

## Changes in the serum proteins, hematological and some serum biochemical profiles in the gestation period in the Sahel goats

Mohammed A. Waziri<sup>1\*</sup>, Abdullahi Y. Ribadu<sup>2</sup>,  
and Nallatanby Sivachelvan<sup>3</sup>

<sup>1</sup>Department of Veterinary Surgery and Reproduction, University of Maiduguri, Nigeria

<sup>2</sup>Vice-Chancellor's Office, Federal University of Technology, Yola, Nigeria

<sup>3</sup>Department of Veterinary Anatomy, University of Maiduguri, Nigeria

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### ABSTRACT

The effects of pregnancy on haematological and some biochemical parameters were studied using 30 (25 pregnant of known gestational age, while five animals remained as cycling non-pregnant control) Sahel does aged between 1½ to 2½ years and managed under controlled conditions. Their weights ranged between 14 to 25 kg. Red blood cell and the white blood cell counts were the only haematological parameters that showed a significant ( $P<0.05$ ) difference between the non pregnant and pregnant does during the 16 and 20 weeks of pregnancy. While cholesterol increased ( $53.9 \text{ mg/dL} \pm 1.59$  to  $82.08 \text{ mg/dL} \pm 1.58$ ) significantly ( $P<0.05$ ), glucose decreased ( $68.33 \text{ mg/dL} \pm 1.21$  to  $45.74 \text{ mg/dL} \pm 1.58$ ) significantly ( $P<0.05$ ) from 12 weeks of gestation. There were no significant differences ( $P>0.05$ ) in the other biochemical parameters determined, namely: Na, Ka, Ca, Total proteins, FFA, Urea, Creatinine, AST, ALT, and Alkaline phosphatase. The present study indicates that haematological and mineral imbalances are unlikely to occur during pregnancy in Sahel does when properly managed.

**Key words:** Sahel, gestation, serum, biochemistry, haematology

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### Introduction

Examining blood for their constituents is used to monitor and evaluate health and nutritional status of animals (GUPTA et al., 2007). The significance and the great variation in the haematological and biochemical indices observed between breeds of goats has been well documented (AZAB and ABDEL-MAKSOU, 1999; TAMBUNWAL et al., 2002).

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\*Corresponding author:

Mohammed Ahmed Waziri, DVM, M.V.Sc., PhD, Department of Veterinary Surgery and Reproduction, University of Maiduguri, P.M.B. 1069, Maiduguri, Nigeria, Tel: +2348035974875; Fax: +076236387; E-mail: mohwaz@gmail.com

These differences have underscored the need to establish an appropriate physiological baseline values for various breeds of livestock including the Sahel goat which could be used in the realistic evaluation of the management practice, nutrition and diagnosis of health condition.

The Sahel goat, also known as the West Africa Long legged is found mainly in the arid and semi-arid Sahel regions of the North East and part of the Sudan savannah in Nigeria. The breed is adapted to the arid sub Saharan savannah regions and does not thrive well when taken to more humid areas. For this reason they are also referred to as 'desert' goats. The Borno white ecotypes are recognised by their physical appearance and performance (KWARI et al., 2004).

Nutrition, age, sex, genetics (breed and crossbreeding), reproductive status (pregnancy and oestrus), housing, starvation, environmental factors, stress and transportation are known to affect haematological and biochemical parameters (BALIKCI et al., 2007).

Much of the available information on the haematological and biochemical studies on the blood of normal goats in the humid tropics has been studied (TAIWO and ANOSA, 1995; IKHIMIOYA and IMASUEN, 2007). There is paucity of similar information on the Sahel goats. Among the few studies available are those of SANDABE and YAHY (2000) and SANDABE et al. (2004). Therefore, the aim of the present study was to assess and determine changes in some haematological and serum biochemical values for non pregnant and pregnant Sahel goats across the gestation period.

### Materials and methods

*Animals.* Thirty sexually mature and cycling Sahel does, and one Sahel buck aged between 1½ to 2½ years based on dentition (DYCE et al., 1987) was used for this study. Their weights ranged from 14 to 25 kg. The animals were kept in the research pen which is a large, roofed, enclosed and well ventilated area within the large animal clinic of the University of Maiduguri Veterinary Teaching Hospital. The animals were stabilized for 2 weeks. During the stabilization period, the animals were prophylactically treated with antibiotics (Terramycin® L.A.) given intra-muscularly at a dose rate of 20 mg/kg body weight and Ivermectin (Bimectin®) at 200 µg/kg body weight given sub-cutaneously to take care of internal and external parasites. They were fed on rations containing beans husk, groundnut haulms, maize bran, and wheat offal given *ad libitum*. Water was also given *ad libitum*.

*Experimental procedure.* Twenty-five of the Sahel does were synchronized with Estrumate® (Cloprostenol, a synthetic analogue of PGF<sub>2α</sub> given at 250 µg/mL, 11 days apart) and naturally served by a healthy and sexually active Sahel buck. Non-return to service was considered as an indication for conception. Twenty-five goats that became pregnant were grouped as pregnant, while five animals remained as cycling non-pregnant

control group. The animals were used within the limits of the International guiding principles for biomedical research involving animals (ANONYM., 1985)

*Sample analysis.* Blood (10 mL) was collected by jugular venipuncture of each animal using disposable syringes and sterile needles 18 gauge x 1½ inches, prior to feeding in the morning every week. The blood samples were placed in three vacutainers, one containing ethylene diamine tetra-acetic acid (EDTA) for haematologic study, another without anticoagulant for serum biochemistry, and another containing sodium oxalate fluoride for the determination of glucose levels.

Red blood cells (RBC) and white blood cells (WBC) were counted with haemocytometer. The packed cell volume (PCV) was determined using microhaematocrit method, while the haemoglobin concentration was determined by the cyanmethaemoglobin method. From the above data, the mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were calculated (SCHALM et al., 1986). Blood smears were stained with Giemsa stain for differential WBC counts.

The blood was allowed to clot, and then the serum was separated immediately by centrifugation at 1000g for 10 minutes. Sodium (Na<sup>+</sup>) and potassium (K<sup>+</sup>) concentrations were measured using the flame photometry. Total protein was estimated by the biuret reaction (PETERS et al., 1982); free fatty acids (FFA) were determined using colorimetric method (KANEKO, 1989); creatinine was determined by the Jaffe reaction method of SEATON and ALI (1984); urea in the serum samples were estimated using the diacetylmonoxime method as described by HAROLD (1988); the serum concentration of calcium and cholesterol were determined using the procedure described by KANEKO (1989); and the alanine transaminase (ALT), aspartate transaminase (AST) and alkaline phosphatase were determined colorimetrically using reagent kits (Randox Lab., Ltd., Co. Antrim, UK).

Sodium oxalate fluoride was used for glucose preservation. The blood glucose was determined by enzymatic colourimetric test (GOD-PAP method) QUIMICA CLINICA APLICADA, S.A. Kit.

*Statistical analysis.* The data were statistically analysed using analysis of variance (ANOVA). ANONYM. (1998) statistical computer software was used.

## Results

Table 1 shows the mean values of PCV, HB, RBC, WBC, Neutrophils, Monocytes, Lymphocytes, eosinophils, Basophils, MCV, MCH and MCHC in non pregnant and pregnant Sahel does at 4, 8, 12, 16 and 20 weeks. There were no statistically significant (P>0.05) variation in the mean values of the haematological parameters between the non pregnant and pregnant Sahel does, except in the values of RBC and WBC. The mean

values of the RBC and WBC, both increased significantly ( $P < 0.05$ ) at 16 and 20 week of gestation (third trimester).

The result for some biochemical profiles of the non pregnant and pregnant Sahel does at 4, 8, 12, 16 and 20 weeks are given in Table 2. There were no statistically significant ( $P > 0.05$ ) variation in the biochemical parameters between the non pregnant and pregnant Sahel does across gestation period, except in the mean values of cholesterol and glucose. There was a statistically significant ( $P < 0.05$ ) increase in the cholesterol level as from twelve weeks of gestation, while there was a statistically significant ( $P < 0.05$ ) decrease in the glucose level as from twelve weeks of the gestation period. There was an increasing trend in the calcium profile, but the increase was not statistically significant ( $P > 0.05$ ).

Table 1. Haematologic parameters (Mean  $\pm$  SEM) of non-pregnant and pregnant Sahel goats at 4, 8, 12, 16, and 20 weeks

Parameter	NP (30)	4 weeks (20)	8 weeks (20)	12 weeks (20)	16 weeks (20)	20 weeks (20)
PCV (%)	27.81 $\pm$ 1.32	28.61 $\pm$ 1.36	27.16 $\pm$ 1.01	27.30 $\pm$ 1.61	27.06 $\pm$ 1.36	28.95 $\pm$ 0.76
HB (g/dL)	9.86 $\pm$ 0.40	9.51 $\pm$ 0.48	9.03 $\pm$ 0.34	9.18 $\pm$ 0.47	9.0 $\pm$ 0.38	9.35 $\pm$ 0.26
RBC ( $\times 10^6/\mu\text{L}$ )	9.1 $\pm$ 0.36	11.54 $\pm$ 0.94	11.01 $\pm$ 0.96	10.33 $\pm$ 1.05	12.97 <sup>a</sup> $\pm$ 0.94	12.54 <sup>b</sup> $\pm$ 0.64
WBC ( $\times 10^6/\mu\text{L}$ )	9.42 $\pm$ 1.25	11.82 $\pm$ 0.95	11.84 $\pm$ 1.23	11.54 $\pm$ 1.19	13.89 <sup>a</sup> $\pm$ 1.03	13.08 <sup>b</sup> $\pm$ 0.65
Neutrophils ( $10^6/\mu\text{L}$ )	3.76 $\pm$ 0.82	4.65 $\pm$ 1.85	4.28 $\pm$ 1.45	4.98 $\pm$ 2.50	5.89 $\pm$ 2.35	5.66 $\pm$ 1.24
Monocytes ( $10^6/\mu\text{L}$ )	0.95 $\pm$ 0.06	1.14 $\pm$ 0.86	1.22 $\pm$ 1.12	1.13 $\pm$ 1.05	1.36 $\pm$ 0.93	1.41 $\pm$ 0.851
Lymphocytes ( $10^6/\mu\text{L}$ )	3.58 $\pm$ 1.34	4.55 $\pm$ 2.31	4.72 $\pm$ 2.51	3.82 $\pm$ 2.93	5.22 $\pm$ 2.93	4.88 $\pm$ 1.31
Eosinophils ( $10^6/\mu\text{L}$ )	1.20 $\pm$ 1.13	1.48 $\pm$ 1.17	1.69 $\pm$ 1.64	1.70 $\pm$ 0.99	1.93 $\pm$ 1.01	1.67 $\pm$ 0.75
Basophils ( $10^6/\mu\text{L}$ )	0.0 $\pm$ 0.0	0.0 $\pm$ 0.0	0.0 $\pm$ 0.0	0.0 $\pm$ 0.0	0.0 $\pm$ 0.0	0.0 $\pm$ 0.0
MCV (fL)	25.89 $\pm$ 1.50	26.79 $\pm$ 1.40	24.85 $\pm$ 0.92	28.15 $\pm$ 1.64	28.78 $\pm$ 1.52	27.97 $\pm$ 0.88
MCH (pg)	9.51 $\pm$ 0.85	9.01 $\pm$ 0.55	7.65 $\pm$ 0.23	9.63 $\pm$ 0.65	9.70 $\pm$ 0.60	8.31 $\pm$ 0.29
MCHC (g/dL)	33.47 $\pm$ 0.50	33.37 $\pm$ 0.57	30.76 $\pm$ 0.55	33.97 $\pm$ 0.53	33.58 $\pm$ 0.51	33.87 $\pm$ 0.55

Values within rows with different superscripts are statistically different ( $P < 0.05$ ) from the control (NP) ( ) Figures in parenthesis represents the sample size

Table 2. Some biochemical profiles (Mean  $\pm$  SEM) of non-pregnant and pregnant Sahel goats at 4, 8, 12, 16, and 20 weeks

Parameter	NP (30)	4 weeks (20)	8 weeks (20)	12 weeks (20)	16 weeks (20)	20 weeks (20)
Na (mmol/L)	143.6 $\pm$ 1.66	140.21 $\pm$ 0.97	143.89 $\pm$ 1.23	142.22 $\pm$ 0.88	142.71 $\pm$ 0.77	140.97 $\pm$ 1.02
Ka (mmol/L)	4.56 $\pm$ 0.12	4.70 $\pm$ 0.20	4.90 $\pm$ 0.33	5.30 $\pm$ 0.24	5.70 $\pm$ 0.43	5.40 $\pm$ 0.76
Ca (mmol/L)	8.94 $\pm$ 0.27	9.96 $\pm$ 0.35	9.97 $\pm$ 0.07	10.01 $\pm$ 0.46	10.96 $\pm$ 0.34	11.86 $\pm$ 0.55
T/protein (mg/dL)	6.37 $\pm$ 0.21	6.22 $\pm$ 0.19	6.40 $\pm$ 0.15	6.32 $\pm$ 0.12	6.42 $\pm$ 0.77	6.43 $\pm$ 0.87
FFA (uE/L)	368.64 $\pm$ 0.49	357.43 $\pm$ 0.44	362.33 $\pm$ 0.52	355.40 $\pm$ 0.93	363.43 $\pm$ 0.66	349.03 $\pm$ 0.54
Urea (mg/dL)	16.16 $\pm$ 0.86	16.02 $\pm$ 0.86	16.14 $\pm$ 0.76	16.09 $\pm$ 0.65	16.42 $\pm$ 0.66	16.11 $\pm$ 0.80
Creatinine (mg/dL)	0.9 $\pm$ 0.41	0.93 $\pm$ 0.36	0.95 $\pm$ 0.32	0.94 $\pm$ 0.62	0.95 $\pm$ 0.33	0.94 $\pm$ 0.92
AST (IU/L)	52.88 $\pm$ 2.73	54.32 $\pm$ 1.91	54.02 $\pm$ 1.01	53.12 $\pm$ 1.09	52.38 $\pm$ 1.91	53.32 $\pm$ 1.11
ALT (IU/L)	28.4 $\pm$ 1.59	29.30 $\pm$ 1.40	29.50 $\pm$ 0.77	29.08 $\pm$ 1.10	29.90 $\pm$ 1.78	28.70 $\pm$ 1.44
AP (IU/L)	46.72 $\pm$ 0.76	47.34 $\pm$ 0.52	47.03 $\pm$ 0.33	46.34 $\pm$ 0.50	46.84 $\pm$ 0.62	47.04 $\pm$ 0.22
Chol. (mg/dL)	53.9 <sup>a</sup> $\pm$ 1.59	54.49 <sup>a</sup> $\pm$ 1.48	55.07 <sup>a</sup> $\pm$ 1.04	66.89 <sup>b</sup> $\pm$ 0.90	75.44 <sup>c</sup> $\pm$ 1.06	82.08 <sup>d</sup> $\pm$ 1.58
Glucose (mg/dL)	68.33 <sup>a</sup> $\pm$ 1.21	70.04 <sup>a</sup> $\pm$ 1.19	69.27 <sup>a</sup> $\pm$ 1.16	62.24 <sup>b</sup> $\pm$ 1.11	46.24 <sup>c</sup> $\pm$ 0.80	45.74 <sup>d</sup> $\pm$ 1.58

Values within rows with different superscripts are statistically different ( $P < 0.05$ ) from the control (NP); ( ) Figures in parenthesis represents the sample size

### Discussion

The mean haemoglobin concentration, haematocrit and erythrocyte in Sahel goats, in the present study, are comparable to the mean values reported in other goat breeds (ODUYE, 1976; PAYNE et al., 1982; POSPISIL et al., 1987; MBASSA and POULSEN, 1993). The significant ( $P < 0.05$ ) increase in the erythrocyte values observed between 16 and 20 weeks of gestation are consistent with the previous report of SANDABE and YAHY (2000) who noted a significant difference in the erythrocyte values between the pregnant and non pregnant Sahel does.

The mean MCV, MCH and MCHC in the Sahel does are also in agreement with those of other goats (MASONI et al., 1985; MBASSA and POULSEN, 1993). In the present study there was no significant ( $P>0.05$ ) variation of these values amongst the non pregnant and the pregnant ones at the various stages of gestation. This is not in total agreement with the previous report of SANDABE and YAHY (2000) who observed a significant decrease in the MCV of pregnant Sahel goats. This may be attributable to variations in ages, sample size, project design and environmental changes (KAMALU et al., 1988).

The total leukocyte counts observed in the present study were close to those reported in other breeds (ODUYE, 1976, VRZGULA et al., 1985). The significant increase in the leukocytes count observed between 16 and 20 weeks of gestation is consistent with the previous reports of FORTAGNE and SCHAFER (1989) who reported an increase in the total leukocyte count in pregnant goats around parturition, and SANDABE and YAHY (2000) who also noted a significant increase in the leukocyte count of pregnant Sahel goats. This could be due to increase in the bone marrow activity as well as, pregnancy stress. According to DELLMANN and BROWN (1987) the stress probably stimulate the release of certain factors called leucocytosis inducing factor (LIF) and colony stimulating factors (CSF) which are known to increase haemopoietic activities and blood cells mobilization into circulation.

The majority of leucocytes in the present study were neutrophils and lymphocytes. PAYNE et al. (1982) and MBASSA and POULSEN (1993) found similar results. However, in some breeds of goats neutrophilic granulocytes predominate over other types of leukocytes (BIALKOWSKI et al., 1988). This could be due to influence of breed, temperatures and environment as well as the fact that, these leukocytic cells are produced independently of each other according to body's demands and health status.

The values of Na, K and Ca obtained in the present study are comparable with the normal values reported for goats (KADZERE et al., 1996). However, the observed increasing trend of Ca as the pregnancy advanced, agrees with the works of SYKES and DINGWALL (1975) and KADZERE et al. (1996). According to KADZERE et al. (1996) the requirements of Ca for pregnancy and lactation are higher than those for maintenance, which increases the quantity of Ca required at tissue level and thereby increase Ca absorption from the gastro-intestinal tract of sheep and goats. GEORGIEVSKII et al. (1982) attributed the rising level of plasma Ca in gestation and lactation to high level of plasma parathyroid hormone in this period which activates osteoclasts and increase the level of calcaemia to mobilise skeletal Ca reserves. Mobilisation is necessary to meet high Ca demand by the foetus for skeletal formation and for milk formation during lactation (FREDEEN and VAN KESSEL, 1990).

In the present study, the values of total proteins and free fatty acids (FFA) were comparable to those of other breeds of goats (KAMALU et al., 1988). There was no

significant variation in the FFA concentrations between the non pregnant and the pregnant ones at various stages of pregnancy. The FFA is the primary source of ketones in the event of under nutrition. According to VALDEZ et al. (1977), a reduction in daily energy intake resulted in an increased concentration of FFA; consequently high demand for energy intake during gestation could result in the mobilisation of fats from adipose tissues and consequent elevation of FFA. This indicated that the animals in this study were not underfed. Similarly, the values of Urea, Creatinine, AST, ALT and Alkaline phosphatase were in agreement with the report of KAMALU et al. (1988). This indicated that during pregnancy, the kidneys (urea and creatinine) and the liver (AST, ALT) were not clinically affected.

The cholesterol levels of Sahel goats were comparable to other breeds of goats (KAMALU et al., 1988). However, the cholesterol concentration increased as pregnancy advanced. The increase became significant ( $P<0.05$ ) as from 12 weeks up to 20 weeks. This is consistent with the previous reports of STARH (1977) and SANDABE et al. (2004). TIETZ (1994) attributed the increase in cholesterol to the physiological alteration of endocrine function. Also, the result of the present study showed the serum levels of glucose in non pregnant Sahel goats are comparable to the other breeds of goats (KAMALU et al., 1988). However, the glucose levels decrease as pregnancy advanced. The decrease became significant ( $P<0.05$ ) as from 12 weeks up to 20 weeks. According to SANDABE et al. (2004), glucose utilization in goats behaves in similar fashion with that of sheep. STEEL and LENG (1973) observed that irreversible loss of glucose increased progressively with the stage of gestation in sheep fed to appetite and maintained on a constant intake throughout pregnancy. This could be attributed to the considerable glucose requirements for nutrition in pregnant animals (PARR et al., 1984), as well as due to differences in permeability and utilization of blood glucose by pregnant and non pregnant goats (BOST and MAGAT, 1975). Further more the significant increase of cholesterol observed in the present study could also be a factor contributing to inhibiting glucose synthesis or, could be responsible for enhancing glucose uptake by the body cells.

In conclusion, the present study has indicated that haematological and mineral imbalances are unlikely to occur during pregnancy in Sahel does when properly managed. This suggests that the goat has a great ability to counteract pregnancy related physiological stress.

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**WAZIRI, M. A., A. Y. RIBADU, N. SIVACHELVAN: Promjene serumskih proteina, hematološki i neki biokemijski pokazatelji u sahelске коze tijekom бредости. *Vet. arhiv* 80, 215-224, 2010.**

**SAŽETAK**

Učinci бредости на hematološke i неке biokemijske pokazatelje истраžени су на 30 (25 бредих s познатим трајањем бредости i пет контролних небредих) sahelских коза u dobi od 1,5 do 2,5 godine držanih pod kontroliranim uvjetima. Njihove mase kretale su se od 14 do 25 kg. Od hematoloških pokazatelja jedino je broj crvenih krvnih stanica i broj bijelih krvnih stanica bio značajno promijenjen ( $P < 0,05$ ) u бредих коза u odnosu na one koje nisu bile бреде, i to u razdoblju od 16 i 20 tjedana бредости. Dok se koncentracija kolesterola značajno povećala ( $53,9 \text{ mg/dL} \pm 1,59$  na  $82,08 \text{ mg/dL} \pm 1,58$ ;  $P < 0,05$ ), koncentracija glukoze se značajno smanjila ( $68,33 \text{ mg/dL} \pm 1,21$  na  $45,74 \text{ mg/dL} \pm 1,58$ ;  $P < 0,05$ ) od 12 tjedana бредости. Nisu bile ustanovljene značajne razlike ( $P > 0,05$ ) u koncentraciji drugih određivanih biokemijskih pokazatelja: Na, K, Ca, ukupnih proteina, FFA, mokraćevine, kreatinina, aspartatne aminotransferaze (AST), alaninske aminotransferaze (ALT) i alkalne fosfataze. Истраžивање показује да се tijekom бредости правилно држаних sahelских коза не јављају промјене hematoloških показатеља i садржаја минерала.

**Кljučне riječi:** sahelске коze, бредост, serum, biokemija, hematologija

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