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Seasonal and gender effects on serum lipid profile and enzyme activity of Muturu and Bunaji cattle in Benue and Ogun States

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Abstract:
Background: *Haematobiochemical studies is gives a good representation of physiological responses to health threat, environmental and nutritional cues. A detailed appraisal of the nutrition and health status of beef cattle in extensive management condition is a prerequisite for effective production of quality beef in the tropics. This method tends to be more economical and less invasive. Apart from veterinary uses of blood picture, it enables one to see weak points on the farm and it is a useful tool to improve the health, welfare and productivity of the animal. Currently in Nigeria, the available information on the serum chemistry of indigenous cattle with reference to seasonal influence is inadequate or tending to being obsolete. Even though these references are relatively important, the fact remains that apart from expanse of time, climate change due to global warming has evidently caused changes in the ambient climatic parameters, which affects directly the physiology of the animal and indirectly nutrient availability. These changes have also encourages the prevalence of disease causing organisms (ecto and endoparasites) which in turn causes changes in composition and constitution of the body fluid of animal. In addition, most of the information on cattle haematology is on epizootic prognosis of breeds other than the Muturu. Hence, the importance of haematological research to establish data that could present the influence of the current climatic challenges on cattle breeds.*
Materials and Methods: *Farmers' animals were used for the study. A total of four hundred and eighty (480) apparently healthy animals were sampled. Two hundred forty (240) mature cattle comprising of Muturu and Bunaji were sampled (per season). This is made up of thirty (30) of either gender in each season in Benue and Ogun States. The experiment was set in a 2×2×2×2 factorial format in a completely randomized design (CRD) with location, season, breed and gender as factors. Samples were collected via venipuncture, and five times at each location. Serum parameters analyzed were Triglyceride, Cholesterols, High density lipoprotein (HDL), Very low density lipoprotein (VLDL), Aspartate aminotransferase (AST), Alkaline Phosphatase (ALP), γ-GlutamylTransferase (GGT). Data collected were subjected to analysis of variance (ANOVA) and where significant differences occurred the mean was subjected to Duncan Multiple Range Test (DMRT).*
Results: *Mean serum triglycerides concentration obtained was significantly ($p<0.05$) higher value (32.03mg/dl) in the dry season at Ogun than in Benue State (23.73mg/dl). Cattle at Ogun State presented significantly ($p<0.05$) lower mean cholesterol concentration (102.14mg/dl) than all other observations. Mean cholesterol concentration in the wet season were higher ($p<0.05$) than cattle in the dry season. The mean concentration of HDL-C was affected by location while seasonal effect was observed in mean serum LDL-C concentration of cattle. Mean VLDL concentration followed the trend observed in mean triglycerides concentration. HDL: LDL ratio in dry season at Benue State was significantly ($P<0.05$) different from the values obtained at Ogun State in both seasons. It was observed that Muturu bulls presented higher ($p<0.05$) tryglycerides, LDL-C and VLDL than Bunaji bulls. It was observed that location influenced mean ALP and GGT activities. Muturu cattle showed significantly ($p<0.05$) higher mean ALT activity (22.13 and 22.50U/L) than Bunaji cattle (19.51 and 19.46U/L). Muturu also presented higher ($p<0.05$) mean GGT activity in the both season than Bunaji. Mean ALP and GGT activities were significantly higher ($p<0.05$) in both gender in Ogun state than those in the Benue state. Mean GGT activity was significantly ($p<0.05$) higher in both gender of Muturu than Bunaji cattle.*
Conclusion: *It can be concluded from the study that serum triglycerides, cholesterol, HDL-C, HDL: LDL ratio, ALP and GGT were affected by location while serum LDL-C was influenced by season. Gender also affected serum triglycerides, LDL-C and VLDL. Similarly, serum triglycerides, LDL-C, VLDL, ALT and GGT was influenced by breed of cattle.*

Key Words: *Lipids, Enzymes, Seasons, Muturu, Bunaji*

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I. Introduction

Haematobiochemical values during different environmental and physiological situations could be used for the diagnosis of various pathological and metabolic disorders, which can adversely affect the productive and reproductive performance of cattle, leading to heavy economic losses [1,2,3]. Serum cholesterol, non-esterified fatty acids and liver enzymes can be used objectively, reliably and routinely to assess the nutritional status of cattle [4]. In addition, serum enzymes levels are the determinants of response to stress in animals[5]. Cattle are a major source of animal protein supply in Nigeria. And[6] estimated cattle population in Nigeria to be about 15.2 million as at 2005. The zebu breeds (including Bunaji or white Fulani cattle) makes up a higher percentage and they are found in the drier north and sub-humid zones of the country. [7] noted that 8.3 percent of the total cattle population in Nigeria is of the muturu breed; which population is gradually going into extinction. The production system of Bunaji and Muturu breed differ; in that the former is more of the nomadic pattern while the latter is sedentary, almost always tethered at grazing spots and housed in the evenings. Location, season, breed and gender (sex) have influence on the animal physiology and productivity. So this study was to investigate the lipid profile and enzyme activity of these breed of cattle.

II. Materials and Methods

The experiment was carried out in Ogun and in Benue States of Nigeria. Abeokuta the capital city of Ogun State, is located in the rain forest zone on latitude 7°10′ North and longitude 3° 2′ East in the altitude of 76 meters above sea level (ASL), in the humid region of Nigeria. The mean relative humidity is 82% throughout the year [8]. The region has an average daily temperature of 34.7°C. The zone receives a mean precipitation of 1,112.7mm with a seasonal distribution of about 110.9mm in period of January-March, 462.1mm in April-June, 376.6mm in July-Sept and 163.1mm in October-December. Similarly, Makurdi the capital city of Benue State is situated in the guinea savanna belt of Nigeria. It lies on latitude 7° 45′ North and longitude 8°31′ East, at a height of 90 meters above sea level [9]. Meanambient temperature is between 22.3^0 C to 33.41^0 C [10];annual rainfall is between the months of April and October,and the mean is about 1244.3mm[11]. The annual mean relative humidity is 60.45% [12].

Farmers' animals were used for the experiment. A total of four hundred and eighty (480) apparently healthy cattles were used for the experiment. Two hundred forty (240) mature cattle comprising of Muturu and Bunaji were sampled (per season). This was made up of thirty (30) of either gender in each season in Benue and Ogun States.Animals sampled in each seasons were different. These animals were sourced throughout the two States of Nigeria as mentioned above and blood samples collected. Pregnancy status of the sampled cows was not determined.

The experiment is a symmetrical factorial (2×2×2×2) arrangement in a complete randomized design (CRD). The factors include two breed of cattle (Muturu and Bunaji), two locations (Benue and Ogun States), two seasons (Wet and Dry seasons) and two genders (Bulls and Cows). Data collected were subjected to analysis of variance (ANOVA) using [13] version 4 statistical software. Where significant differences occurred the mean was subjected to Duncan Multiple Range Test (DMRT) using SAS® (2009) version 9.2 statistical packages.

Linear equation:

$Y_{ijklm} = \mu + R_i + S_j + B_k + G_l + (SB)_{jk} + (SG)_{jl} + (BG)_{kl} + ((RSBG)_{ijkl} + \varepsilon_{ijklm}$

Y_{ijklm} – Trait of interest

μ - overall mean

R_i– fixed effect of ith location (i=Benue State, Ogun State)

S_j – fixed effect of jth season (j= dry and rainy season)

B_k – fixed effect of kthbreed (k=muturu, bunaji)

G_l – fixed effect of lth gender (l=bulls, cows)

$(SB)_{jk}$ -interaction of season and breed

$(SG)_{jl}$– interaction of season and location

$(BG)_{kl}$ – interaction of breed and location

$(RSBG)_{ijkl}$ – effect of interaction of ith location, jth season, kth breed and lth gender

ε_{ijklm} – residual random error (nid)

Where: Dry season = November- March

Rainy season = April- August

Five mililitres (ml) of blood sample was collected from the jugular vein of each animal by veinupuncture. The sample was collected into plain tube and serum was collected after separation. The serum so collected was preserved in the freezer at about -20°C and was analysed for biochemical parameters.The sera

wereanalyzed for the concentrations of triglycerides, cholesterol, and the activities of aspartate aminotransferase (AST), alanine aminotransferase (ALT), gamma-glutamyl-transferase (GGT), alkaline phosphatase (ALP), high density lipoprotein (HDL) using automated Humalizer®-3000. Agappe diagnostics®, Switzerland (www.agappeswiss.com), procedure for the chemistry of these parameters were used. Low density lipoprotein (LDL) were calculated as below.

LDL= Cholesterol - (Triglycerides⁄5 + HDL)

III. Results

Table no 1 showed the effect season and location on the lipid profile and enzyme activity of cattle. Mean serum triglycerides concentration obtainedwas significantly ($p<0.05$) higher value (32.03mg/dl) in the dry season at Ogunthan in Benue State (23.73mg/dl). It was observed that mean triglyceride concentration for cattle in both locations in the wet season were comparable. Cattle at Ogun State presented significantly ($p<0.05$) lower mean cholesterol concentration (102.14mg/dl) than all other observations. It was also observed that cattle at Benue State showed significantly ($p<0.05$) higher mean cholesterol concentration (120.07mg/dl) in the wet season than in the dry season (112.21mg/dl). But the mean cholesterol concentration obtained in both seasons for cattle in Benue State compared with concentration observed for cattle in the wet season at Ogun State. The mean concentration of HDL-C was similar for cattle at Benue State in both seasons and significantly ($p<0.05$) higher than their counterparts at Ogun State. Mean serum HDL-C concentrations of cattle at Ogun State were alsosimilar. The mean serum LDL-C concentration of cattle during the wet seasons in both location were significantly ($p<0.05$) higher (71.74mg/dl and 74.01mg/dl) than obtained in the dry season in both locations (65.13mg/dl and 64.64mg/dl).Mean VLDL concentration followed the trend observed in mean triglycerides concentration. HDL: LDL ratio also showed significant ($P<0.05$) variations across it treatment means. The mean ratio in dry season at Benue State was significantly ($P<0.05$) different from the values obtained at Ogun State in both seasons. However, the HDL: LDL ratio obtained in each location was comparable in both seasons.

Mean serum enzymes activities investigated depicted variations ($P<0.05$) among observations.Mean ALT activities of cattle at Ogun State in the wet season was significantly ($p<0.05$) higher (22.24U/L) than observed (19.73U/L) in the dry season, but both the values obtained in both season were comparableto observed cattle at Benue State in both seasons. Mean AST activity in cattle was found to be similar at Benue State in both seasons, likewise Ogun State. But cattle at Benue State in the wet season showed significantly ($P<0.05$) higher activity (96.08U/L) from those at Ogun State (90.69U/L) in the dry season. Serum ALP activity presented significantly ($P<0.05$) lower activity (17.95U/L) from other values observed in this study. GGT activity were similar ($p<0.05$) and higher in cattle sampled at Ogun State than the values obtained at Benue State.

Table no.1: Effect of location and Season interaction on serum biochemistry of cattle

	Benue		Ogun		
Parameters	Dry	Wet	Dry	Wet	SEM
Lipids (mg/dl)					
Triglycerides	23.73^{b}	27.85^{ab}	32.03^{a}	27.83^{ab}	1.55
Cholesterol	112.21^{b}	120.07^{a}	102.14^{c}	114.31^{ab}	2.20
HDL-C	42.33^{a}	42.77^{a}	38.26^{b}	34.74^{b}	1.54
LDL-C	65.13^{b}	71.74^{a}	64.64^{b}	74.01^{a}	2.35
VLDL	4.75^{b}	5.57^{ab}	6.40^{a}	5.57^{ab}	0.31
HDL:LDL ratio	1.04^{a}	0.85^{ab}	0.77^{bc}	0.58^{c}	0.09
Enzymes (U/L)					
ALT	21.30^{ab}	20.34^{ab}	19.73^{b}	22.24^{a}	0.65
AST	93.97^{ab}	96.08^{a}	90.69^{b}	93.94^{ab}	1.45
ALP	17.95^{b}	34.67^{a}	42.89^{a}	43.17^{a}	3.14
GGT	32.46^{b}	37.30^{b}	43.60^{a}	47.48^{a}	2.12

Key: HDL-C=High density lipoprotein cholesterol; LDL-C=Low density lipoprotein cholesterol; VLDL=Very low density lipoprotein; ALT=Alanine aminotransferase; AST=Aspartate transaminase; ALP= Alkaline phosphatase; GGT= Gamma glutamyltransferase; SEM= standard error of means. Means in the same row with different superscript(s) differ significantly ($P<0.05$).

Table no 2 shows location and breed effect on serum lipid profile and enzyme activity of cattle. It was observed that mean serum triglyceride concentration of Bunaji at Benue State (20.42mg/dl) was lower ($p<0.05$) than all other observations. Mean cholesterol concentrations (104.29mg/dl)obtained in Muturu at Ogun Statewas lower than all other observations.Similar means were observed for HDL-C concentration for both breeds at either locations. But mean concentration of HDL-C of Bunaji at Benue State (44.34U/L) was higher ($p<0.05$) than observed in Muturu (35.76U/L) at Ogun State. The means of LDL-C were not significantly ($P<0.05$) different. But VLDL concentration followed the same trend as serum triglycerides. HDL: LDL ratio (1.01) was

higher (p<0.05) in Bunaji at Benue State than Muturu (0.66) at Ogun State.

Enzyme activity showed that Muturu cattle had higher (p<0.05) serum ALT activity than Bunaji cattle in both locations. Muturu cattle in Benue State presented significantly (p<0.05) higher mean AST activity (96.37U/L) than Bunaji cattle (91.20U/L) in Ogun State. It was observed that cattle at Ogun State showed higher (p<0.05) mean ALP activity than found in cattle in Benue State. In addition, ALP activity of Bunaji cattle in Ogun State (49.54U/L) showed significantly (p<0.05) higher value than other observations. Mean GGT activity of muturu at either locations was significantly (p<0.05) higher than observed in Bunaji cattle in those locations. It was observed that cattle at Ogun State showed higher (p<0.05) mean GGT activity than those in Benue State.

Table no 2 Effect of location and breed on serum biochemistry of cattle

	Benue		Ogun		
Parameters	Bunaji	Muturu	Bunaji	Muturu	SEM
Lipids (mg/dl)					
Triglycerides	20.42^{b}	31.16^{a}	30.72^{a}	29.13^{a}	1.55
Cholesterol	114.15^{a}	112.20^{a}	118.13^{a}	104.29^{b}	2.20
HDL-C	44.34^{a}	40.76^{ab}	37.23^{bc}	35.76^{c}	1.54
LDL-C	65.73	71.14	68.78	69.87	2.35
VLDL	4.09^{b}	6.23^{a}	6.14^{a}	5.83^{a}	0.31
HDL:LDL	1.01^{a}	0.88^{ab}	0.69^{b}	0.66^{b}	0.087
Enzymes (U/L)					
ALT	19.51^{b}	22.13^{a}	19.46^{b}	22.50^{a}	0.65
AST	93.68^{ab}	96.37^{a}	91.20^{b}	93.43^{ab}	1.45
ALP	27.45^{c}	25.17^{c}	49.54^{a}	36.53^{b}	3.14
GGT	30.38^{c}	39.38^{b}	36.71^{b}	54.38^{a}	2.12

Key: HDL-C=High density lipoprotein cholesterol; LDL-C=Low density lipoproteincholesterol; VLDL=Very low density lipoprotein; ALT=Alanineaminotransferase; AST=Aspartate transaminase; ALP= Alkaline phosphatase; GGT= Gamma glutamyltransferase; SEM= standarderror of means. Means in the same row with different superscript(s) differ significantly (P<0.05).

The effect of season and breed on serum lipid profile and enzyme activity of cattle is presented in table no 3. It was found that mean serum triglyceride concentration for Muturu in the wet season (32.05mg/dl) was significantly (p<0.05) higher than observed (23.63mg/dl) in Bunaji in the same season. But concentration of triglyceride obtained in both breeds in the wet season were comparable with either breed in the dry season. Serum cholesterol concentrations were similar in both breeds in the wet season likewise in the wet season. But the serum cholesterol concentration in both breeds in the wet season higher (p<0.05) than their counterparts investigated in the dry season. Mean serum HDL-C did not show any variation (p>0.05). LDL-C fraction of lipoproteins showed that Muturu presented (68.70mg/dl) higher (p<0.05) mean value than Bunaji (61.10mg/dl) in the dry season. The concentration observed in Muturu in the dry season compared with the observation in both breeds in the wet season. Mean serum VLDL followed the same trend as observed in serum triglyceride. HDL: LDL ratio in Bunaji in the dry season was significantly (p<0.05) higher (0.96) than observed in Muturu (0.69) in the wet season.

Serum activity of ALT showed that Muturu in dry seasons (22.64U/L) wassignificantly (p<0.05) higherthan obtained in Bunaji in both seasons. Observation in the wet season showed that both breeds had comparable mean ALT activity. AST activity was observed to be similar for both breeds in the wet season and comparable to the value (95.39U/L) in Muturu during the dry season.But Bunaji in the dry showed lower (p<0.05) mean AST activity (89.28U/L) than other observations.Mean ALP activity of Bunaji (43.50U/L) in the wet season was higher (p<0.05) than other observations. Muturu had similar serum GGT activity across the seasons which were significantly (p<0.05) higher than values obtained Bunaji across the seasons.

Table no 3: Effect of season and breed interaction on serum biochemistry of cattle

	Dry		Wet		
Parameters	Bunaji	Muturu	Bunaji	Muturu	SEM
Lipids (mg/dl)					
Triglycerides	27.52^{ab}	28.24^{ab}	23.63^{b}	32.05^{a}	1.55
Cholesterol	108.35^{b}	106.00^{b}	117.97^{a}	116.42^{a}	2.20
HDL-C	41.78	38.81	39.79	37.72	1.54
LDL-C	61.10^{b}	68.70^{a}	73.50^{a}	72.30^{a}	2.35
VLDL	5.50^{ab}	5.65^{ab}	4.73^{b}	6.41^{a}	0.31
HDL:LDL	0.96^{a}	0.86^{ab}	0.74^{ab}	0.69^{b}	0.09
Enzymes (U/L)					
ALT	18.38^{c}	22.64^{a}	20.59^{b}	21.99^{ab}	0.65
AST	89.28^{b}	95.39^{a}	95.61^{a}	94.42^{a}	1.45
ALP	33.45^{b}	27.39^{b}	43.50^{a}	34.31^{b}	3.14

GGT	31.46[b]	44.60[a]	35.62[b]	49.16[a]	2.12

Key: HDL-C=High density lipoprotein cholesterol; LDL-C=Low density lipoprotein cholesterol; VLDL=Very low density lipoprotein; ALT=Alanine aminotransferase; AST=Aspartate transaminase; ALP= Alkaline phosphatase; GGT= Gamma glutamyltransferase; SEM= standard error of means. Means in the same row with different superscript(s) differ significantly (P<0.05).

Table no 4 shows the effect of location and gender interaction on serum lipid profile and enzyme activity of cattle. It was observed that mean triglyceride concentration was higher (p<0.05) in cows (32.05mg/dl) at Ogun State than bulls (23.63mg/dl). Values obtained at Ogun State for both gender compared with those from cattle at Benue State. Serum cholesterol concentration of both gender in Benue State were comparable and compared with the mean value (113.50mg/dl) observed in cows at Ogun State. Bulls in Benue showed significantly (p<0.05) lower mean cholesterol concentration (103.00mg/dl). Mean serum HDL-C concentration were similar for both gender at Benue State, likewise for both gender at Ogun State. But bulls at Benue State exhibited significantly (p<0.05) different mean (43.46mg/dl) from both gender at Ogun State.LDL-C did not differed (p<0.05) among observed means. The mean concentrations of VLDL in cattle showed that cows at Ogun State had higher (p<0.05) mean (6.21mg/dl) than cows in Benue State. Bulls in both location presented comparable means. Bulls in Benue showed significantly (p<0.05) higher mean (1.04) HDL: LDL ratio than both gender in Ogun State.

Enzyme activities showed that location and gender did not affect ALT significantly (p<0.05). AST activity in both gender of cattle at Benue State were comparable (p<0.05) likewise for cattle at Ogun State. But cows at Benue State showed significantly (P<0.05) higher serum AST activity than bulls at Ogun State. Mean ALP activity showed thatboth gender at Ogun State were comparable and significantly (P<0.05) higher activity than the mean ALP activity at Benue State in both gender. Mean GGT activity followed the same trend as ALP.

Table no 4: Effect of location and gender interaction on serum biochemistry of cattle

	Benue		Ogun		
Parameters	Bulls	Cows	Bulls	Cows	SEM
Lipids (mg/dl)					
Triglycerides	27.52[ab]	28.24[ab]	23.63[b]	32.05[a]	1.55
Cholesterol	117.40[a]	114.90[a]	103.00[b]	113.50[a]	2.20
HDL-C	43.46[a]	41.63[ab]	37.90[bc]	35.09[c]	1.54
LDL-C	68.40	68.40	66.50	72.2	2.35
VLDL	5.45[ab]	4.87[b]	5.76[ab]	6.21[a]	0.31
HDL:LDL	1.04[a]	0.85[ab]	0.72[b]	0.63[b]	0.09
Enzymes (U/L)					
ALT	21.57	20.07	20.38	21.58	0.65
AST	93.45[ab]	96.60[a]	91.72[b]	92.91[ab]	1.45
ALP	24.20[b]	28.40[b]	47.40[a]	38.70[a]	3.14
GGT	36.20[b]	33.60[b]	45.40[a]	45.70[a]	2.12

Key: HDL-C=High density lipoprotein cholesterol; LDL-C=Low density lipoprotein cholesterol; VLDL=Very low density lipoprotein; ALT=Alanine aminotransferase; AST=Aspartate transaminase; ALP= Alkaline phosphatase; GGT= Gamma glutamyl transferase; SEM= standarderror of means. Means in the same row with different superscript(s) differ significantly (P<0.05).

Table no 5 shows the influence of season on lipid profile and enzyme activity of cattle. Season or gender variations (p<0.05) were not observed with serum triglycerides concentration means. Serum cholesterol mean concentrations were similar for both genders of cattle in the wet season likewise in the dry season. Cows in the wet season on the other hand showed a value (118.02mg/dl) that was significantly (p<0.05) than from both gender in the dry season. HDL-C did not vary (p>0.05) with season and gender. Mean serum LDL-C concentration (75.41mg/dl) of cows in the wet season washigher (p<0.05) than in both gender in the dry season. It was also found that VLDL concentration did not vary (p>0.05) among observed means. HDL: LDL ratio showed that bulls in the dry season presented higher (p<0.05) mean (0.99) than cows (0.66) in the wet season. Both aforementioned compared with other observed means of HDL: LDL ratio.

Among enzymes studied, ALT and GGT were not affected (p<0.05) by season/gender interaction. AST activity was similar (p<0.05) in the wet season for both gender and comparable to observed activity in cows during the dry season. Bulls in the dry season, however, showed lower (p<0.05) mean (90.42U/L) than the values obtained in the wet season. It was found that ALP activity was similar (p<0.05) for both gender in the wet season but were significantly (p<0.05) higher than observed mean (28.21U/L) in cows during the dry season.

Table no 5: Effect of season and gender interaction on lipid profile and enzyme activity of cattle in Benue and Ogun States

	Dry		Wet		
Parameters	Bulls	Cows	Bulls	Cows	SEM
Lipids (mg/dl)					
Triglycerides	29.72	26.35	29.72	26.33	1.55
Cholesterol	103.95^{c}	110.39^{bc}	116.37^{ab}	118.02^{a}	2.20
HDL-C	40.61	39.98	40.76	36.74	1.54
LDL-C	64.56^{b}	65.21^{b}	70.35^{ab}	75.41^{a}	2.35
VLDL	5.94	5.21	5.27	5.87	0.31
HDL:LDL	0.99^{a}	0.82^{ab}	0.77^{ab}	0.66^{b}	0.09
Enzymes (U/L)					
ALT	20.41	20.61	21.56	21.08	0.65
AST	90.42^{b}	94.25^{ab}	94.75^{a}	95.27^{a}	1.45
ALP	32.63^{ab}	28.21^{b}	38.92^{a}	38.92^{a}	3.14
GGT	39.30	36.80	42.40	42.30	2.12

Key: HDL-C=High density lipoprotein cholesterol; LDL-C=Low density lipoprotein cholesterol; VLDL=Very low density lipoprotein; ALT=Alanine aminotransferase; AST=Aspartate transaminase; ALP= Alkaline phosphatase; GGT= Gamma glutamyltransferase; SEM= standard error of means. Means in the same row with different superscript(s) differ significantly (P<0.05).

Table no 6 shows the breed and gender interaction on serum lipid profile and enzyme activity of cattle. The results showed that mean triglycerides concentration of Muturu bulls (30.58mg/dl) was significantly (p<0.05) higher than observed in both gender of Bunaji cattle. However, the mean triglycerides concentration of Muturu cows (29.71mg/dl) compared with all observations. Serum cholesterol mean did not differ (p<0.05) with breed /gender interaction. HDL-C mean concentrations (42.31mg/dl) for Bunaji bulls was higher (p<0.05) than observed (37.47mg/dl) in Muturu cows. Similar (p<0.05) mean values were however, observed between genders and breeds. Both gender of Muturu showed similar (p<0.05) mean concentration of LDL-C which were higher (p<0.05) than the mean concentration (63.62mg/dl) observed in Bunaji bulls. Bunaji cows, however, presented mean concentration (69.72mg/dl) which compared to all other observations. It was observed that VLDL mean concentrations followed the same trend as in triglycerides. HDL: LDL ratio showed that the mean ratio (0.99) of Bunaji bulls was significantly (P<0.05) higher than their cows (0.72).But both observations in the serum of the Bunaji compared with the mean values of obtained in both gender of the Muturu.

Enzyme activity showed that the mean activity of ALT (23.08U/L) in muturu cows was significantly (p<0.05) higher than obtained in both gender of Bunaji (bulls=20.39U/L: cows= 18.58U/L). Bunaji and Muturu bulls showed comparable means (20.39U/L and 21.56U/L respectively). Bunaji cows presented the lowest (p<0.05) mean ALT activity. It was observed that the mean AST activity (95.31U/L) in Muturu cows was significantly (P<0.05) higher than obtained in Bunaji bulls (90.67U/L). But both gender of either breed of cattle presented comparable means.There was no significant (p>0.05) difference within the mean activity of ALP. Mean GGT activity was not gender sensitive in Muturu and Bunaji cattle. But the mean activity in both gender of Muturu were significantly (P<0.05) higherthan values obtained in both gender of Bunaji.

Table no 6 Effect of breed and gender interaction on serum biochemistry of cattle in Benue and Ogun States

	Bunaji		Muturu		
Parameters	Bulls	Cows	Bulls	Cows	SEM
Lipids (mg/dl)					
Triglycerides	25.47^{b}	25.68^{b}	30.58^{a}	29.71^{ab}	1.55
Cholesterol	111.00	115.30	109.30	113.10	2.20
HDL-C	42.31^{a}	39.25^{ab}	39.05^{ab}	37.47^{b}	1.54
LDL-C	63.62^{b}	69.72^{ab}	70.90^{a}	71.30^{a}	2.35
VLDL	5.09^{b}	5.14^{b}	6.12^{a}	5.94^{ab}	0.31
HDL:LDL	0.99^{a}	0.72^{b}	0.78^{ab}	0.77^{ab}	0.09
Enzymes (U/L)					
ALT	20.39^{b}	18.58^{c}	21.56^{ab}	23.08^{a}	0.65
AST	90.67^{b}	94.21^{ab}	94.49^{ab}	95.31^{a}	1.45
ALP	38.50	38.40	33.00	28.70	3.14
GGT	32.40^{b}	34.70^{b}	49.30^{a}	44.50^{a}	2.12

Key: HDL-C=High density lipoprotein cholesterol; LDL-C=Low density lipoprotein cholesterol; VLDL=Very low density lipoprotein; ALT=Alanine aminotransferase; AST=Aspartate transaminase; ALP= Alkaline phosphatase; GGT= Gamma glutamyltransferase;. SEM= standarderror of means. Means in the same row with different superscript(s) differ significantly (P<0.05).

IV. Discussion

Lipids, cholesterol and triglycerides are so important in the animal life and they are found in almost all parts of the body. Species and within species variation have been known to exist in serum triglycerides, cholesterols and lipoproteins concentrations among domestic animals [14]. Blood levels of these parameters are also known to be influenced by diseases such as trypanosomiasis[15], physiological status [16]. [17] demonstrated that triglycerides concentration lowered significantly in ketotic compared to healthy cows. The findings of this experiment were contrary to [18]who worked on multiparous Holstein cows.The variation noted between this study and the previous study could also be attributed to sex, breed or nutritional effect. The observed triglyceride concentrations in both locations were similar to the finding of [19] when high energy diet was fed to beef cattle. [20] affirmed that triglyceride is inversely proportional to HDL level, implying that increment in one means a decrease in the other. It has been shown that when blood triglycerides decreases there is a likelihood of it accumulating in the liver cells this hinders gluconeogensis which tends to hypoglycaemia in animals [21]. It was also found in this study that the mean concentration of serum HDL-C increased significantly while VLDL was lower at Benue State which was described by [22]as a case that occurs in the metabolism of VLDL. During the hydrolysis of triglycerides linked to VLDL, the protein moiety forms HDL, accounts for the high level of serum HDL. The cause of such lipomobilisation may be stress due to disease, starvation or other environmental factors. [18] mentioned high triglycerides value may be as result of the energy needs of the cattle, which occurs in the case of negative energy balance. [23] noted that cattle in certain physiological status (early lactation) may come into this situation when energy requirement exceeds feed consumption capacity. Furthermore, bovine liver is poor in the exportation of triglycerides affiliated with VLDL, hence when lipid uptake by hepatocytes exceed oxidation and the secretion of lipids, leading to triglycerides accumulation in the liver which results in impairment of hepatic metabolism. However, cases of mild and moderate fatty liver may not show any clinical signs and may be passed for other health and production related issues [23]. The report of 26.57mg/dl (healthy cows) and 34.54mg/dl (fatty liver cows) for tryglycerides[23] placed the cattle in this study on a relatively clinically healthy state.

The levels of cholesterol obtained in this study were within the range for cattle[24]. This values are lower than the findings of [16] for pregnant cows at various stages of gestation and dry unmated cows at various times. [15] reported a value of 77.2 ± 4.6mmol/L for cattle. [23] found the concentration of 181.85±1.17mg/dl (healthy cows) and 61.00±0.61mg/dl in fatty liver cows. About 1g/day of cholesterol is produced in the body and about 0.3g/day is obtained from feedstuff [25]. One of this two may have occurred in the cattle at Benue State: Feeds that has the propensity to be converted to cholesterol are been consumed by the cattle or the body is in active synthesis of cholesterol via acetyl-CoA produced by beta oxidation of fatty acids in the liver, intestine and almost all cells. Two molecules of Acetyl-CoA is condensed to form acetoacetyl-CoA, which reacts with another molecule of acetyl-CoA to form 3-hydroxy-3-methylglutaryl-CoA, after which mevalonate is synthesized. Mevalonate is a principal compound in a series of reactions that leads to the formation of cholesterol [25]. But it must be noted that cholesterol varies with species and within species [14]. It was also found that concentration of HDL-C was related to the concentration of cholesterol. HDL-C accounts for the majority of the blood cholesterol pool in cattle [26]. To this, [27]added that the serum HDL-C concentration is determined by the total cholesterol concentration because HDL-C includes cholesterol in its structure. The HDL-C observed in this study was lower than that which was reported; 93.35±8.9mg/dl [18]; 74.90±0.71mg/dl [23]. HDL-C concentration may be affected by esterification of cholesterol, unsaturated fatty acids or lactation [18].

LDL-C is the major transport vehicle for cholesterol in the blood [28]. Mean serum LDL-C in this study were relatively lower than the value obtained 105.02±1.17mg/dl [23].The observed concentration of very low density lipoprotein (VLDL) is comparable to the finding of [23] reported 5.44±0.05mg/dl. [29] noted that ruminants are susceptible to fatty liver because they basically have low ability to excrete VLDL from the liver. Increment in serum VLDL may be due to an increase rate of VLDL turnover. Hence the relatively high serum VLDL in cattle at Ogun State may be due to the increased movement of accumulated triglycerides from the liver to the peripheral tissues to reduce hepatic lipidosis. It was also found that HDL/LDL ratio were significant for cattle in Benue State. This ratio is a predicator of arteriosclerosis. A high HDL/LDL level leads to propensity of heart death [30].

Season has been found to affects cholesterol, low density lipoprotein (LDL-C) and the ratio of HDL/LDL but triglyceride, HDL-C and VLDL were not influenced. [31]demonstrated that season influenced cholesterol and triglycerides. Some percentage of cholesterol is acquired through diet. Sequel to this, it may be affirmed that feed and feed sources were available and utilizedby the breeds of cattle studied, in the wet season compared to the dry season, hence increase in serum cholesterol. The corresponding increased level of LDL-C affirms the higher concentration of cholesterol in the plasma since more of LDL-C will be needed to move it to the cells and tissues. [28] stated that LDL-C is the main transporter of cholesterol in the body. Breed differences were noticed in triglycerides and VLDL; Muturu cattle have higher concentration of both parameters than

Bunaji. The result of this work is at variance with the report of [20] since Muturu cattle had relatively high concentration of triglycerides and VLDL. But [27] observed that VLDL in dry cattle tends to increase significantly while other lipoprotein decreases. It was noted earlier that VLDL is a major transporter of triglycerides, to the peripheral organ and tissues such as adipose tissue, heart, and skeletal muscles via the plasma of meat animals. Hence it may be correlated that increase in serum triglycerides leads to increase in VLDL.It can be inferred from this study that gender has no influence on triglyceride and the other lipid fractions.

Enzymes are responsible for highly complex reactions and they direct the metabolic events and exhibit specificity toward substrates, regulate the entire metabolism [32]. The mean values of enzyme activities observed in this experiment were within the range [33;25]. [34] noted that ALT activity is not high in liver cells but it does increase due to physiological status. It is observed in this experiment that alanine transaminase (ALT) and aspartate transaminase (AST) were not affected by the location of the animal. But alkaline phosphatase (ALP) and gamma glutamyltransferase (GGT) were influence by location (Ogun). [35] has stated that enzyme activity of ALP is a quick and reliable blood marker for heat stress. [36] demonstrated that healthy cattle and cattle with histopathologically injured liver showed similarity in the level of AST while GGT varied among treatment means with the injured animals having a mean concentration of 23U/l as against 18U/l in the healthy animals. This Suggest that the cattle at Ogun State may be under some form of environmental or heat stress. A check with table 4 showed low cholesterol (108.20mg/dl) at Ogun State as against 116.10mg/dl at Benue State. Sometimes, in chronic hepatic disease the serum cholesterol concentration is abnormally low [36]. Though the level of cholesterol in this study is within normal range for cattle but the level of GGT is suggestiveof hepatic abnormality. Mean ALP in this study is at variance with 132.60±18.21U/l reported in non-lactating Frisian × Bunaji [37]. But the concentration of serum ALP can be influenced by Age [38]the physiological status [37] of the animal. [38] observed that ALP varies with growing cattle. [32] stated that increment of serum alkaline phosphatase could be due to vitamin D deficiency, congestive heart failure as a result of injury to the liver. [39] agreed that ALP could increase due to hepatotoxicity but noted that it is a protein which has antimicrobial activity. The liver enzymes (ALP and GGT) activity noticed coupled with cholesterol increment at Ogun State is suggestive of a challenge to the hepatic system. [34] attributed this to liver fat infiltration and liver metabolism condition.

Activity of serum enzymes were observed to vary with seasons. Some of the values obtained from cows in periparturient period and reported by [34] corresponded with the result of this work. But the activities of enzymes obtained in this work also differ from that reported for cows: ALT (34.0±3.0U/L); AST (72.4±7.1U/L); ALP (49.8±3.1U/L) and GGT (29.0±4.0U/L) [40]. The ALP activity in this work was similar to the finding of [16]that ALP varied with season. The activity of ALT though not significant was within the reference range (6.9 – 35U/l)[34]. In this work liver enzymes (ASTand ALP) were high in the wet season which is indicative of a hepatic challenge. In ruminants hepatic disease could be as result of plant toxicoses, worm (liver flukes) infections, clostridia diseases, mycotoxicosis, ingestion of toxic substances, mineral toxicosis, vitamin E or selenium deficiency bacterial hepatitis and ascarid migration [41]. Since varieties of organisms, materials and circumstances are more prevalent in the wet season; it may be asserted that these cattle studied had some form of pathogenic challenge.

Enzyme activity of cattle in Ogun state could be due to prevalence of pathogenic organism which may have challenged the hepatic system. Ogunstate lies in the humid rain forest of western Nigeria; which makes the location a thriving environment for microrganisms and their vectors.The values are within normal ranges for cattle [25]. Breed difference were also reported for Nguni and crossbred cattle for ALT, ALP and AST [42]. The elevation of GGT in the muturu at Ogun state may imply that the liver status of these animals may have been compromised. This is of note because GGT activity reflects liver impairment specifically in cattle, since there is a significant relationship between the severity of liver damage and serum GGT activity in ruminants [43]. Elevated serum GGT activity has been observed in sheep with severely impaired liver [44]. Gender effect on enzyme activitiesshowed that cows presented higher activity than bulls. It was observed that effect of season did not vary with gender. This corroborates the report of[45] that the enzyme (monooxygenase) activity in rat liver microsomes decreases with low-protein diet resulting in gender variation in enzyme activity. But [46] reported non influence of gender on enzyme (ALT, AST and ALP) in cattle. [47]investigating mountain reedbucks (*Redbunculafulvorufula*) found significant gender effect on the activity of serum ALT and AST. And[48] reported gender difference among angoni cattle.

V. Conclusion

It can be concluded from the study that serum triglycerides, cholesterol, HDL-C, HDL: LDL ratio, ALP and GGT were affected by location while serum LDL-C was influenced by season. Gender also affected serum triglycerides, LDL-C and VLDL. Similarly, serum triglycerides, LDL-C, VLDL, ALT and GGT was influenced by breed of cattle.

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