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Full Length Research Paper

Haematological and blood biochemical indices of West African dwarf goats vaccinated against *Pestes des petit ruminants* (PPR)

Aikhuomobhogbe, P. U. and Orheruata, A. M.*

Department of Animal Science, University of Benin, Benin City, Nigeria.

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The effect of *Pestes des petit ruminants* (PPR) vaccine on haemoglobin genotype, haematological and blood biochemical indices of forty randomly selected West African dwarf (WAD) goats were studied. Packed cell volume (PCV), haemoglobin concentration (Hb), neutrophil (NEU), lymphocyte (LYM), albumin (ALB), total blood protein (TBP), and globulin (GLO) concentrations were evaluated regarding body weight, sex, location and *Peste des petit ruminants* vaccine (PPRV) treatment on the traits. Haematological and blood biochemical determinations were performed pre- and 14 days post-vaccination against PPR with PPRV. Body weight, sex, location and PPRV had no influence on packed cell volume (PCV) and haemoglobin concentration (Hb) but exerted significant (P<0.05) influence on post-vaccination neutrophil (NEU^2), while sex and location significantly affected post-vaccination lymphocyte (LYM^2). Males presented an overall lower number of lymphocyte, higher neutrophil/lymphocyte ratio and white blood cells (WBC) than females. Post-vaccination albumin (ALB^2) was significantly (P<0.05) influenced by weight group and location. The increase in the value of total blood protein (TBP), albumin (ALB) and globulin (GLO) concentrations at pre and post vaccination were not consistent. Only the HbAA genotype was found among the entire WAD goats tested, thus indicating the genetic uniformity of WAD goats' population in Edo central, in terms of haemoglobin genotype. . The correlation between PCV and Hb concentration was high, positive and highly (P<0.001) significant. Low (r = -0.345), negative and significant (P<0.05) correlation was obtained between post-vaccination packed cell volume (PCV^2) and post-vaccination white blood cells (WBC^2). The observed relationship between PCV and LYM as well as NEU, indicates that PCV levels could be used to assess the immune status of goats. A negative and highly significant (P<0.001) correlation existed between NEU and LYM (r = -0.98). Post-vaccination albumin (ALB^2) had significant association with post vaccination globulin (GLO^2). The results obtained in the study therefore suggest that PPR vaccine led to increased lymphocyte content and thus increased immunity. It is therefore advisable to vaccinate WAD goats in order to retain immunity status.

Key words: Haematological and biochemical indices, goats PPR vaccine.

INTRODUCTION

The West African dwarf goats are valuable animal germplasm, which has attracted many research efforts. Despite available information, only a few on-farm reports exist on the biological characterization of this breed. It has also been noted that the major constraint in goat has been the high mortality rate due to disease. *Peste des petit ruminants* (PPR) is a disease ranked high as a major cause of death, especially among young goats. The use of vaccines in the effective control of PPR has been demonstrated (Ademosun, 2002). However, extensively reared goats are less susceptible to this disease probably due to physical exercises which has influence on blood indices (Kaneko et al., 1997). Similarly, haematological and blood biochemical measurements may vary depending on factors such as sex, age, weather, stress, season, pregnancy status and

*Corresponding authors E-mail: maorheruata@yahoo.co.uk or micorhe@uniben.edu. Tel: +234 8023438773.

physical exercise (Kaneko et al., 1997). Significant changes in these parameters are used to draw inference in clinical investigation. Nottidge et al. (1999) and Krishnamurthy (1984) reported significantly higher weaning percentage of lambs from haemoglobin types in Nigarili sheep, suggesting that haemoglobin genotypes may be related to some reproductive and productive traits in animals.

Haematological and biochemical indices of animals may give some insight as to their production performance potentials of the West African dwarf goats. Various reports (Aba-Adulugba and Joshua, 1990; Nottidge et al., 1999; Tambuwal et al., 2002) have documented haematological and biochemical parameters of domestic species in Nigeria, only very few were on goats and hardly any on the effect of PPR vaccine that is widely used for the prevention and treatment of the PPR disease on these indices. This study therefore has as its objective to determine the effect of PPR vaccine on the haematological and blood biochemical values of WAD goats' population under the extensive system of production.

MATERIALS AND METHODS

The study was conducted in July 2003. Forty goats comprising of 8 males and 32 females were randomly selected from 120 WAD goats reared extensively in the area. The goats grazed mostly on natural pasture of mainly grasses (*Panicum maximum*, *Pennisetum purpureum*), browses (*Gliricidia sepium*, *Manihot esculentum*, *Aspilia africana*) and herbaceous forage legumes (*Centrosema molle*, *Calopogonium mucunoides*) and consuming kitchen and food processing waste in the locality. No conscious efforts were made by the farmers to provide supplementary feed.

The goats were weighed and identified with ear tags prior to blood collection. Data were collected on only non-pregnant goats to reduce error that may be introduced as a result of pregnancy status.

Blood sample collection

5 ml of blood was drawn from the external jugular vein by venipuncture of the 40 goats. The blood sample from each of the goats was emptied gently into labeled tubes containing K_2EDTA. Two blood samples were collected from each goat at an interval of 14 days. Immediately following the first blood sample collection, 32 out of the 40 goats were vaccinated against *Peste des petit ruminants* (PPR) using PPR homologous vaccine (PPRV). The remaining nine goats were not vaccinated, thus serving as control. The blood samples were sent for laboratory analysis immediately after collection for the determination of haematological and blood biochemical parameters.

Haematological and blood biochemical analysis

Packed cell volume (PCV) and haemoglobin (Hb) concentration were determined by microhaematocrit and cyanmethemoglobin methods, respectively. White blood cell (WBC) counts were performed using a haemacytometer technique. Differential leucocytes counts were performed according to the method described by Schalm et al. (1975), while haemoglobin genotype were determined by cellulose acetate electrophoresis, after the haemolysate was prepared according to the method described by Deedo (1973). Total blood protein and albumin were measured using the biuret method and bromocresol green method, respectively. The globulin was estimated by difference.

Statistical analysis

The data were organized and analyzed using the general linear model procedure (PROC GLM) of SAS (1999). The fixed effects considered were weight group, sex, location and PPRV. The model used was:

$$Y_{ijkLm} = \mu + W_i + S_j + L_k + P_L + e_{ijkLm}$$

Where Y_{ijkLm} = the haematological and blood biochemical measurements on each WAD goat; μ = overall mean; W_i = effect of the i^{th} weight group of the animal (i = ≤ 5.5 kg weight group 1, 6 to 10.5 kg weight group 2, 11 to 15.5 kg weight group 3, 16 to 20.5 kg weight group 4, ≥ 20.5kg weight group 5); S_j = effect of the j^{th} sex of animal (j = Male, Female); L_k = effect of k^{th} location of animal (Ekpoma, Irrua, Uromi, Ubiaja), = effect of the L^{th} PPRV (vaccinated, non-vaccinated) and e_{ijkLm} = the random error term associated with each haematological and blood biochemical measurements on each animal. All effects were random, normally and independently distributed (~ NID) with zero mean and variance σ_e^2.

The significant effects of the factors on all the traits studied were separated according to Duncan (1955) multiple range test option of PROC GLM of SAS (1999). Descriptive statistics (means, standard error, range, CV) were also obtained using the procedure means (PROC MEANS) of SAS (1999).

RESULTS AND DISCUSSION

As set out in Table 1 are the descriptive statistics of haematological and blood biochemical indices of WAD goats reared extensively. Results obtained compared favourably with reports in literature (Olotu et al., 1998; Lazzaro, 2001). These authors reported similar values for goats as was obtained in this study. The WBC and differential leucocytes counts had the highest coefficient of variation (CV). Wide variation in leucocytes number is a reflection of the leucocytes' response to infection. The variation observed in this study could be attributed to the prevalence of disease conditions that were aggravated by environmental factors such as poor management and nutrition at different times in the locality.

The mean values of the effect of the body weight group, sex, location and PPRV on PCV and Hb are shown in Table 2, while those for NEU and LYM and biochemical indices are set out in Tables 3 and 4, respectively. Weight group, sex, location and PPRV at both pre- and post-vaccination had no influence on PCV and Hb. Similar observation was reported by Osueni (2001). Non significant differences between sexes have also been reported in cattle (Olusanya et al., 1976) and guanacos (Zapata et al., 2003). The non-significant influence of location could be attributed to the similar eco-climatic conditions that exist in all the locations of the study and the abundance of high quality pasture during

Table 1. Descriptive statistics of haematological and blood biochemical indices of West African Dwarf (WAD) goats reared extensively in Edo central, Nigeria.

Variable	N	Mean	SE	Range	Coefficient of Variation (%)
PCV (%)	40	30.4	0.8	18.0 – 38.0	16.1
WBC (/mm^3)	40	16040.0	858.4	7500.0 – 27900.0	33.8
Neutrophil (%)	40	46.0	2.4	22.0 – 80.0	33.6
Lymphocyte (%)	40	53.5	2.3	20.0 – 78.0	27.3
Eosinophil (%)	7	3.7	0.8	2.0 – 8.0	57.6
Basophil (%)	1	2.0	NA	0.0 – 2.0	NA
Monocyte (%)	2	2.0	NA	0.0 – 2.0	NA
Total blood					
protein (g/100ml)	40	7.78	0.20	6.7 – 9.1	11.9
Albumin g/100ml)	40	3.56	0.05	3.0 – 4.1	8.6
Haemoglobin	40	4.21	0.19	3.1 – 5.5	17.2
conc. (g/100ml)	40	10.03	0.26	5.9 – 12.6	16.2

Table 2. Effect of weight group (WTGRP), sex, location and PPRV on packed cell volume and hemoglobin concentration in WAD goatc reared extensively.

TRAITS								
Variable	**Packed Cell Volume (PCV)**				**Hemoglobin Concentration (Hb)**			
	N	**Pre-**	**N**	**Post-**	**N**	**Pre-**	**N**	**Post-**
WTGRP								
1	20	29.5	19	27.0	20	9.7	19	8.9
2	3	31.3	3	31.3	3	10.4	3	10.3
3	8	31.0	8	31.6	8	10.2	8	10.4
4	8	31.1	8	27.4	8	10.3	8	8.9
5	1	33.0	1	31.0	1	10.9	1	10.3
SEM		4.6		1.6		1.5		0.6
Sex								
1	8	28.0	8	25.6	8	9.3	8	8.5
2	32	30.9	31	29.2	32	10.2	31	9.6
SEM		2.3		0.8		0.7		0.3
Location								
1	10	29.3	10	28.4	10	9.7	10	9.3
2	10	31.4	9	29.7	10	10.4	9	9.7
3	10	30.7	10	28.0	10	10.2	10	9.2
4	10	30.0	10	27.9	10	9.9	10	9.2
SEM		1.3		0.9		0.4		0.3
PPRV								
Vaccinated	31	30.6	31	28.6	31	10.1	31	9.4
Non-vaccinated	9	29.6	8	27.7	9	9.8	8	9.1
SEM		2.2		0.8		0.7		0.3

the wet season when this study was carried out. PVC and Hb levels indicate the nutritional status of animals. The values obtained in this study for the goats in all locations suggested that the goats had access to similar feed/pasture. The NEU, LYM and biochemical indices values obtained thus indicated that the goats were in good physiological state. The mean PCV and Hb concentration showed similar difference in value from pre–vaccination value to post–vaccination value for vaccinated and non-vaccinated goats, respectively. However, there was no significant difference ($P > 0.05$) between vaccinated and non–vaccinated goats for both variables although the vaccinated goats had higher values. The attachment of PPR antigen to erythrocyte membrane may have rendered the cells more susceptible to phagocytosis by macrophages, thus resulting in varia-

Table 3.Effect of weight group (WTGRP), sex, location and PPRV on white blood cells, neutrophil and lymphocyte count in WAD goats.

Variable	White blood cells				Neutrophil				Lymphocyte			
	N	WBC^1	N	WBC^2	N	NEU^1	N	NEU^2	N	LYM^1	N	LYM^2
WTGRP												
1	20	15505	19	15216	20	45.0	19	45.6^a	20	54.4	19	53.4
2	3	17700	3	15467	3	35.3	3	43.0^{ab}	3	64.7	3	56.3
3	8	14363	8	14538	8	50.6	8	43.4^{ab}	8	48.9	8	53.9
4	8	17900	8	14438	8	50.4	8	48.4^a	8	49.4	8	48.9
5	1	20300	1	14900	1	26.0	1	36.0^b	1	70.0	1	60.0
SEM		4142.4		2181.3		8.9		1.9		9.0		2.6
Sex												
1	8	17075	8	17300	8	47.0	8	54.7^a	8	52.7	8	44.0^b
2	32	15781	32	14316	32	45.7	32	42.8^b	32	53.6	32	55.3^a
SEM		2025.8		1069.3		4.3		0.9		4.4		1.3
Location												
1	10	18650	10	15360	10	51.6	10	37.2^c	10	48.0	10	60.4^a
2	10	13010	9	14010	10	46.9	9	44.7^b	10	52.5	9	53.3^b
3	10	16010	10	15440	10	44.2	10	52.7^a	10	53.0	10	45.7^c
4	10	16490	10	14810	10	41.3	10	46.5^b	10	58.3	10	52.5^b
SEM		1145.9		1222.5		2.5		1.1		2.5		1.5
PPRV												
Vaccinated	31	16845	31	15310	31	45.9	31	44.4	31	53.9	31	53.9
Non-Vaccinated	9	13267	8	13450	9	46.2	8	48.7	9	52.0	8	49.2
SEM		1940.5		1069.3		4.2		0.9		4.2		1.3

Means in the same column with different superscripts are significantly different (P<0.05). Superscript 1 represents pre-vaccination value; 2 represent post-vaccination value.

tion of PCV values. Weight group, sex, location and PPRV had no significant (P > 0.05) influence on WBC (Table 3). However, post–vaccination neutrophil value was significantly (P < 0.05) influenced by weight group, sex and location, while sex and location had significant (P < 0.05) influence on post-vaccination lymphocyte (LYM^2). Males presented overall lower numbers of lymphocyte and higher neutrophil/lymphocyte ratio than females with a ratio of 0.90:1.23 versus 0.83:0.76 for male and female respectively. Similar observations were made by Zapata et al. (2003). Sex significantly influenced neutrohpil and lymphocyte value. The lower lymphocytes in males compared to females may be attributed to physiological stress response arising from their social behaviour which consist of aggressiveness and hierarchical fights. Zapata et al. (2003) noted physiological stress response is accompanied by increase lymphopenia.

Table 3 shows that no significant (P > 0.05) influence was exerted by PPRV on neutrophil and lymphocyte. But within the vaccinated goats, the increased lymphocyte value indicates different levels of immune status of the goats at the time of this study. The NEU and LYM had negative relationship. While goats in location 1 had the least NEU value at post vaccination, those in this same location had the highest post vaccination LYM value. Similarly, goats in location 3 with the highest post vaccination NEU value had the least LYM value. The response of the goats to the vaccine thus varied. Where PPR vaccine triggered an increase in one, a decreased was observed in the other. However, the data suggest that lymphoproliferative response to the vaccine may be associated with local variations in the environment. Location 1 (Ekpoma) had the highest LYM^2 values (60.4%), significantly (P < 0.05) different from location 2 (Irrua), location 3 (Uromi) and location 4 (Ubiaja). Table 4 shows the effect of weight group, sex, location and PPRV on blood biochemical parameters of WAD goats. Mean value obtained indicated statistical difference (P < 0.05) in post-vaccination albumin (ALB^2) between weight groups. However, increase in mean values of total blood protein (TBP), albumin (ALB) and globulin (GLO) were not consistent with age (reflecting weight group). By contrast, Chineke et al. (2002) reported increase concentration of TBP and GLO with corresponding decrease in ALB concentration with age in rabbits. There were no statistical (P > 0.05) differences in TBP, ALB and GLO between sexes. Similar observations were reported in rabbit and sheep (Schalm et al., 1975) and in guanacos (Zapata et al., 2003). Differences in serum biochemical parameters may be caused by nutrition, environment and hormonal factors (Chineke et al., 2002). Table 4 shows that location and PPRV had no significant

Table 4. Effect of weight group (WTGRP), sex, location and PPRV on total blood protein, Albumin and globulin concentration of WAD goats.

[1]Variable	BLOOD BIOCHEMICAL PARAMETERS											
	Total Blood Protein				Albumin				Globulin			
	N	TBP[1]	N	TBP[2]	N	ALB[1]	N	ALB[2]	N	GLO[1]	N	GLO[2]
WTGRP												
1	20	7.3	19	6.2	20	3.6	19	3.1[ab]	20	3.7	20	3.1
2	3	7.1	3	5.6	3	3.7	3	3.0[a]	3	3.3	3	2.3
3	8	6.9	8	6.2	8	3.6	8	3.1[ab]	8	3.3	8	3.2
4	8	6.7	8	5.7	8	3.5	8	3.0[b]	8	3.3	8	2.7
5	1	8.5	1	6.2	1	4.0	1	3.0[b]	1	4.5	1	3.2
SEM		0.8		0.3		0.2		0.1		0.9		0.3
Sex												
1	8	7.8	8	6.0	8	3.5	8	3.0	8	4.2	8	3.0
2	32	6.9	31	6.1	32	3.6	31	3.1	32	3.4	31	3.0
SEM		0.4		0.2		0.1		0.0		0.4		0.2
Location												
1	10	7.1	10	5.8	10	3.6	10	2.9[b]	10	3.5	10	2.9
2	10	6.7	9	5.8	10	3.6	9	3.2[a]	10	3.2	9	2.7
3	10	7.8	10	6.2	10	3.5	10	3.0[ab]	10	4.3	10	3.2
4	10	6.9	10	6.3	10	6.6	10	3.1[a]	10	3.3	10	3.2
SEM		0.2		0.2		0.1		0.1		0.2		0.2
PPRV												
Vaccinated	31	7.2	31	5.9	31	3.6	31	3.1	31	3.6	31	2.9
Non-vaccinated	9	6.8	8	6.5	9	3.5	8	3.0	9	3.3	8	3.5
SEM		0.4		0.2		0.1		0.0		0.4		0.2

[a,b,c,] means in the same column bearing different superscript are significantly different (P<0.05).

(P > 0.05) influence on blood biochemical parameters, except ALB[2], where location exerted significant (P < 0.05) influence. However, values obtained for the blood biochemical indices were within the range that has been reported in literature for WAD goats (Aba-Adulugba and Joshua, 1990; Tambuwal et al., 2002).

Haemoglobin genotype of the WAD goats in Edo Central Nigeria was 100% AA for males and females. However, Osueni (2001) reported that 91.6% of WAD goats evaluated for Hb genotype in Edo state had the AA genotype. Ayeni (1991) identified 3 Hb genotypes in WAD goats, AA, AB and BB. He reported that 119 of the 162 WAD goats, evaluated were HbAA, while 41 and 2 goats were HbAB and HbBB genotypes, respectively, giving genotype frequencies of 0.735 AA, 0.253 AB and 0.012 BB. The result of this study, suggest that the WAD goats in this zone can be said to be of uniform genetic make-up in haemoglobin genotype, indicating that they have not been subjected to crossbreeding.

The correlation coefficients among all the haematological and blood biochemical indices showed positive and highly significant (P < 0.01) correlation between PCV and Hb concentration at pre- (r = 0.999) and post-vaccination (r = 0.997) of WAD goats with PPRV. Similar value was obtained by Osueni (2001) in non-vaccinated WAD goats. The relationship indicates corresponding increase in Hb concentrations per unit increase in PCV. The relationship between PCV and Hb concentrations implies that both parameters are affected by the same factors. This is further shown in their relationship with haematological parameters which followed the same trend. Low, negative (r = -0.345) and significant (P < 0.05) correlation coefficient obtained was between post-vaccination packed cell volume (PCV[2]) and post-vaccination white blood cells (WBC[2]). Similarly Mohammed et al. (1991) reported significant decrease in PCV and Hb concentration and significant increase in white blood cells (WBC) after bilateral urethra ligation in Borno white goats. However, very low, negative (r = -0.073) and non-significant association was observed between pre-vaccination (PCV[1]) and pre-vaccination white blood cells (WBC[1]). The data obtained indicates that PCV levels could be used to assess the immune status of WAD goats. While a positive, low (r = 0.347) and significant (P < 0.05) correlation existed between PCV[1] and pre-vaccination lymphocyte (LYM[1]), a low (r = -0.377), negative and non-significant (P>0.05) correlation was observed between PCV[1] and pre-vaccination neutrophil (NEU[1]). Lazzaro (2001) noted that depressed levels of lymphocytes might indicate either an exhausted

immune system or elevated neutrophil level in an active infection.

High, negative (r = -0.98) and highly significant (P < 0.01) correlation was observed between NEU^1 and LYM^1. Exactly the same value and trend was observed for post-vaccination neutrophils (NEU^2) and post-vaccination lymphocyte (LYM^2). This implies that an increase in neutrophils is associated with a decrease in lymphocyte and vice versa. Similar observations were made by Osueni (2001) and Lazzaro (2001).

The correlation between post vaccination albumin (ALB^2) and globulin (GLO^2) was negative (r = -0.460) and significant (P < 0.01). This is consistent with the finding of Kalu et al. (1987). They reported significantly decreased levels of total blood protein, albumin/globulin ratio with corresponding increase in globulin fraction and calcium with *Trypanosoma vivax* infection in Nigeria Red Sokoto goats. However, by contrast the relationship between post-vaccination globulin (GLO^2) and post-vaccination total blood protein (TBP^2) was positive, high (r = 0.872) and significant. The correlation between ALB^2 and GLO^2 was probably influenced by vaccination. This might be explained by the role of globulin in the development of immunity since the relationship between pre-vaccination albumin (ALB^1) and pre-vaccination globulin (GLO^1) was low, positive and insignificant (P>0.05).

In conclusion, results of the study revealed that the WAD goats reared in Edo central were generally of HbAA genotype, suggesting high degree of adaptation of WAD goats to this environment, probably resulting from prolonged periods of natural selection. PPR vaccine injection led to increased LYM content which will consequently lead to increased phagocytosis ability thus will confer higher immunity. NEU and LYM have been noted to fight pathogens once they have passed the barrier of the shin into the cell (Politis et al., 2002), therefore an increase number will increase immunity which the PPR vaccine can be implicated to be involved by increasing the LYM content. Although, the vaccinated and non-vaccinated goats may not have shown significant difference in the NEU and LYM value probably due to lack of challenge by the management system adopted, which does not predispose the goats to PPR infection, vaccinated goats had higher LYM content. It is therefore advisable to vaccinate WAD goats reared extensively in order to retain immunity status.

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