, 1.46, 0.61 and 2.36 due to loading and unload time stress at holdtime periods (Table 4). A similar effect had been reported due to transportation stress in goat (Kannan *et al.*, 2000) and in cattle (Tarrant *et al.*, 1992). Another useful measures of the sustained effect of stress is the N:L ratio, which increased at higher magnitude due to unload time stress, in cattle at holdtime period (Table 4). Kegley *et al.* (1997) and Kannan *et al.* (2000) also observed an increased in N:L ratio with load time stress in goat and cattle, respectively.

The magnitude of the changes in eosimophil count (+0.15, +0.01 and -0.16%)due to transportation and unload time stress at hold time periods of 0,6 and 12 h agreed with the findings reported by Nwe *et al.* (1996) and Srikandakumar *et al.* (2003). The authors also noted a marked eosinopenia in Japanesse native and Spannish goats after the beginning of transport. Nwe *et al.* (1996), however noted that eosinopil (%) returned to baseline level 12 h after transportation, while Srikandakumar *et al.* (2003) reported that there was no decrease in the percentage of eosnopihils or monocyte due to transportation. However, in the present study, there was a marked decrease in the percentage of eosnophil or monocyte at 12 h holdtime period. The leucocyte profile observed in the present study could probably have an adverse effect on disease resistance in cattle. In the present study, the magnitude of the changes in leucocyte profile in both breed indicated that white Fulani cattle was more affected by loadtime stress as many of this breed were observed to be lying down immediately after transportation.

In addition, to stress due to loadtime procedure during transportation animals in the present study, were inevitably exposed to feed deprivation. These factors have direct negative effect on optimum production by reducing heat production and the energy available for maintenance and production (Verstegen, 1987; Plyaschenko and Sidorov, 1987; Von Borell, 2001). They also weaken significantly the body resistance to diseases by depressing cellular and humeral immunity. As a result, fatigue and strong depression, which occurred just immediately after the transport (0 h holdtime) became pronounced about 6 h of holding an some of the animals could be seen lying down. The observed changes in plasma concentration of glucose, protein, Urea N, calcium and leucocyte profile count were evidence of internal catabolism and are of particular importance in animals intended for slaughter. These measurements could indirectly indicated the amount of muscle damage and therefore, meat quality (Romans *et al*., 1994). Food animals slaughtered before or during the restorative phase can produce dark cutting meat (Warner *et al*., 1986; Apple *et al.*, 1995; Von Borell, 2001).

CONCLUSION

The procedures of loading and unloading during transportation of animal in Nigeria could be traumatic as evident in the present study. During the procedure, the animals were subjected to excessive noise level, kicking and pushing, long standing, while waiting to be loaded into the vehicle and feeding level which in combination, trigger off physical and psychic exertion on the animal body system. No matter how conducive the procedures of loading, the animal at loadtime must suffer some degree of stress (Gracey, 1986). Since, adverse effect of stress factors during loadtime periods could not be completely eliminated, it is pertinent to either prevent or minimize simultaneous action of these stress factors on the animal so as to reduce losses due to loadtime procedure in animals. This could be achieved by utilizing vehicles customized and optimized for animal transportation. It is therefore expected that this vehicles will have restraining devices with adequate feeding and watering mechanism and proper design of loading facilities.

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