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EFFECT OF SEASON AND GENOTYPE ON HEMATOLOGICAL PROFILE AND PARASITIC SUSCEPTIBILITY OF TWO NIGERIAN GOAT BREEDS AND THEIR RECIPROCAL CROSSES

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ABSTRACT

Parasitic susceptibility and hematological profile of 192 goats belonging to four genotypes (RSxRS, WADxWAD, WADxRS and RSxWAD) were assessed during wet and dry seasons of Sudan savannah zone of Nigeria. The goats were produced from the pure-breeding and reciprocal crossing of Red Sokoto (RS) and West African Dwarf (WAD) breeds. Packed Cell Volume (PCV), Hemoglobin (Hb) concentration and White Blood Cell (WBC) count were analyzed from blood samples taken from the goats. Fecal Egg Count (FEC) and Tick counts were obtained from fecal samples and skin examination (respectively). The data obtained were subjected to Analysis of Variance using 2x4 factorial arrangements in a completely randomized design. There were significant ($P<0.05$) interactions between genotype and season in all the parameters except FEC. The crossbred goats (i.e. RSxWAD and WADxRS) had significantly higher Hb than the purebreds. RSxRS had the highest WBC ($11.76c/mm^3x10^3$) in the dry season, and highest ticks infestation (4.80 ticks/head) in the wet season, which were significantly ($P<0.05$)higher than the WBC and ticks infestation of other genotypes. Significantly ($P<0.05$) higher level of ticks infestation was observed in the wet season than the dry season among the four genotypes, except WADxWAD. Hb concentration and PCV were significantly ($P<0.05$) higher in the dry season than the wet season in all the genotypes, except in WADxWAD. It is therefore concluded that hematological indices and parasitic susceptibility of goat are influenced by season and genotype. Crossbreeding and adequate management measures toward reducing parasitic infestations are therefore recommended.

Key words: Fecal sample, genotype, hematology, season, tick infestation

INTRODUCTION

The Commercial viability of goat production in Nigeria has been hampered over the years by diseases, parasitic infestations and some other interrelated problems leading to mortality. Ticks infestation, for instance, was indicated to create sites for secondary invasion by pathogenic organisms (Gates and Westcott, 2000), while some species of ticks were reported to transmit both protozoan and rickettsial diseases (Soulsby, 1986; Adediminiyi, 1992). According to Ofukwu *et al.* (2008) ticks infestation aids substantial losses in goat production in terms of skin damage, drastic reduction in weight gain, reduce productivity and in severe cases, death of the animals.

Gastrointestinal parasites were reported among the factors hindering the realization of peak potential of small ruminant production in Nigeria (Fakae, 2003). Some of these gastrointestinal parasites are microscopic and are often orally ingested while grazing; hence, their infestation is inevitable. Akerejola *et al.* (1979) had earlier reported a significant annual loss in Nigeria livestock industry, as a result of parasitic gastroenteritis. A known alternative to the prevention of the adverse effect of gastrointestinal parasites on goat is periodic usage of anti-helminthic drugs. This approach is however complicated by the influx of adulterated drugs and drug resistance by some strains of nematode populations (Vatta and Lindberg, 2006).There is the need for sustainable measures to check to parasitic interference and its dire consequences on goat farming and animal protein supply.

Selective upgrading and rearing of parasitic resistant breeds to control endo-parasitic havoc on Nigeria livestock herds have been suggested (Fakae *et al*., 2003). Hematological indices had been reported as a reliable way of assessing the health status of an animal, particularly with respect to pathological, nutritional and physiological conditions (Belewu *et al.,* 2007). Different species of animal have varying ranges or threshold of hematological values at their normal physiological functioning of their systems. Apart from extreme cases when an easy diagnosis could be made on goats that are deeply affected by parasitic infestations, hematological indices maybe used to determine the physiological state and well-being of an apparently normal animal. This study was therefore aimed at evaluating the parasitic susceptibility of pure West African Dwarf (WAD) and Red Sokoto (RS) goats, and their reciprocal crosses during the wet and dry seasons of the year.

MATERIALS AND METHODS

Experimental Site

The experiment was carried out in the Small Ruminant Research Unit of College of Agriculture, Zuru, Kebbi state Nigeria. Zuru is located in the Sudan savannah agro-ecological zone of Nigeria andlies between latitude 11^o 5^1N and longitude 4^o 5^1 to 5^o 5^1E.

Breeding Plan and Management of Experimental Animals

The breeding flock composed of forty-eight matured (12 - 18 months) goats belonging to two breeds (West African dwarf, WAD and Red Sokoto goats, RS). Each breed composed of 20 does and 4 bucks. Kids born were weaned at 3 months of age. A total of 192 pure (RSxRS, WADxWAD) and reciprocal crossbred (WADxRS and RSxWAD) kids produced by the breeding flock were managed semi-intensively by allowing the animal to graze on cultivated pastures in addition to the supply of hays, salts licks and water under an open-sided housing unit.

Data Collection

Pre-weaning mortality of kids was expressed as percent of the number dead to total birth. Ticks count, blood and fecal samples were collected from each kid at the4th and 10th month of age. The tick count, blood and fecal samples collection were done in the wet and the dry seasons of the year. Ticks were closely observed at the inter-digital spaces, ears, ventral and dorsal parts of the animals. The ticks were removed by hand picking, counted and recorded. Blood and fecal samples were also collected and preserved as described by Hassan *et al*. (2004). Blood and fecal samples were taken to Veterinary Physiology and Parasitology Laboratory of Usmanu Danfodio University, Sokoto (Sokoto State). Fecal egg count was done as described by Zajac and Conboy (2012).The blood samples were analyzed for Packed Cell Volume (PCV), Hemoglobin (Hb) concentration and White Blood Cells (WBC).

Data Analysis.

The data obtained for tick count, hematology indices and fecal egg count was subjected to Analysis of Variance (ANOVA) suitable for a2 x 4 factorial model of a Completely Randomized Design. The mathematical model for the study is as follows:

$y_{ijk} = \mu + G_i + S_j + GS_{ij} + e_{ijk}$

y_{ijk} = observation from k-th kid born in the j-thseason by the i-thgenotype

μ = overall mean

G_i =fixed effect of genotype i-th

S_j = fixed effect of j-th season

GS_{ij} = interaction between genotype and season

e_{ijk}=random error components for k-thprogeny born in the j-thseason by the i-thgenotype.

RESULTS AND DISCUSSION

Genotype was observed to have a significant effect (P<0.05) on all the studied parameters in the present experiment (Table 1). Purebred RS (RSxRS) had the highest mean WBC (10.36 c/mm^3 x 10^3) which was significantly higher (P<0.05) than the WBC obtained for purebred WAD (6.50 c/mm^3 x 10^3). The WBC count of 13.5 x 10^3 cell/mm^3 reported for WAD by Daramola *et al.* (2005) was higher than the value obtained for the same breed in this study. Addass *et al.* (2010) also found a mean WBC of 12.52 x 10^{3}cells/mm^3 for RS goat, which was higher than the mean values obtained in the present study. Thismay indicate reduced pathogenic load (Sompayrac, 2008) in the kids used for this experiment or an influence of age. The highest PCV (30.35%) was recorded for purebred WAD (WADxWAD), and was significantly higher (P<0.05) than the PCV of the other genotypes. However, PCV values obtained for crossbred kids (i.e. RSxWAD and WADxRS) were significantly (P<0.05) higher than that of RSxRS. This results indicate favorably higher blood oxygen transportation tendency (Birchard, 1997) for WADxWAD and crossbred kids than SRxSR.Crossbred kids also had significantly (P<0.05) higher Hb concentration than purebred WAD and RS kids.The two reciprocal crosses (WADxRS and RSxWAD) were not significantly different (P>0.05) from each other in all the hematological indices considered. The variation observed among genotypes in these hematological values corroborates the earlier report by Azab and Abdel-Maksoud (1999) and Tambuwal *et al*. (2002) who observed breed differences in the hematological indices of goat. However, it is contrary to the findings of Obua *et al.,* (2012) who reported no significant difference (P<0.05) in all the hematological indices of WAD and RS reared in the same environment. Although, most of the blood PCV values fell within the normal range reported for a clinically healthy goat (Sirois, 1995; Daramola *et al.,* 2005) but the PCV among other hematological parameters was not significantly (P>0.05) influenced by season. The hemoglobin (Hb) concentration measured in the dry season was significantly higher (P<0.05) than that of the wet season. Higher incidence of parasitism is usually encountered in the wet season of the tropics (Menkir *et al.,* 2007) and could be responsible for the low Hb concentration in this season. Kotepui *et al.* (2015) had earlier reported a positive relationship between the level of parasitemia and Hb concentration. However, the mean WBC count in the wet season was significantly higher (P<0.05) than what was obtained in the dry season, and hence justifying a response to immune challenge and reduced Hb in the wet period.

Parasitic susceptibility of the goats was significantly (P>0.05) influenced by genotype (Table 2). Purebred RS and crossbred RSxWAD had significantly (P<0.05) higher tick counts than the purebred WAD. Ticks Count (TC) and Fecal Egg Count (FEC) were significantly higher (P<0.05) in the wet season than the dry season, which corroborates earlier report by Kemal and Terefe (2013).Pre-weaning mortality varied among genotypes of the kids, and was comparatively higher in the wet than the dry season (Table 2). This shows possible aftermath effect of higher parasitism in the wet season (Kemal and Terefe, 2013). Lowest pre-weaning mortality (1.00%) was observed in WADxWAD while RSxRS ranked highest (4.61%).The pre-weaning mortality of WADxRS cross was also lower than that of its reciprocal (i.e. RSxWAD) with 0.67%, an indication variation in genetic influence on the survivability of goat kids (Perez-Razo *et al*., 1998).

Table 1: Effects of genotype and season on hematological indices in purebred and crossbred Nigerian goats

Factors		Parameters WBC (c/mm^{3}x 10^3)	PCV (%)	Hb (g/dl)
Genotypes:	RSxRS	10.36^a	20.39^c	6.62^b
	WADxWAD	6.50^b	30.35^a	7.05^b
	WADxRS	9.74^a	24.29^b	8.12^a
	RSxWAD	9.56^a	25.33^b	8.61^a
	SEM (±)	0.91	1.53	0.49
Season:	Wet	8.38^b	24.31	6.62^b
	Dry	9.70^a	25.86	8.57^a
	SEM (±)	0.64	1.30	0.35

Mean values with the same superscripts for the same factor in the same column are not significantly different (P>0.05). RS means Red Sokoto goat; WAD means West African Dwarf goat; SEM = Standard Error of Mean.

Table 2: Effects of genotype and season on tick count and fecal worm load in purebred and crossbred Nigerian goats

Factors		Parameters Ticks Count (ticks/hd)	Fecal Egg Count (e.p. g.)	Mortality (%)
Genotypes:	RSxRS	3.50^a	1.0x50^b	4.61
	WADxWAD	0.93^c	0.5x50^c	1.00
	WADxRS	2.70^{ab}	1.0x50^b	2.65
	RSxWAD	2.10^b	1.25x50^a	3.32
	SEM (±)	0.50	0.15x50	-
Season:	Wet	2.81	0.31x50	4.30
	Dry	1.80	0.16x50	1.33
	SEM (±)	0.37	0.09x50	-

Mean values with the same superscripts for the same factor in the same column are not significantly different (P>0.05). RS means Red Sokoto goat; WAD means West African Dwarf goat; SEM = Standard Error of Mean.

There were significant (P<0.05) interactions between genotype and season in the values obtained for ticks count, fecal egg counts and all the hematological indices included in the study (Table 3). The WBC obtained in the dry season were significantly higher (P<0.05) than the values observed for the wet season in purebred RS and WAD while the crossbred kids had significantly higher (P<0.05) WBC in the wet season (Table 3). Unfixed WBC count of an animal is not unexpected (Sompayrac, 2008) as it indicates the level of production of phagocytic cells to invade pathogens which are highly influenced by environment (Kemal and Terefe, 2013).Higher WBC count for RSxRS and WADxWAD in the dry season, though not expected when compared to the wet season, shows higher immune challenges and consequential increase in WBC production (Sompayrac, 2008) to combat foreign bodies during the period. The WBC of RSxRS in the dry season was, however, intermediate to 10.6 x 10^3 cells/mm^3 reported for the breed by Tambuwal *et al.* (2002) and 12.52 x 10^3 cells/mm^3 reported by Addass *et al.* (2010). There was no significant difference (P>0.05) between the Hb concentrations of WADxWAD and that of crossbred kidsin the dry season. However, the Hb concentration varied significantly (P<0.05) among the genotypes in the wet season, and were generally lower than what were observed in the dry season for each genotype. Meanwhile, the Hb of purebred RS and WAD in the wet season were below the minimum threshold of 7g/dl reported for clinically healthy goat by Daramola *et al.* (2005) who did not put season and age into consideration. The lower (P<0.05) Hb in the wet season may be a reflection of the high parasitic burden that characterized this period of the year. A similar trend of lower value in the wet was also observed in PCV for all the kid's genotypes except WADxWAD, where it was otherwise. This may explain favorably higher moisture tolerance of WAD which could account for its higher adaptability in the coastal regions (Hamayun *et al.* (2006). RSxRS had the highest pre-weaning mortality (7.88%) in the wet season while the crossbred kids had slightly higher pre-weaning mortality than RSxRS in the dry season (1.99 versus 1.34%). The higher livability of WAD kids during the wet season suggest a higher moisture tolerance of the breed. This may ultimately explain the reasons for their survival and abundant distribution in the coast and central Nigeria. The lower pre-weaning mortality of the crossbred kids, when compared with the purebred SR, suggests some degree of vigor as a result of crossbreeding (Hossain *et al.*, 2002).

Table 3: Interaction between genotype of goat and season of rearing on hematological indices, ticks Infestation and worm load in purebred and crossbred Nigerian mean.

	Genotype/Season								
	RSxRS		WADxWAD		WADxRS		RSxWAD		
Parameters	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	SEM (±)
WBC (c/mm^{3}x 10^3)	8.96^c	11.76^a	3.48^e	9.52^c	10.52^b	8.95^c	10.54^b	5.58^d	0.91
PCV (%)	19.08^e	21.70^d	34.05^a	26.64^c	21.67^d	26.90^{bc}	22.44^d	28.22^b	1.52
Hb (g/dl)	6.06^d	7.19^c	5.19^e	8.90^a	7.18^c	9.07^a	8.08^b	9.19^a	0.43
TC (ticks/hd)	4.80^a	2.20^d	0.05^e	1.80^d	3.60^b	1.80^d	2.80^c	1.40^d	0.50
FEC (e. p. g. x 50)	1.5	0.5	1.0	0.4	1.0	1.0	1.5	1.0	1.1
Mortality (%)	7.88	1.34	1.99	0.01	3.31	1.90	4.64	1.90	-

Mean values with the same superscripts for the same factor in the same column are not significantly different (P>0.05). RS means Red Sokoto goat; WAD means West African Dwarf goat; SEM = Standard Error of Mean. FEC = Fecal Egg Count; TC = Ticks' count; SEM = Standard Error of Means.

Purebred WAD (WADxWAD) and WADxRS were similar in fecal egg counts during the wet season; however purebred WAD was markedly lower in fecal egg count during the dry season (Table 3). Reduced worm burden observed in the dry season confirms the earlier reports that survival and proliferation of pre-parasitic stage of gastrointestinal nematodes are accelerated during wet environmental conditions and thereafter, decline in population of the cyst is expected in the dry season (Nwosu *et al.*, 2007; Mbuh *et al*., 2008; Gwaze *et al.*, 2010). However, the fecal egg counts in the present study were generally low compare to the values reported by Adedeji *et al.*, (2011). This is probably a reflection of restricted movement associated with semi-intensive management employed in the present study. The main factor influencing the development and survival of these endo-parasites is environment (Hassen and Perry, 1994). TheWADxWAD and RSxRS were not significantly (P<0.05) different in tick counts during the dry season; however WADxWAD was markedly lower in tick count during the raining season. This variation in the degree of tick susceptibility between season and among genotype is contrary to an earlier report by Ofukwu *et al.* (2008) who reported no significant difference between Red Sokoto and West Africa dwarf goats in the degree of ticks' infestation. The results agree with the reports by Opasina (1985) who indicated May to October (or wet season) as the major period of ticks' proliferation in Nigeria. Comparatively low susceptibility to tick infestation observed in WADxWAD indicates passive immunity or resistance inherited from parental lines due to previous exposure. This was earlier reported for cattle by Obadiah and Shekaro (2012). The present report confirms the earlier report by Gwaze *et al.* (2010) that season plays a significant role in hematological indices and worm burden of goats.

CONCLUSION

It is concluded from this study that season and genotype (breed) have influenceon the parasitic burden as well as hematological indices of Nigerian breeds of goat and their crosses. However, the parasitic burden on highly susceptible goats could be reduced if crossbreeding is employed to complement a well-designed de-worming and ecto-parasite control program.

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