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Hematological and serum biochemical indices of West African dwarf goats with foreign body rumen impaction

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Summary: Hematological and biochemical parameters were determined in 82 West African Dwarf goats with foreign body rumen impaction (FBR) and 40 normal WAD goats without foreign body rumen impaction (WFBR) in order to evaluate their influence on the etio-pathogenesis of rumen impaction. The mean PCV (26.22%), RBC (9.03 X 10^6/µL), Hb (8.38g/dl) and MCHC (32.20g/dl) were significantly lower (P<0.05) in FBR than in WFBR. The values obtained for serum sodium, potassium, calcium and magnesium in FBR goats were not significantly different (P<0.05) from that of WFBR goats. Mean values of serum total protein (4.02gm/dl), phosphorus (3.38mg/dl), glucose (29.33gm/dl), zinc (0.72mmol/L) and copper (0.49mmol/L) in FBR goats were significantly lower than in WFBR goats. The results suggest that foreign body rumen impaction in WAD goats is influenced by some hematological (PCV, RBC, Hb, MCHC) and serum biochemical (total protein, phosphorus, glucose, zinc, copper) parameters and can be used as a basis for formulating preventive measures.

Keywords: Hematology, Serum biochemistry, WAD goats, Foreign body rumen impaction

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INTRODUCTION

Goat production in Nigeria makes a major contribution to the agrarian economy. The West African Dwarf (WAD) goats are found in the region south of latitude 14°N across West Africa in the coastal area, which is humid and favors high prevalence of diseases (Adeloye, 1998). In Nigeria and West Africa, goat is reared traditionally at subsistence level. They are usually left to scavenge and cater for their own nourishment (Adeloye, 1985). Goats are selective feeders but under harsh conditions, they are likely to ingest foreign bodies (Otesile *et al*, 1982, 1983).

The report of Elsa *et al* (1995) indicated that rumen impaction consequent upon the ingestion of foreign body and associated with nutritional inadequacies and poor husbandry practices, constituted the major indication for rumenotomy in small ruminants. A phenomenal increase in the incidence of foreign body rumen impaction proportional to increase in demand and use of polythene materials in urban and rural areas has also been reported by Sanni *et al* (1998). Adequate attention has not been given to the grave consequences of foreign body ingestion due to the fact that the effects of impaction many times, go unnoticed or wrongly diagnosed as it presents similarities to other conditions (Akinrinmade *et al*, 1988; Garba and Abdullahi, 1995). Many cases have, therefore, been discovered at necropsy or after slaughter (Abdullahi *et al*, 1984; Adewumi *et al*, 2004).

Previous studies have shown that changes in hematologic and biochemical indices are pointers to various disease conditions, even at sub-clinical levels and have been used to provide diagnostic and prognostic aids in some disease conditions (Jain, 1980; Taiwo and Anosa, 1988). Although reports from previous workers have described the prevalence and risk factors of foreign body rumen impaction in cattle, sheep and goats in the various geographical zones of Nigeria (Abdullahi *et al*, 1984; Sanni *et al*, 1998; Adewumi *et al*, 2004, Akinrinmade and Akinrinde, 2012), the etio-pathogenesis of the condition still remain poorly understood and speculative. No attempt till date has been made to investigate and determine specifically the hematological and biochemical profiles of goats with foreign body rumen impaction (FBR). Such an investigation would provide the necessary data that may facilitate the recognition of the disorder and formulate appropriate therapeutic modalities. These are the objectives which the present investigation sought to achieve.

MATERIALS AND METHODS

The investigation was conducted at the Central abattoir, Ibadan during the months of March to May, 2011. It involved pre-slaughter collection of blood and post-slaughter examination of WAD goats for the presence of foreign body rumen impaction with indigestible garbage. Identification of animals was facilitated by the use of distinguishable color markings, tags, breed and sex. Blood samples were collected from the jugular vein. Five milliliters (5ml) of the blood was stored in plastic sample bottles containing EDTA (3mls) and sodium oxalate fluoride (2mls) respectively for hematological and glucose determinations, while another 7 ml was deposited into anticoagulant-free plastic tubes and allowed to clot at room temperature within 3 hours of collection. The serum samples were later stored at a temperature of -20^{o}C for biochemical analysis. Blood samples were similarly obtained for hematological and biochemical analyses in 40 WAD goats without foreign body rumen impaction (WFBR) to serve as controls.

The packed cell volume (PCV) was determined by Hawskey microhematocrit method (Schalm *et al*, 1986). The hemoglobin (Hb) concentration was measured spectrophotometrically by the cyanmethemoglobin method (Kelly, 1979) using the SP6-500UV spectrophotometer (PYE, UNICAM, England). The red blood cell (RBC), total and differential white blood cell (WBC) counts were estimated by the hemocytometer method (Schalm *et al*, 1986) using improved Hawskey hemocytometer. Mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCHC) and mean corpuscular hemoglobin (MCH) were calculated from PCV, Hb and RBC values (Schalm *et al*, 1986).

Biochemistry

Sodium (Na) and potassium (K) concentrations were measured using the flame photometer (Corning model 400, Corning Scientific Ltd, England). Calcium (Ca), Magnesium (Mg), Zinc (Zn) and phosphorus (P) were determined using a BUXX2000 Atomic absorption spectrometer (AAS). Total protein (TP) was estimated by the Biuret reaction (Peter *et al*, 1982).Sodium oxalate fluoride was used for glucose preservation while the blood glucose was determined by enzymatic colorimetric test (Quimica Clinica Applicada, S.A. kit).

Statistical analysis

The data obtained were expressed as mean and standard deviation (mean±S.D.) and statistically analysed using analysis of variance (ANOVA). ANONYM (1998) statistical computer software was used. P values less than or equal to 0.05 were considered significant using Student t-test.

RESULTS

Table I shows the mean values of PCV (%), RBC(10^6/µL), Hb (gm/dl), MCHC (gm/dl), MCV (fl), MCH (pg), WBC (10^3/µL), neutrophils (%), lymphocytes (%), eosinophils (%), basophils (%) and monocytes (%) in WAD goats with foreign body rumen impaction (FBR) and those without foreign body rumen impaction (WFBR). The mean values of PCV, RBC, Hb, MCV, and MCHC were significantly higher ($p<0.05$) in WFBR than FBR goats. There were no significant differences ($p<0.05$) in total and differential WBC counts between FBR and WFBR goats. The mean values of biochemical parameters of FBR and WFBR goats are given in Table 2. No statistically significant differences ($p<0.05$) were

Table 1: Hematological values of WAD goats with and without rumen impaction

Variable	Goats with rumen impaction (n=82)	Goats without rumen impaction (n=30)	Daramola *et al* (2005) n=20	Oduye (1976) n=85	Opara *et al* (2010) n=130	Oyewale (1991) n=8	Adejinmi & Akinboade (1999) n=14	Waziri *et al* (2010) n=30
PCV (%)	26.22±3.10*	29.60±1.70	29.40±0.9	26.10±4.10	28.4±0.9	34.38±2.55	28.67±4.04	27.81±1.32
RBC (x10^6µl)	9.03±2.88*	12.64±2.94	11.5±0.4	12.3±2.40	2.7±0.1 (x10^{12}µl)	15.86±1.92	13.09±1.37	9.1±0.36
Hb (gm/dl)	8.38±3.30*	11.12±2.77	9.8±0.3	8.59±1.31	9.5±0.3	11.62±1.39	10.19±1.41	9.86±0.40
MCHC (gm/dl)	32.20±0.86*	37.56±2.34	33.1±0.1	33.1±3.40	33.2±2.5	34.33±3.62	35.53±0.06	33.47±0.50
MCV (fl)	28.81±4.82*	23.41±1.22	ND	21.80±4.40	114.5±7.4	21.87±2.08	22.27±5.41	25.89±1.50
MCH (pg)	9.28±1.90	8.79±0.98	ND	ND	37.8±2.2	ND	7.89±1.92	9.51±0.85
Total WBC (x10^3µl)	16.13±4.56	14.82±3.99	13.5±0.8	16.10±4.65	17.3±1.7	ND	10.25±1.80	9.42±1.25 (x10^6µl)
Neutrophils (%)	31.02±1.20	32.60±1.60	33.5±1.7	ND	32.9±1.6	ND	2.99±0.67	3.76±0.82
Lymphocytes(%)	67.38±.2.1	65.11±2.10	65.8±1.1	46.80±10.80	64.8±1.7	ND	7.16±1.15	3.58±1.34
Eosinophils %)	1.35±0.22	1.25±0.60	0.6±0.2	4.70±4.50	0.3±0.1	ND	0.07±0.12	1.20±1.13
Basophils (%)	0	0	0	0	0.2±0.1	ND	0	0
Monocytes (%)	0.80±1.20	0.70±0.30	0	0.90±0.90	2.4±0.3	ND	0.03±0.06	0.95±0.06

Values are presented as mean±s.d; n=number of samples; ND=not determined; *significant as compared with goats without foreign body rumen impaction.

Table 2: Serum biochemical values of WAD goats with and without rumen impaction

Variable	Goats with rumen impaction	Goats without rumen impaction	Daramola *et al* (2005) N=20	Oduye and Adadevoh (1976) N=70	Opara *et al* (2010) N=130	Adejinmi & Akinboade (2000) N=14	Kamalu *et al* (1988)	Waziri *et al* (2010) N=30	Awe and Arowolo (1995) N=20
Sodium (mmol/l)	131.26±2.15	130.41±2.1	135.1±1.7	138.76±9.71	126.1±2.2	114.7±3.79 (mEq/L)		143.6±1.66	
Potassium (mmol/l)	4.97±0.88	4.56±0.93	4.8±0.1	4.44±0.49	7.1±0.5	4.77±0.96 (mEq/L)		4.56±0.12	
Calcium (mmol/l)	7.99±0.57	8.87±0.46	1.6±0.1	9.57±11.51 (mg/dl)	ND	8.50±0.10 (mEq/L)		8.94±0.27	
Total protein (gm/dl)	4.02±0.13*	6.45±0.92	7.1±0.1	6.36±0.80	5.2±0.1	7.50±0.80	5.28-6.65	6.37±0.21	5.87±2.4
Magnesium (mmol/l)	0.80±0.13	0.99±0.95	ND	ND	ND	ND	3.2±0.35 (mEq/L)	ND	
Phosphorus (mg/dl)	3.38±0.85	3.85±0.56	7.43±0.2	6.69±2.14	ND	6.60±0.1	8.14-10.32	ND	
Glucose (mg/dl)	29.33±3.10*	34.01±4.83	ND	ND	32.9±3.8	ND	45-60	68.33±1.21	
Zinc (mmol/l)	0.72±0.11*	1.03±0.60	ND	ND	ND	ND		ND	1.48±0.5
Copper (mmol/l)	0.49±0.31*	0.77±0.22	ND	ND	ND	ND		ND	0.98±0.25
Manganese			ND	ND	ND	ND		ND	
Cobalt			ND	ND	ND	ND			

Values are presented as mean±s.d; n=number of samples; ND=not determined; *significant as compared with goats without foreign body impaction.

observed in Na, K, Ca, and Mg levels in FBR and WFBR goats. Mean values of TP, glucose, , Zn and Cu were significantly higher ($p<0.05$) in WFBR than FBR goats. Mean values of P were low in FBR goats compared to WFBR goats, but not significant.

DISCUSSION

The mean packed cell volume (PCV) obtained in this study in goats with foreign body rumen impaction and those without impaction, are within normal range of mean values earlier reported in WAD goats and other goat breeds (Oduye, 1976, Adejinmi and Akinboade, 1999, Tambuwal, 2002, Daramola *et al*, 2005, Opara *et al*, 2010, Waziri *et al*, 2010). The mean PCV value in WAD goats with foreign body rumen impaction (FBR) was, however, significantly lower than that obtained for animals without foreign body rumen impaction (WFBR). WAD goats have been shown to have tendency for compensatory accelerated production of PCV in case of infection (Dargie and Allonby, 1975, Daramola *et al*, 2005). This compensatory mechanism may be overwhelmed by the enormity of ruminal physiological derangements caused by continuous ingestion of non-biodegradable foreign materials in goats with foreign body rumen impaction.

The serum RBC and Hb values obtained for WFBR goats were significantly higher than those of FBR goats. Hb concentration is an indication of the oxygen carrying capacity of the blood. The lower values of RBC and Hb obtained in FBR goats in this study could be ascribed to gastrointestinal disease and malnutrition as suggested by previous reports (Akinrinmade *et al*, 1988, Otesile and Akpokodje, 1991, Remi-Adewumi *et al*, 2004).

Generally, the mean total WBC count obtained in this study for both categories of animals fell within the range of mean values obtained for WAD goats by previous workers (Oduye, 1976; Daramola *et al*, 2005; Opara *et al*, 2010), with majority of WBC made up of lymphocytes and neutrophils.

Leucocytic cell distribution is affected by breed, temperature, environmental as well as body's demand and health status (Mbassa and Poulsen, 1993). The presence of foreign body materials in the rumen of WAD goats in this study did not appear to have an obvious impact on the mean total and differential WBC counts except for the relatively high eosinophil count obtained in both categories of goats and which may not be unrelated to concurrent helminthosis and ectoparasitic infestations in majority of animals brought in for slaughter.

The mean serum total protein value (4.02±0.13gm/100ml) obtained in FBR goats was significantly lower than that obtained in WFBR goats (6.45±0.92gm/100ml). This value was also comparatively lower than mean values reported by other authors in WAD goats and other goat breeds (6.36±0.1gm/100ml, Oduye (1976); 7.1±0.1, Daramola *et al* (2005); 6.37±0.21, Waziri *et al*, 2010).

The mean PCV and serum total protein values obtained in this study in WAD goats with and without foreign body rumen impaction suggest that both indices vary proportionately and that PCV and serum total protein levels may be beneficial in assessing WAD goats with foreign body impaction and possibly forecast appropriate nutritional supplementation.

Mean values of Na, K, Ca, and Mg obtained in this study for both FBR and WFBR goats did not

differ significantly (P<0.05) and are comparable to normal values obtained for WAD goats by other workers (Oduye, 1976; Adejinmi and Akinboade, 2000; Daramola *et al*, 2005; Opara *et al*, 2010). The mean phosphorus level obtained in FBR goats was low, but not significant compared to the value in WFBR goats. However, both values are significantly lower (P<0.05) than those obtained in normal WAD goats in previous studies (Oduye, 1976; Adejinmi and Akinboade, 2000; Daramola *et al*, 2005). This implied that quite a substantial number of goats slaughtered at the peak of the dry season when the study was conducted, were either severely or marginally deficient of phosphorus. This may not be unexpected since most livestock grazing areas of tropical countries contain soils and plants low in phosphorus (McDowell, 1992). Sowande *et al* (2008) reported a significant decrease in phosphorus concentration in the blood of WAD goats and sheep grazing natural pastures in southwest Nigeria and ascribed this to climatic fluctuations. High incidence of foreign body rumen impaction reported by Adewumi *et al* (2004) in their study in sheep and goats during the dry season also supported seasonal variation in phosphorus levels. The significantly low phosphorus levels obtained in this study in both FBR and WFBR goats may have clinical and economical implications with respect to its probable role in the etio-pathogenesis of foreign body impaction and depraved appetite related disorders. Deficiency of this essential element is regarded as the most widespread and economically important of all the mineral disabilities affecting grazing livestock (McDonald *et al*, 1998)

The rumen glucose levels in FBR goats was significantly (p<0.05) lower than that obtained for WFBR goats, even though, the level in the latter was comparable to that reported for the same breed by other workers (Opara *et al*, 2010). Low glucose level in FBR goats could be ascribed to high levels of free fatty acids and cholesterol associated with reduced energy intake and decreased availability in animals with foreign body rumen impaction. This could also be a factor that contributed to inhibition of glucose synthesis, or could be responsible for enhanced uptake by the cells. This observation is in agreement with the report of Valdez *et al* (1977).

In FBR goats, mean serum copper values were significantly low (P<0.05) compared with the values obtained in WFBR goats. Copper plays an important role in the genesis of the immune response (Keen and Graham, 1989. According to McDonald (1995), serum concentration of copper is determined by the efficiency of absorption. It seems reasonable to suggest that goats with foreign body rumen impaction would have an inferior immune response to infection than those without impaction. Again, the presence of foreign body materials in the rumen would hamper absorption and utilization of copper.

Serum zinc concentration in FBR goats was significantly lower (P<0.05) than in WFBR goats. Concentration of zinc in blood is influenced by age, stress, infections and malnutrition (Kincaid, 1999). These factors, which are similar to those earlier described by Sanni *et al* (1998) and Adewumi *et al* (2004) to be involved in the etio-pathogenesis of foreign body rumen impaction, may be contributory to the observed low copper level in goats with foreign body rumen impaction.

The components of hematological and serum biochemical parameters in WAD goats in this study seem to indicate differences in the values obtained for FBR goats and WFBR goats. Packed cell volume, RBC, Hb, total protein, phosphorus, glucose, copper and zinc values were observed to differ significantly between FBR and WFBR goats. The findings of this study also suggest that foreign body rumen impaction in WAD goats may represent a complex and multi-factorial process that involved the interplay of some hematological and biochemical indices. The specific influence of the individual hematological and biochemical parameters in the etio-pathogenesis of foreign body rumen impaction needs further investigation. The findings of this study may serve as references for diagnostic and therapeutic purposes in goats with foreign body rumen impaction.

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REFERENCES

Abdullahi, U.S., Mohammed, G.S.A. and Mshella, T.A. (1984). Impaction of the rumen with indigestible garbage in cattle and sheep in urban and sub-urban environment. Nig. Vet. J. Vol 13, No2, 89-95.

Adejinmi, JO and Akinboade, O.A. (1999). Changes in body weight, temperature and hematological parameters in WAD goats with experimental mixed Trypanosoma brucei and Cowdria ruminatium infections. Trop. Vet. 17: 211-217.

Adeloye, A.A. (1985). Water utilization by the goat fed with maize cob. Nutrition Report International 32 (6), 1461-1466.

Adeloye, A.A. (1998). The Nigerian small ruminant species. Corporate Office Max, Ilorin, Nigeria, pp7-8.

Adewumi, B.G., Gyang, E.O. and Osinowo, A.O. (2004). Abattoir survey of foreign body rumen impaction in small ruminants. Nig. Vet. Journal 25 (2) 32-38.

Akinrinmade, J.F., Akusu, M.O., and Oni, S.O. (1988). Gastro-intestinal foreign body syndrome in sheep: A case report, Nig Journal of Anim. Prod. 15: 145-148.

Akinrinmade, J.F. and Akinrinde, A.S. (2012). Prevalence of rumen impaction with non-biodegradable materials in cattle in Ibadan, Nigeria. Nig. J. Anim. Prod. (In press)

Anosa, V.O., (1988). Hematological and biochemical changes in human and animal trypanosomiasis. Rev d'Elev et de Med. Vet. Des pays. Trop Part 1. 41 (1): 65-78, Part II, 41 (2) 151-164.

Daramola, J.O., Adeloye A.A., Fatoba, T.A. and Soladoye A.O. (2005). Hematological and biochemical parameters of West African Dwarf goats: Livestock Research for Rural Development. 17(8) 21-27.

Elsa, A.T., Garba, H. and Daneji, A.I. (1995). Indications, causes and complications of rumenotomy in small ruminants in Sokoto, Nigeria. Nig. Vet. Journal Vol 13, 45-49.

Garba, HS and Abdullahi, M.Z. (1995). Problems associated with pregnancy diagnosis in abdominal ballotment in small ruminants in Nigeria. 30th Annual conference of the Nig. Soc. For Animal Production, Minna. Pp 54.

Ghergariu, S., Rolands, G.J., Danielescu, A.L., Pop, N. and Moldova, A. (1984). A comparative study of metabolic profiles obtained in dairy herds in Romania. Brit. Vet. Journal, 140: 600-608.

Jain, N.C., (1986). Schalm Veterinary Hematology, 4th ed. Lea and Febiger, Philadelphia, USA.

Kamalu, T.N., Shetty, S.N. and Nair, S.G. (1988). Biochemistry of blood of West African dwarf goats. Trop. Vet. 6: 2-5.

Keen, C.L. and Graham, T.W. (1989). Trace elements In: J.J. Kaneko (Editor). Clinical Biochemistry of domestic animals. 4th edn. Academy Press Inc, London.

Kincaid, RL, (1999). Assessment of trace mineral status of ruminants: A review. Proceedings of the American Society of Animal Science.

McDonald, P., Edwards, R.A., Greenhalgh, J.F. and Morgan, C.A. (1998). Animal Nutrition, 5th edition, Longman, Essex, United Kingdom.

McDowell, L.R., (1992). Nutrition of grazing ruminants in warm climates. Academic Press Inc, San Diego, CA.

Obi TU and V.O. Anosa, (1980). Hematological studies of domestic animals. IV: Clinico-hematological features of bovine trypanosomiasis, theileriosis, anaplasmosis, eperythrozoonosis and helminthiasis, Zenntral blatt fur Veterina Medizi ni, 27(17): 789-797.

Oduye, O.O. (1976). Hematological values of Nigeria goats and sheep. Trop Anim. Health and Production. 8: 131-136.

Oduye, O.O. and Adadevoh, B.K. (1976). Biochemical values of apparently normal Nigerian goats. T. Nig. Vet. Assoc. 5: 51-55.

Opara, M.N., Udevi, N. and Okoli, I.C. (2010): Hematological parameters and blood chemistry of apparently healthy WAD goats in Owerri, South eastern Nigeria. New York Science Journal 3 (8) 68-72.

Otesile, E.B., Kasali, O.B. and Babalola, M.L. (1982). Mortality in sheep on the University of Ibadan Teaching and Research Farm, Nigeria. Bull. Anim. Hlth. Prod. Afr., 30:135-142.

Otesile E.B., Kasali, O.B. and Nzakwu, C.K. (1983). Mortality in Goats on the University of Ibadan Teaching and Research Farm. Bull. Anim. Hlth. Prod. Afr. 31, 185-191.

Peters, T., Biamonte G.T. and Doumas, B.T. (1982). Protein (total protein) in serum, urine and cerebrospinal fluid. In: Selected Methods in Clinical Chemistry, Vol 9 (Faulkner, WRS, Meites, Eds). American Assoc, Clinical Chemistry, Washington DC, USA.

Sanni, B. D., Gyang E.O., Osinowo, A.O. (1998). Polythene bag induced rumen impaction in small ruminants. An environmental hazard. In: Proceedings of Silver anniversary conference of the Nig. Soc. Anim. Prod. Abeokuta, 97-98.

Schalm, O.W., Jain, N.C. and Carol, E.J. (1975). Veterinary Hematology 3rd edition, Lea NA D Febiger, Philadelphia, USA pp 1-13

Sowande, O.S., Odufowora, E.B., Adelakun A.O. and Egbeyale, L.T. (2008). Blood minerals in WAD sheep and goats grazing natural pastures during wet and dry seasons. Arch. Zootec. 57 (218): 275-278.

Taiwo, V.O. and Anosa, V.O. (1995). Fibrinogen, Leucocyte and hematocrit values of cattle with various disease conditions. Trop. Vet 13: 51-57.

Tambuwal, F.M., Agale, B.M. and Bangana, A. (2002). Hematological and Biochemical values of apparently healthy red sokoto goats. Proceeding of 27th annual conference. Nigerian Society of Anim. Prod. (NSAP), March 17-21, 2002. FUTA. Akure. Nigeria. P.50-53.

Valdez, R.E., Robinson, J.J. and D. Scoh, D. (1977). The effect of different degrees of food restriction in late pregnancy on Nitrogen metabolism in ewes. J. Agric. Science, Cambridge 88: 399-403.

Vihan, V.S. and Rai, P. (1987). Certain hematological and biochemical attributes during pregnancy, parturition and post-parturition periods in sheep and goats. Indian Vet. Journal of Animal Science 57 (11): 1200-1204.

Waziri, M.A., Ribadu, A.Y. and Sivachelvam, N. (2010). Changes in the serum proteins, hematological and some serum biochemical profiles in the gestation period in the Sahel goats. *Veterinarski Arhiv 80* (2): 215-224.