



**RESEARCH ARTICLE**

**Effect of Gonadotrophin (Pergonal®) on Erythrocyte Indices, Serum Protein Values and Liver/Kidney Functions of Mature West African Dwarf Rams Treated for Sperm Production**

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**ABSTRACT**

Three groups of 6 healthy West African dwarf rams aged 2.0-2.6 years were assigned to either 16.50i.u. Pergonal (T<sub>2</sub>), 33.00i.u. Pergonal (T<sub>3</sub>) or 49.50i.u.Pergonal (T<sub>4</sub>) injections (of Ferring Labs., USA), each divided into 3 doses and given for 3 consecutive days. Another group of 6 rams was given normal saline (1.00ml) during the same period to serve as control (T<sub>1</sub>). All treatments were given to study the effect of the drug on erythrocyte indices, serum protein values, liver and kidney functions. All the treatments were given by intramuscular injection. The results showed significant differences (P<0.05) among the treatment groups in packed cell volume (PCV), haemoglobin (HB) and mean corpuscular volume (MCV) values. However, there were no significant differences (P>0.05) among the treatment groups in red blood cells (RBC), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) values. The results further showed that there were significant differences (P<0.05) among the treatment groups in serum total protein, albumin and globulin values, and albumin-globulin ratio. The result also showed that there were significant differences (P<0.05) among the treatment groups in sodium, potassium, chloride, bicarbonate, creatinine, Alkaline phosphatase, Aspartate transaminase and Alanine transaminase values. The results of this study showed that apart from RBC, MCH and MCHC, the PCV, HB, MCV and serum protein values, liver and kidney functions of West African Dwarf rams may be affected when 16.50 i.u or more of Pergonal are used for induction of spermatogenesis and so should be constantly monitored.

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**INTRODUCTION**

The West African dwarf (WAD) sheep is a hardy animal with a compact body, small and short-legged. It is predominantly found in the humid zone of southern Nigeria. It is the smallest of the Nigerian breeds with a mature body weight of about 15 to 25kg in ewes and 20 - 30kg in rams (Oni, 2002). The breed is believed to be tolerant to trypanosomes because they survive in the heavily tse-tse flies infected forest areas of Southern Nigeria (Adu and Ngere, 1979).

The significance of determining hematological and serum biochemical indices of domestic animals have been well documented (Obi and Anoso, 1980; Coles, 1986; Taiwo and Anosa, 1988). Similarly Various reports: (Kalamu *et al.*, 1988; Aba-Adulugba and Joshua, 1990;

Esiewo and Moor, 1990; Taiwo and Ogunsami, 2003; Nottidge *et al.*, 1999; Egbe-Nwiiyi *et al.*, 2000; Iheukwumere *et al.*, 2001 ;Iheukwumere *et al.*, 2004; Iheukwumere *et al.*, 2006; Iheukwumere *et al.*, 2008; Oguike and Ude, 2008) have documented hematological and serum biochemical parameters of domestic species in Nigeria. However, only a few were on sheep particularly the WAD sheep raised in the southern part of Nigeria. Hematological responsiveness of the animal to its external and internal environments may serve as a veritable tool for use in monitoring animal health and nutritional status (Iheukwumere and okoli, 2002; Esonu *et al.*, 2001; Churias, 2002).

Human Gonadotrophin (Pergonal®), a fertility drug (Ferring Labs., USA) also known as Humagon or Menthrophin with similar constituents like Pulsset® is

Gonadotrophin lyophilized in vials containing a mixture of follicle stimulating hormone (FSH) and Luteinizing hormone (LH) in a ratio 1:1 (Dixon and Hopkins, 1996). Follicle stimulating hormone and LH present in Pergonal play vital roles in the initiation of spermatogenesis (Abu *et al.*, 2006).

The hormone preparation is cheap, readily available and does not require cold chain storage (Iheukwumere, 2005). It has not been determined if the administration of the hormone preparation for spermatogenesis would induce any side effects on erythrocyte indices, liver and kidney functions and other functions of the treated animals as deviation from normal values may affect the physiological status of the animals and consequently their performance.

## MATERIALS AND METHODS

### Experimental animal and their management

Twenty-four healthy, sexually matured West Africa Dwarf rams aged 2-2.6 years were used for this study. The animals were purchased from the local markets and housed in clean pens constructed in such a way that the rams could come outside during the day for access to sunlight and forage. The animals were dewormed and routine inspection for cleanliness was carried out. Freshly cut forage (*Panicum maximum*, *Aspiliaafricana* and *Pennisetumpurpleum*) was supplied as basal diet and a concentrate ration of Grower's mash was used as supplement. The animals were fed twice daily, in the morning and evening. Salt lick was provided as mineral supplement. Water was given *ad libitum* to the animals.

### Experimental design and drug administration

Twenty-four WAD rams were divided into 4 treatment groups consisting of 6 rams per group with one ram per replicate in a Completely Randomized Design (CRD). These groups were assigned to 4 levels of Pergonal as treatments. The levels of Pergonal were 0.00, 0.11, 0.22 and 0.33ml Pergonal<sup>®</sup> represented as T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> respectively. T<sub>1</sub> which contained no Pergonal served as the control.

Pergonal was supplied in 5 vials, each vial containing FSH 75 I.U and LH 75 I.U. The content of the first vial was dissolved in 1ml of physiological saline solution immediately prior to use, resulting in a solution of Pergonal-follicle stimulating hormone (75 I.U) plus Pergonal-luteinizing hormone (75 I.U) per ml.

The injections were given as follows:

**Group T<sub>1</sub>:** Each ram received 1.00ml of physiological saline for 3 days.

**Group T<sub>2</sub>:** Each ram received 2.75 I.U of PFSH and 2.75 I.U of PLH (0.036ml) on the first day. Second day, the group received 2.75 I.U of PFSH and 2.75 I.U of PLH (0.036ml), while on the 3<sup>rd</sup> day, the group received 2.75 I.U of PFSH and 2.75 I.U of PLH (0.036ml) giving a total of 16.50 I.U of PFSH and PLH (0.11ml) Pergonal<sup>®</sup> injections within 3 days.

**Group T<sub>3</sub>:** Each ram received 5.50 I.U of PFSH and 5.50 I.U of PLH (0.073ml) on the first day. Second day, the group received 5.50 I.U of PFSH and 5.50 I.U of LH (0.074ml), while on the 3<sup>rd</sup> day, the group received 5.50

I.U of DFSH and 5.50 I.U of DLH (0.073ml) giving a total of 33.00 I.U of PFSH and PLH (0.22ml) Pergonal<sup>®</sup> injections within 3 days.

**Group T<sub>4</sub>:** Each ram received 8.25 I.U of PFSH and 8.25 I.U of PLH (0.11ml) on the first day. Second day, the group received 8.25 I.U of PFSH and 8.25 I.U of PLH (0.11ml), while on the 3<sup>rd</sup> day, the group received 8.25 I.U of PFSH and 8.25 I.U of PLH (0.11ml) giving a total of 49.50 I.U of PFSH and PLH (0.33ml) Pergonal<sup>®</sup> injections within 3 days.

All treatments were administered intramuscularly on the hind leg (thigh) of each ram using a one ml syringe with 0.01ml graduation.

### Blood collection and haematological evaluation

The rams were bled one week after Pergonal injection between 9am and 10.30am from a punctured jugular vein and aspirated about 12ml of blood from each ram. Two milliliters of each blood sample were poured into Bijou bottles containing ethylene diamine tetra-acetic acid (EDTA) for haematological evaluation. The remaining 10ml of each blood sample were allowed to coagulate to produce sera for blood chemistry analysis. Blood samples were analysed within 2 hours of their collection for packed cell volume (PCV), haemoglobin (Hb). Erythrocyte or red blood cells were determined as described by Jain (1986). Erythrocyte count was done in a haemocytometer chamber placed under a light microscope. Packed cell volume was determined by the microhaematocrit method (Jain, 1986) with 75 x 16mm capillary tubes filled with blood and centrifuged at 3000 rpm for 5 minutes. Haemoglobin concentration was also determined by the cyanmethemoglobin method (Jane, 1986). The various red cell indices like MCH, MCHC and MCV were calculated from RBC, HB and PCV (Lazzaro, 2003).

### Serum Biochemical Evaluation

The bottles of coagulated blood were subjected to standard methods of serum separation and the harvested sera were used for biochemical evaluation. Creatinine concentration was determined following methods described by Baker and Silverton (1986). The standard flame photometry using Gallenkamp analysis was used to determine serum sodium (Na<sup>+</sup>) ion and potassium (k<sup>+</sup>) ion. While bicarbonate and chloride ions were assayed according to the methods of Baker and Silverton (1986). Alkaline phosphatase, Aspartate transaminase and Alanine transaminase activities were determined using spectrophotometric method as described by Rej and Hoder (1983). Serum total protein was determined by Goldbery refractometer method as described by Kohn and Allen (1995). Albumin and globulin concentrations were determined using bromocresol green (BCG) method as described by Randox (2006).

### Data analysis

Data collected on erythrocyte indices and serum biochemical parameters of WAD rams were subjected to one-way analysis of variance (ANOVA) using the technique of steel and Torrie (1980). Significant treatment means were separated using Duncan's New Multiple Range Test as described by Obi (1990).

## RESULTS AND DISCUSSION

The results of gonadotrophin (Pergonal<sup>®</sup>) administration on erythrocyte indices of West African dwarf rams are shown in Table 1. There were significant differences ( $P < 0.05$ ) among the treatment groups in packed cell volume (PCV), haemoglobin (Hb) and mean corpuscular volume (MCV). However, there were no significant differences ( $P > 0.05$ ) among the treatment groups in red blood cell (RBC), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) values.

**Table 1:** Effect of Pergonal<sup>®</sup> on Erythrocyte Indices of WAD Rams

Parameters	Treatment (Pergonal <sup>(R)</sup> i.u)				SEM
	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>	
PCV (%)	0.00	16.50	33.00	49.50	1.85
Hb (g/dl)	40.25 <sup>b</sup>	46.00 <sup>a</sup>	48.25 <sup>a</sup>	48.00 <sup>a</sup>	0.84
RBC ( $\times 10^{12}/L$ )	13.40 <sup>b</sup>	14.58 <sup>a</sup>	16.25 <sup>a</sup>	16.05 <sup>a</sup>	0.34
MCH (pg)	4.48	4.85	5.35	5.30	0.34
MCHC (g/dl)	84.25 <sup>b</sup>	90.00 <sup>a</sup>	90.50 <sup>a</sup>	90.40 <sup>a</sup>	1.52
MCH (pg)	30.00	30.00	30.00	30.00	0.00
MCHC (g/dl)	33.30	33.33	33.33	33.33	0.01

<sup>ab</sup>Means in the same row with different superscript are significantly ( $P < 0.05$ ) different. SEM = Standard error of mean.

Rams on T<sub>3</sub> and T<sub>4</sub> recorded the highest value in PCV 48.00% and this differed significantly ( $P < 0.05$ ) from rams on T<sub>1</sub>. There were no significant differences ( $P > 0.05$ ) among rams on T<sub>3</sub>, T<sub>4</sub> and T<sub>2</sub> in PCV values. The lowest value in PCV was observed in rams on T<sub>1</sub> (40.25%). The PCV values obtained in the Pergonal treated groups were higher than the normal range of 27-45.0 (%) reported in sheep by Radostits *et al.* (1997), and higher than the values 44.33% reported in West African Dwarf sheep by Oguike and Ude (2008) and 35.5% reported by Taiwo and Ogunsami (2003) in WAD sheep, and the range 31.30%  $\pm$  1.30-37.80  $\pm$  2.20% reported by Adenkola and Ayo (2007) in WAD sheep. This disparity in the results of Oguike and Ude (2008) may not be unconnected to the differences in the sex and physiological status of these WAD sheep since their study was on lactation in WAD ewes.

Rams on T<sub>3</sub> recorded the highest value in haemoglobin 16.25(g/dl) and this differed significantly ( $P < 0.05$ ) from rams on T<sub>1</sub>. There were no significant differences ( $P < 0.05$ ) among rams on T<sub>3</sub>, T<sub>4</sub> and T<sub>2</sub> in haemoglobin values. The lowest value in haemoglobin was observed in rams on T<sub>1</sub> (13.40g/dl). The hemoglobin values obtained in this study were higher than the range of 10.40  $\pm$  0.40 (g/dl) - 12.60  $\pm$  0.70 (g/dl) reported by Adenkola and Ayo (2007) in WAD sheep and higher than the normal range of 9.0-15.0 (g/dl) reported by Radostits *et al.* (1997). It is possible that higher level of gonadotrophin injection increased metabolism and efficient utilizing of nutrients. Haemoglobin concentration in the blood had been associated with availability of nutrients to the animal (Esonu *et al.*, 2001; Iheukwumere and Herbert, 2002). Rams on T<sub>3</sub> recorded the highest numerical value of 5.35 ( $\times 10^{12}/L$ ) in red blood cell. The lowest numerical value in red blood cell was observed in rams on T<sub>1</sub> (4.48  $\times 10^{12}/L$ ). It could be that high dose of the drug (Pergonal<sup>®</sup>) increased efficient utilization of

nutrients. The red blood cell values obtained in this study were higher than the range of 2.32  $\pm$  0.18-3.17  $\pm$  0.09 ( $\times 10^{12}/L$ ) reported by Sowande *et al.* (2008) in WAD sheep.

Rams on T<sub>3</sub> recorded the highest value in mean corpuscular volume 90.50(fl) and this differed significantly ( $P < 0.05$ ) from rams on T<sub>1</sub>. There were no significant differences ( $P > 0.05$ ) among rams on T<sub>3</sub>, T<sub>4</sub> and T<sub>2</sub> in mean corpuscular volume values. The lowest value in mean corpuscular volume (MCV) 84.25 (fl) was observed in rams on T<sub>1</sub>. The MCV values obtained in this study were higher than the mean value of 52.40  $\pm$  5.6 (fl) reported by Adenkola and Ayo (2007) in WAD sheep and higher than the normal range of 27-40 (fl) reported by Radostits *et al.* (1997) in sheep. Mean corpuscular volume is an indication of the average volume of blood cells (Lazzaro, 2003). There were no significant differences ( $P > 0.05$ ) among the treatment groups in Mean corpuscular haemoglobin (MCH). The MCH value obtained in this study 30.00 (pg) was higher than 24.50  $\pm$  8.50 (pg) reported by Adenkola and Ayo (2007) in WAD sheep and higher than the normal range of 8-12 (pg) Reported by Radostits *et al.* (1997) in sheep.

There were no significant differences ( $P > 0.05$ ) among the treatment groups in mean corpuscular haemoglobin concentration values. The highest mean corpuscular haemoglobin concentration value of 33.33 (g/dl) was observed in rams treated with Pergonal injection. This value however, was within the average 33.30  $\pm$  0.04 (g/dl) reported by Adenkola and Ayo (2007) in WAD sheep and within the normal range of 31.0-34.0 9g/dl reported by Radostits *et al.* (1997) in sheep. The observed variations in MCV, MCH and MCHC values may not be unconnected to the difference in season, nutritional and physiological status of the animals as suggested by Esonu *et al.* (2001).

The results of gonadotrophin (Pergonal<sup>®</sup>) administration on serum protein values of West African dwarf rams are shown in Table 2. There were significant differences ( $P < 0.05$ ) among the treatment groups in serum total protein values. Rams on T<sub>3</sub> recorded the highest value in serum total protein (88.70g/L) and this differed significantly ( $P < 0.05$ ) from rams on T<sub>4</sub> which had 78.00(g/L). There were no significant differences ( $P > 0.05$ ) among rams on T<sub>3</sub>, T<sub>2</sub> and T<sub>1</sub> in serum total protein values. The lowest serum total protein value of 78.00(g/L) was observed in rams on T<sub>4</sub>. Serum total protein values obtained in this study were higher than the normal range of 62.0-79.0 (g/L) reported in sheep by Kaneko *et al.* (1997). Serum total protein is the protein retained in the animal's body (Esonu *et al.*, 2001). While blood protein content has been shown to depend on the quantity and quality of dietary protein (Esonu *et al.*, 2001).

There were significant differences among the treatment groups in serum albumin values. Rams on T<sub>3</sub> recorded the highest value of 43.70g/L in serum albumin and this differed significantly ( $P < 0.05$ ) from rams on T<sub>2</sub>. There were no significant differences ( $P > 0.05$ ) among rams on T<sub>3</sub>, T<sub>4</sub> and T<sub>1</sub> in serum albumin level. The lowest value in serum albumin was observed in rams on T<sub>2</sub> (33.00g/L). Serum albumin values obtained in this study were higher than the normal range of 24.0-30.0 (g/L) reported in sheep by Kaneko *et al.* (1997). Low albumin suggests poor clotting ability of blood and hence poor prevention of haemorrhage (Robert *et al.*, 2000).

**Table 2:** Protein Values of Mature WAD Rams Treated With Gonadotrophin (Pergonal®)

Parameters	Treatment (Pergonal® i.u)				SEM
	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>	
	0.00	16.50	33.00	49.50	
Serum total					
Protein (g/l)	88.30 <sup>a</sup>	88.30 <sup>a</sup>	88.70 <sup>a</sup>	78.00 <sup>b</sup>	2.61
Albumin (g/l)	42.70 <sup>a</sup>	33.00 <sup>b</sup>	43.70 <sup>a</sup>	40.00 <sup>a</sup>	2.41
Globulin (g/l)	40.80 <sup>a</sup>	40.70 <sup>a</sup>	40.00 <sup>a</sup>	29.86 <sup>b</sup>	2.67
Albumin – globulin					
Ratio	0.85 <sup>a</sup>	0.74 <sup>b</sup>	0.71 <sup>b</sup>	0.76 <sup>a</sup>	0.03

<sup>ab</sup>: Means in the same row with different superscripts are significantly (P<0.05) different. SEM = Standard error of mean.

**Table 3:** Effect of Pergonal® on Liver and kidney functions of mature WAD rams.

Parameters	Treatment (Pergonal® i.u)				SEM
	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>	
	0.00	16.50	33.00	49.50	
Sodium (mmol/L)	40.50 <sup>ab</sup>	44.25 <sup>a</sup>	37.25 <sup>b</sup>	38.35 <sup>b</sup>	1.54
Potassium (mmol/L)	3.98 <sup>b</sup>	5.23 <sup>a</sup>	5.38 <sup>a</sup>	5.39 <sup>a</sup>	0.34
Chloride (mmol/L)	98.25 <sup>b</sup>	98.50 <sup>b</sup>	100.75 <sup>a</sup>	99.85 <sup>ab</sup>	0.95
Bicarbonate (mmol/L)	21.50 <sup>a</sup>	20.75 <sup>b</sup>	20.75 <sup>b</sup>	22.30 <sup>a</sup>	0.37
Creatinine (mmol/L)	59.75 <sup>c</sup>	68.00 <sup>a</sup>	61.50 <sup>bc</sup>	65.66 <sup>ab</sup>	1.89
Alkaline phosphates (iu/L)	42.00 <sup>a</sup>	36.00 <sup>b</sup>	35.25 <sup>b</sup>	35.75 <sup>b</sup>	1.59
Aspartate					
Transaminase (iu/L)	17.60 <sup>b</sup>	28.00 <sup>a</sup>	26.65 <sup>a</sup>	27.48 <sup>a</sup>	2.32
Alanine					
Transaminase (iu/L)	21.50 <sup>a</sup>	19.75 <sup>ab</sup>	18.80 <sup>b</sup>	18.82 <sup>b</sup>	0.63

<sup>abc</sup>: Means in the same row with different superscript are significantly (P<0.05) different. SEM = Standard error of mean.

There was significant difference (P<0.05) between the treatment groups in serum globulin values. Rams on T<sub>1</sub> recorded the highest value of 40.80 (g/L) in serum globulin and this differed significantly (P<0.05) from rams on T<sub>4</sub>. There were no significant differences (P>0.05) among rams on T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> in serum globulin levels. The lowest serum globulin value of 29.86(g/L) was observed in rams on T<sub>4</sub>. Serum globulin values obtained in this study were within the normal range of 35.0-57.0 (g/L) reported in sheep by Kaneko *et al.* (1997) except in rams on T<sub>4</sub> where it was lower than the normal range. Serum globulin values reduced with increased levels of the test drug. This is an indication that administration of this drug could result in mortality in the animals if used at high levels. Iheukwumere *et al.* (2005) inferred that a decrease in serum globulin is an indication of reduced fighting ability of the body system and could lead to mortality.

There was significant difference (P<0.05) between the treatment groups in albumin-globulin ratio. Rams on T<sub>1</sub> recorded the highest albumin globulin ratio of 0.85 and this differed significantly (P<0.05) from rams on T<sub>2</sub> and T<sub>3</sub> which were similar (P>0.05) to each other in albumin-globulin ratio. There was no significant difference (P>0.05) between rams on T<sub>1</sub> and T<sub>4</sub> in albumin-globulin ratio. The lowest value of 0.71 in albumin-globulin ratio was observed in rams on T<sub>3</sub>. The values for albumin-globulin ratio obtained in this study were slightly lower than the literature values (1.14-1.60) for different classes of livestock (Chinekeet *et al.*, 2002; Graw Hill, 2000; Cheesbrough, 2004; Singgh, 2004). This may be attributed to environment and nutritional status of the animals. Serum albumin and globulin vary both among

breeds and within breeds depending on location (Orji *et al.*, 1987).

The results of gonadotrophin (Pergonal®) administration on kidney and liver functions of West African dwarf rams are shown in Table 3. There were significant differences (P<0.05) among the treatment groups in sodium, potassium, chloride, bicarbonate, creatinine, Alkaline phosphatase, Aspartate transaminase and Alanine transaminase values.

Rams on T<sub>2</sub> recorded the highest value of 44.25 (mmol/L) in serum sodium and this differed significantly (P<0.05) from rams on T<sub>3</sub> and T<sub>4</sub> which were similar (P>0.05) to each other and similar (P>0.05) to rams on the T<sub>1</sub> in sodium values. There was no significant difference (P>0.05) between rams on T<sub>2</sub> and T<sub>1</sub> in serum sodium value. The lowest value in serum sodium was observed in rams on T<sub>3</sub> (37.25mmol/L). The sodium values obtained in this study were lower than the normal range of 139-152 (mmol/L) reported in sheep by Kaneko *et al.* (1997) and lower than the range 139.33-139.57 (mmol/L) reported by Oguike and Ude (2008) in WAD sheep. This may be as a result of decreased sodium reabsorption in the kidney possibly caused by insufficient release of aldosterone responsible for sodium reabsorption in the kidney.

Rams on T<sub>4</sub> recorded the highest potassium value of 5.39 (mmol/L) and this differed significantly (P<0.05) from rams on T<sub>1</sub> which had 3.98 (mmol/L). There were no significant differences (P>0.05) among rams on T<sub>4</sub>, T<sub>3</sub> and T<sub>2</sub> in serum potassium. Potassium values obtained in this study were within the normal range of 3.9-5.4 (mmol/L) reported in sheep by Kaneko *et al.* (1997). However, the potassium values obtained in the Pergonal treated groups were higher than the value 4.07 (mmol/L) reported by Oguike and Ude (2008) in WAD sheep. Potassium is excreted in the kidney and elevations of plasma potassium are indicative of under excretion suggesting kidney impairment. When plasma potassium is low, the level of sodium in plasma is elevated. Thus, they help in depolarization and repolarization in the nerve cells and muscle cells, and in the transmission of impulses in the nerve cells, intracellular fluid and extracellular fluid.

Rams on T<sub>3</sub> recorded the highest chloride value of 100.75 (mmol/L) and this differed significantly (P<0.05) from rams on T<sub>1</sub> and T<sub>2</sub> which had 98.25 (mmol/L) and 98.50 (mmol/L) respectively and which were similar (P>0.05) to rams on T<sub>4</sub> in serum chloride value. There was no significant difference (P>0.05) between rams on T<sub>3</sub> and T<sub>4</sub> in serum chloride value. The lowest value in serum chloride was observed in rams on T<sub>1</sub> (98.25mmol/L). Serum chloride values obtained in this study were within the normal range of 95-103 (mmol/L) reported in sheep by Kaneko *et al.* (1997).

Rams on T<sub>4</sub> recorded the highest serum bicarbonate value of 22.30 (mmol/L) and this differed significantly (P<0.05) from rams on T<sub>2</sub> and T<sub>3</sub> which were similar (P>0.05) to each other in bicarbonate value. There was no significant difference (P>0.05) between T<sub>4</sub> and T<sub>1</sub> in bicarbonate value. The lowest value of 20.75 (mmol/L) in serum bicarbonate was observed in rams on T<sub>2</sub> and T<sub>3</sub>. Bicarbonate values obtained in this study were within the normal range of 20-25 (mmol/L) reported in sheep by Kaneko *et al.* (1997). However, the bicarbonate values obtained in this study were lower than the range 25.83-

26.33 (mmol/L) reported by Oguike and Ude (2008) in WAD sheep. Bicarbonate is used in the buffering system in the blood, extracellular fluid and kidney.

Rams on T<sub>2</sub> recorded the highest creatinine value of 68.00 (mmol/L) and this differed significantly (P<0.05) from rams on T<sub>1</sub> and T<sub>3</sub> which were similar (P>0.05) to each other in creatinine value. There was no significant difference (P>0.05) between rams on T<sub>2</sub> and T<sub>4</sub> which were similar (P>0.05) to rams on T<sub>3</sub> in creatinine value. The lowest creatinine value of 59.75 (mmol/L) was observed in rams on T<sub>1</sub>. The creatinine values obtained in this study were lower than the normal range of 106-168 (mmol/L) reported in sheep by Kaneko *et al.*, (1997). Creatinine measurement is used almost exclusively in the assessment of kidney function. The rate of production of creatinine is constant and elevations of plasma creatinine are indicative of under-excretion, suggesting kidney impairment.

Rams on T<sub>1</sub> recorded the highest alkaline phosphatase value (42.00iu/L) and this differed significantly (P<0.05) from rams on T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> which were similar (P>0.05) to each other in Alkaline phosphatase values. The lowest value of 35.25iu/L in Alkaline phosphatase was observed in rams on T<sub>3</sub>. The highest Alkaline phosphatase value obtained in this study 42.00 (iu/L) was lower than the value 49.67 (iu/L) reported by Oguike and Ude (2008) in WAD ewes and lower than the normal range of 68-387 (iu/L) reported in sheep by Kaneko *et al.* (1997). This disparity may not be unconnected to the differences in physiological factors of these WAD sheep.

Analysis of liver enzymes (AST, ALT, and ALP) activities give valuable diagnostic information for a number of disease conditions. Alkaline phosphatase assay is used in the diagnosis of obstructive liver diseases (Murray *et al.*, 2003). The liver is the organ involved in the detoxification of xenobiotics and other harmful chemicals that gain entrance into the body (Murray *et al.*, 2003).

Rams on T<sub>2</sub> recorded the highest value in Aspartate transaminase 28.00 (iu/L) and this differed significantly (P<0.05) from rams on T<sub>1</sub> (17.60 iu/L). However, rams on T<sub>2</sub> did not differ significantly (P>0.05) from rams on T<sub>3</sub> and T<sub>4</sub> in Aspartate transaminase values. Aspartate transaminase values obtained in this study were below the normal range of 60-280 (iu/L) reported in sheep by Kaneko *et al.* (1997). An increase in Aspartate transaminase, Alkaline phosphatase and Alanine transaminase values would signify necrosis or myocardial infarction which are all indicators of drug toxicity or harmful chemicals in the body (Nelson and Cox, 2005). In this regard, Pergonal can be considered safe for the rams, as the values in the liver enzyme (Aspartate transaminase) activity of the treatment groups were below the normal range 60-280 (iu/L) reported in sheep by Kaneko *et al.* (1997). This disparity in the values of the liver enzymes may be attributed to breed, nutritional and physiological factors of these rams.

Rams on T<sub>1</sub> recorded the highest Alanine transaminase value of 21.50 (iu/L) and this differed significantly (P<0.05) from rams on T<sub>3</sub> and T<sub>4</sub> which had 18.80 (iu/L) and 18.82 (iu/L) respectively and which were similar (P>0.05) to each other in Alanine transaminase values. There was no significant difference

(P>0.05) between rams on T<sub>1</sub> and T<sub>2</sub> in Alanine transaminase values. The lowest value in Alanine transaminase was observed in rams on T<sub>3</sub> (18.18iu/L). Alanine transaminase values obtained in this study were below the range 30±4.0 (iu/L) reported in sheep by Kaneko *et al.* (1997). However, the Alanine transaminase values obtained in this study were much higher than the range 7.33 – 7.50 (iu/L) reported by Oguike and Ude (2008) in WAD sheep. This disparity may not be unconnected to the differences in physiological factors of these animals. Alanine transaminase assay is important in the diagnosis of liver damage caused by drug toxicity or harmful chemical (Nelson and Cox, 2005).

### Conclusion

The results of this study showed that the administration of Gonadotrophin (Pergonal®) to West Africa dwarf rams had no hepatotoxic and nephrotoxic effects and was not detrimental to the erythrocyte indices and serum protein values, except globulin level which reduced progressively with increased doses of the test drug, indicating that administration of Pergonal could result in mortality in the animals if used in high levels.

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