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Evaluation of Serum Biochemistry of Uda Rams Managed Under Different Housing Conditions and Season in Semi-arid region of Nigeria

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ABSTRACT

A study was conducted at the Usmanu Danfodiyo University, Sokoto, Livestock Teaching and Research Farm to evaluate the effects of housing type and season on the performance and some physiological parameters of Uda rams. A total of sixty (60) yearling Uda rams were used in the study with twenty (20) rams in each season. Factorial completely randomised design (3x5) was used in this experiment with animals (4) representing replicates while housing types (5) and season (3) representing the factors (treatments). Four animals were allotted to each housing types with each animal serving as replicate, the housing types were half wall with zinc roofing (HZ), half wall with thatch roofing (HT), full wall with zinc roofing (FZ), full wall with thatch roofing (FT) and finally natural without wall and roofing (N). At the end of each season blood was collected for analysis. The data generated were analysed. In the hot season, there was significant (P<0.05) variation in all parameters (albumin, globulin, total protein, HDL, LDL, triglycerides, creatinine, cholesterol, urea and glucose). In rainy season animals placed in N have significantly (P<0.05) higher values of total protein, globulin and urea, while those in HZ had higher (P<0.05) values of urea, total protein and globulin. In cold season, there was no significant (P>0.05) variation in of albumin, HDL, LDL, triglycerides and cholesterol. There was lower (P<0.05) globulin and creatinine for animals placed in FZ and HT respectively compared to the other housing types.

Keywords: Serum biochemistry, Uda rams, Housing, Season.

INTRODUCTION

Sheep production systems in Nigeria are as numerous as the socio-economic and varied agricultural situations in the country. The terms ‘production’ and ‘management’ systems are

used interchangeably by many authors (Akpa et al, 2006) to refer to means by which livestock are reared. Wilson (1991) grouped the production systems of sheep into two major types; these are traditional and modern. The two systems differ essentially in the use of main factors of production (Akpa et al., 1994), with traditional systems based mainly on land and labour, while modern systems have large capital requirements and generally lesser requirement for one of the other factors. An important impetus for the decision to house livestock comes from the experience that, by controlling the range of an animal's 'thermal environment' (itself an integral part of the interaction between the animal and its environment), productivity and reproductive efficiency can be increased.

From time immemorial blood has been regarded by humans as the essence of life, the seat of the soul and the progenitor of psychic and physical strength (Cetin *et al.,* 2009). Haematological and serum biochemical profiles provide reliable information on the health status of animals (Suchy *et al*., 2007; Cetin *et al*., 2009). They also reflect the responsiveness of an animal to its internal and external environments. Haematological tests have been widely used for the diagnosis of various livestock diseases (Tibbo *et al.,* 2008; Cetin *et al.,* 2009). The information obtained from blood parameters substantiates physical examination and, coupled with medical history, provide excellent basis for diagnosis of stress and diseases (Tibbo *et al*., 2004). Serum biochemical analyses are used to determine the level of heart attack, liver damage and to evaluate protein quality and amino acids utilization and stress in animals (Harper *et al*., 1999).

MATERIALS AND METHODS

Experimental Site

The study was conducted at the Teaching and Research Farm of the Department of Animal Science of Usmanu Danfodiyo University, Sokoto, Nigeria. The farm lies at longitude 5^{o} 27" E and latitude 13^{o} 08"N and at altitude of 266m above sea level, the readings were obtained from GNSS viewer software for androids. The average annual environmental temperature is 28.3^{o}C (82.9^{o} F). However, the maximum daytime temperature for most of the year are generally under 40^{o}C (104.0^{o}F). The low humidity of Sokoto state makes the heat bearable. Heat is more severe in the state in March and April, but the weather in the state is always cold in the mornings and hot in the afternoons except during the harmattan period (SSMIYSC, 2010). The rainy season starts from late May to October. Rainfall starts late and ends early with annual rainfall ranging between 500mm to 1,200mm (SSMIYSC, 2010). There are two major seasons in the state namely: wet and dry seasons. The dry season starts from October and last up to April and may extend to May or June. The wet season on the other hand begins in most part of the state in May and last up to September or October (SSMIYSC, 2010).

Experimental Design

A factorial design (3x5) was used in this experiment with number of animals representing replicates while housing types and season representing the factors (treatment combination). Four animals were allotted to each housing types with each animal serving as replicate. The weight of the animals was balanced between treatments. Five housing types were used; full wall with Zinc roofing (FZ), full wall with Thach roofing (FT), Half wall with zinc roofing (HZ), half wall with Thach roofing (HT) and without walls and shade (N). The FZ, FT, HZ, HT and N environments received 4 animals each.

Three studies, one each in a defined season was carried out to determine the effect of housing on performance and some physiological responses of Uda rams during different seasons. Season 1 (hot season) from March to June; here there is high temperature and low humidity, temperature may reach up to 41°C during the day, there is no rain usually, but we experience little drop during the last month of the period. Season 2 (wet season) from July to October; this season is characterised by low temperature and high humidity, it is the main season for vegetative growth, low temperature of 25°C and humidity may reach up to 85% and season 3 (cold season), from November to February, when the growth of vegetation stops, there is a low temperature (value) and low humidity.

Experimental Animals and their Management

Twenty (20) yearling rams aged by dentition (Dyce *et al*., 2002) in each season were used in this experiment, the animals were purchased from local markets around Sokoto state. The apparently healthy sheep were quarantined at the Livestock Teaching and Research Farm for 14 days for adaptation to new environment. The animals were diagnosed for possible infection or disease and treated before the commencement of the experiment. The feeding pens were cleaned regularly so also the feeding and water troughs every morning before feeding. The gross composition of the experimental feed is presented in Table 1.

Table 1: Gross Composition of the Experimental Diet

Ingredients (%)	**Diet**
Maize	17.00
Wheat offal	20.2
Cowpea husk	7.60
Cowpea haulms	17.20
Rice offal	12.45
Cotton seed cake	42.0
Salt	0.5
Total	100
Calculated chemical composition	
Energy (Kcal/Kg)	2514
Crude protein (%)	14
Crude fibre (%)	22.1

Blood Sample Collection

Blood (7mls) samples was collected at the end of each season from all the animals. The blood samples were aseptically collected via jugular venepuncture of each animal using separate sterilized disposable 20ml syringe and 23 gauge needle. The samples from each replicate were collected in plain tubes and were left at room temperature until red blood cells precipitate themselves to avoid rupture of thrombocytes due to centrifugation, where the serum will be above. The serum was used for serum biochemical analysis and hormonal assay of environmental related hormones such as cortisol.

Serum Chemistry

The plasma total protein was measured using biuret reaction according to the procedure of Savory and Sunderman (1968), while albumin was measured by colorimetric estimation using

sigma diagnostic kit according to the method described by Reinhold (1953). Globulin was obtained by calculating the difference of total protein and albumin. The serum enzyme, Aspartate aminotransferase (AST), Alanine aminotransferase (ALT) and alkaline phosphatase (ALP) were determined using photoelectric colorimeter as described by Duncan *et al*. (1994). Blood urea, nitrogen and creatinine levels were determined using photoelectric colorimeter as described by Gbore *et al*. (2006). Total cholesterol was evaluated as described by Baker *et al*. (2007).

Statistical Analysis

The data generated were subjected to analysis of variance with season and housing as the independent variables (Steel and Torrie, 1980), to determine their effects on other parameters, the interaction of season vs. housing was obtained. Duncan's multiple range test (DMRT) was used to express the difference between treatment means each.

RESULTS

Serum Biochemistry of Uda Rams During Hot, Rainy and Dry Seasons

Results on of serum biochemistry as influenced by the housing types and seasons is presented in Tables 2 to 4.

Table 2: Effect of housing types on serum chemistry of Uda sheep in the hot season

Parameters	Housing Type					SEM	Reference values*
	N	HT	HZ	FT	FZ		
Albumin (g/dl)	2.10^{c}	2.70^{b}	3.00^{a}	2.30^{c}	2.30^{c}	0.04	2.4-3
Globulin (g/dl)	3.90^{a}	3.90^{a}	3.70^{b}	3.63^{bc}	3.60^{c}	0.03	3.6-4.9
Total protein (g/dl)	6.00^{b}	6.60^{a}	6.70^{a}	5.97^{b}	5.90^{b}	0.05	6-7.9
HDL (mmol/L)	0.96	0.98	0.94	0.97	0.98	0.02	0.8-2.6
LDL (Mmol/L)	0.87	0.80	0.83	0.90	0.92	0.08	0.5-4.3
Triglycerides (Mmol/L)	0.57	0.60	0.58	0.60	0.59	0.06	0.5-2.8
Creatinine (umol/L)	100.00^{a}	70.00^{d}	75.00^{cd}	90.00^{b}	80.00^{c}	2.61	70-105
Cholesterol (mmol/L)	0.65^{c}	1.25^{b}	1.10^{b}	1.80^{a}	0.90^{bc}	0.13	1.05-1.5
Urea (mmol/L)	6.00^{a}	4.00^{b}	4.00^{b}	4.50^{b}	3.90^{b}	0.30	3-10
Glucose (Mmol/L)	3.07^{a}	1.97^{ab}	2.30^{b}	2.50^{ab}	2.93^{a}	0.20	1.7-3.6

a,b,c means in the same row with different superscripts are significant (P<0.05) different. N= without shade and walls, HT= Half wall with Thatch, HZ= Half wall with Zinc, FT= Full wall with Thatch, FZ= Full wall with Zinc. *source = (Elmhurst *et al*., 2002)

Table 3: Effect of housing types on serum chemistry of Uda sheep in the rainy season

Parameters	Housing Type					SEM	Reference values*
	N	HT	HZ	FT	FZ		
Albumin (g/dl)	2.40^{ab}	2.50^{a}	2.30^{b}	2.40^{ab}	3.00^{a}	0.04	2.4-3
Globulin (g/dl)	3.60^{c}	4.00^{b}	4.50^{a}	4.10^{b}	3.00^{d}	0.05	3.6-4.9
Total protein (g/dl)	6.00^{c}	6.50^{b}	6.80^{a}	6.50^{b}	6.00^{c}	0.05	6-7.9
HDL (mmol/L)	1.03	0.98	1.04	1.10	1.03	0.08	0.8-2.6
LDL (Mmol/L)	0.88	0.80	0.90	0.88	0.87	0.05	0.5-4.3
Triglycerides (Mmol/L)	0.70	0.70	0.68	0.69	0.70	0.06	0.5-2.8
Creatinine (umol/L)	71.50^{b}	72.70^{b}	75.00^{ab}	71.30^{b}	81.00^{a}	2.47	70-105
Cholesterol (mmol/L)	1.50^{a}	1.78^{a}	1.73^{a}	1.80^{a}	1.00^{b}	0.15	1.05-1.5

Urea (mmol/L)	6.60	6.60	6.00	8.30	5.30	1.02	3-10
Glucose (Mmol/L)	2.17^{bc}	1.90^{c}	2.47^{ab}	2.77^{a}	2.77^{a}	0.14	1.7-3.6

a,b,c means in the same row with different superscripts are significant (P<0.05) different. N= without shade and walls, HT= Half wall with Thatch, HZ= Half wall with Zinc, FT= Full wall with Thatch, FZ= Full wall with Zinc. *source = (Elmhurst *et al*., 2002)

Table 4: Effect of housing types on serum chemistry of Uda sheep in the cold season

Parameters	**Housing Type**					**SEM**	**Reference values***
	N	HT	HZ	FT	FZ		
Albumin (g/dl)	2.50	2.50	2.40	2.40	2.50	0.35	2.4-3
Globulin (g/dl)	5.0^{a}	4.80^{b}	5.00^{a}	4.80^{b}	4.00^{c}	0.02	3.6-4.9
Total protein (g/dl)	7.50^{a}	7.30^{bc}	7.40^{ab}	7.20^{c}	6.50^{d}	0.05	6-7.9
HDL (mmol/L)	1.10	1.00	1.03	1.10	0.96	0.03	0.8-2.6
LDL (Mmol/L)	0.88	0.80	0.85	0.70	0.89	0.07	0.5-4.3
Triglycerides (Mmol/L)	0.65	0.63	0.60	0.65	0.67	0.05	0.5-2.8
Creatinine (umol/L)	82.00^{a}	82.30^{b}	82.70^{b}	83.00^{b}	90.00^{a}	1.69	70-105
Cholesterol (mmol/L)	1.33	1.27	1.35	1.40	1.43	0.24	1.05-1.5
Urea (mmol/L)	7.00^{ab}	6.30^{b}	9.30^{a}	7.30^{ab}	7.70^{ab}	0.20	3-10
Glucose (Mmol/L)	2.57^{a}	1.83^{bc}	1.93^{b}	1.70^{c}	0.98^{d}	0.73	1.7-3.6

a,b,c means in the same row with different superscripts are significant (P<0.05) different. N= without shade and walls, HT= Half wall with Thatch, HZ= Half wall with Zinc, FT= Full wall with Thatch, FZ= Full wall with Zinc. *source = (Elmhurst *et al*., 2002)

In the hot season, there was significant (P<0.05) variation in all parameters (albumin, globulin, total protein, HDL, LDL, triglycerides, creatinine, cholesterol, urea and glucose). Albumin levels were below the normal range except for animals in HZ, so also in FT and FZ, the total protein was below the normal range, the cholesterol levels was below the normal range in N and FZ. Significantly higher (P<0.05) values of albumin, total protein, HDL were found for animals placed in HZ. Animals in HT had significantly (P<0.05) higher globulin and total protein. Those in FT had higher HDL, LDL and triglycerides. The animals placed in N had higher (P<0.05) values of globulin, triglycerides, creatinine, urea and glucose.

In the rainy season, there was significant (P<0.05) variation in terms of LDL and urea. All the parameters (albumin, globulin, total protein, HDL, LDL, triglycerides, creatinine, cholesterol, urea and glucose) were within the normal range values. Animals placed in N have significantly (P<0.05) higher values of total protein, globulin and urea, while those in HZ had higher (P<0.05) values of urea, total protein and globulin. FT and FZ are similar (P>0.05) in terms of glucose and urea. Higher creatinine levels was recorded in animals placed in FZ compared to other treatments.

In cold season, there was no significant (P>0.05) variation in of albumin, HDL, LDL, triglycerides and cholesterol. Animals placed in HZ had lower albumin levels while those in FZ had lower globulin. Higher albumin, total protein, HDL, creatinine, cholesterol and glucose were found in animals placed in HZ. Animals in FZ have significantly (P<0.05) lower albumin, globulin, total protein, HDL, LDL, triglycerides, cholesterol, urea and glucose. Animals in FZ had lower (P<0.05) glucose levels.

Main (overall) and Interactive Effect of Housing Types and Season on Serum Chemistry of Uda Sheep

The result (Table 5) showed significant variation (P<0.05) in albumin, globulin, total protein, HDL, triglycerides, creatinine, cholesterol and glucose). The result showed that animals placed in N had higher triglycerides compared to other treatments. Variation in albumin was observed between animals placed in HT, HZ and those in N. Animals placed in N had the lowest HDL. There was lower (P<0.05) globulin and creatinine for animals placed in FZ and HT respectively compared to the other housing types. Cholesterol was higher (P<0.05) for animals placed in FT compared to those placed in N and FZ.

The globulin, HDL and total protein were higher at cold season compared to rainy and hot seasons. Higher values (P<0.05) of LDL and creatinine was observed at rainy season compared to hot and cold season. There was lower values (P<0.05) of glucose and urea in the hot season than the rainy and cold season. No significant (P>0.05) difference observed between cold and rainy season and between cold and hot season in terms of cholesterol levels. There was significant interaction between housing types and seasons on cholesterol and urea levels of the experimental animal (Table 6).

Table 5: Serum biochemistry of Uda Rams as Influenced by main (overall) effect of Housing Type and Season

Parameter	Housing Type					SEM	Reference values
	N	HT	HZ	FT	FZ		
Albumin (g/dl)	2.33^{b}	2.57^{a}	2.58^{a}	2.38^{ab}	2.60^{a}	0.07	2.4-3
Globulin (g/dl)	4.17^{a}	4.23^{a}	4.40^{a}	4.18^{a}	3.53^{b}	0.17	3.6-4.9
Total protein (g/dl)	6.50^{ab}	6.80^{a}	6.98^{a}	6.56^{ab}	6.13^{b}	0.15	6-7.9
HDL (mmol/L)	1.03	0.99	1.00	1.06	0.99	0.06	0.8-2.6
LDL (Mmol/L)	0.85	0.80	0.86	0.83	0.89	0.05	0.5-4.3
Triglycerides (Mmol/L)	0.64	0.64	0.62	0.65	0.65	0.04	0.5-2.8
Creatinine (umol/L)	84.44^{a}	75.00^{b}	77.56^{ab}	81.22^{ab}	83.67^{a}	2.65	70-105
Cholesterol (mmol/L)	1.15^{b}	1.43^{ab}	1.39^{ab}	1.67^{a}	1.11^{b}	0.12	1.05-1.5
Urea (mmol/L)	6.56	5.67	6.44	6.72	5.63	0.65	3-10
Glucose (Mmol/L)	2.54^{a}	1.72^{b}	2.23^{ab}	2.32^{a}	2.46^{a}	0.17	1.7-3.6
Season							
	Hot Season		**Rainy season**		**Cold Season**		**SEM**
Albumin (g/dl)	2.49		2.53		2.46		0.06
Globulin (g/dl)	3.75^{b}		3.84^{b}		4.72^{a}		0.09
Total protein (g/dl)	6.23^{b}		6.37^{b}		7.18^{a}		0.09
HDL (mmol/L)	1.04		1.04		0.97		0.07
LDL (Mmol/L)	0.87		0.81		0.86		0.05
Triglycerides (Mmol/L)	0.69		0.64		0.59		0.05
Creatinine (umol/L)	83.00^{a}		74.27^{b}		83.87^{a}		1.86
Cholesterol (mmol/L)	1.14^{b}		1.56^{a}		1.35^{ab}		0.09
Urea (mmol/L)	4.48^{b}		6.60^{a}		7.53^{a}		0.38
Glucose (Mmol/L)	2.55^{a}		2.41^{a}		1.80^{b}		0.12

a,b,c means in the same row with different superscripts are significant (P<0.05) different. N= without shade and walls, HT= Half wall with Thatch, HZ= Half wall with Zinc, FT= Full wall with Thatch, FZ= Full wall with Zinc.
*source = (Elmhurst *et al*., 2002)

Table 6: Serum biochemistry of Uda Rams as Influenced by Interactive Effect of Housing Type and Season

Parameter	Level of significant
Albumin (g/dl)	NS
Globulin (g/dl)	NS
Total protein (g/dl)	NS
HDL (mmol/L)	NS
LDL (Mmol/L)	NS
Triglycerides (Mmol/L)	NS
Creatinine (umol/L)	NS
Cholesterol (mmol/L)	*
Urea (mmol/L)	*
Glucose (Mmol/L)	NS

NS = Not significant, * = P<0.05.

DISCUSSION

Effect of Housing and Season on Serum Chemistry

The result of this study found that total protein in the animals was low. This lowers the function on holding adequate percentage of water in the intra-vascular fluids and maintaining the viscosity of blood according to Harper *et al.* (1977). This was found for animals placed in FT and FZ during hot season due to stress caused by elevation of temperature leading to high total protein molecules degradation by excess dehydration caused by evaporative cooling. Cholesterol levels was below the normal range in animals placed in FZ in hot and cold seasons. This might be caused by dilution and the increase in total body water and decrease in acetate concentration, which is the primary precursor for the synthesis of cholesterol. The marked increase in glucocorticoid hormone level (in heat stressed animals) could be another factor causing decline in blood cholesterol. The studies show that glucose level was higher in the hot season compared to cold season. This conforms to the findings of Webster (1976) who found out that the increase in plasma glucose in hot conditions cause decrease in the glucose utilization, in addition to depression of both catabolic and anabolic enzyme secretions causing subsequent reduction of metabolic rate. This is contrary to the findings of Abd-El-Fattah (1988) who found that blood total protein was higher in hot season than in cold season. In the present study, it was found that seasonal differences in albumin contradict the findings of Baumagartner and Parnthaner (1994) and Marai *et al.* (1992). Results of the study further suggest that serum globulin are higher in cold season compared to hot and rainy seasons due to increase in either body water content or utilization of fatty acids for energy production as a consequence of a decrease in glucose concentration. Urea, and creatinine were also found to be higher during cold season compared to the hot season, decreased urea/creatinine and albumin/globulin ratios and increased albumin and creatinine levels may be due to low protein uptake and dehydration due to fluid loss (Yokus *et al*., 2006). The urea levels of the serum is within the normal reference range. This infers that the work rate of the liver and kidney of the animals are safe and normal.

Conclusion

Housing types and seasonal variations significantly influence the serum biochemical profiles of Uda rams. Rams without adequate shelter or housed in fully enclosed systems exhibited higher

glucose and creatinine, while seasonal temperature and humidity affected protein utilization and creatinine contents.

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