



## Trend in Occurrence of Diseases Causing Abnormal Haematological Values In Domestic Animals Based on Haematological Records of Cases In Zaria And Its Environs

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### SUMMARY

Haematology could be defined as a branch of medical science that studies the blood and blood-forming tissue and organs, which employ blood cells as principal effectors of the physiologic functions determination (Waugh and Grant, 2001). Blood is a specialized fluid that makes up the greatest percentage of total body fluid that serves as the major route of drugs, nutrients and oxygen transport to the body cells (Guyton and Hall, 2001; Katzung et al., 2009; Sembulingam and Sembulingam, 2010; Saka et al., 2011). It also eliminates waste products away from the cells (Cheeke and Shull, 1999). Hence, it is important for pulmonary and tissue respiration. It is the major medium of endocrine and neurohumoral transmissions, biotransformation, and metabolic excretion, nutritional and immunological processes, as well as homeostatic responses and drug transport (Oze, 1992; Adebayo et. al., 2005; Saka et al., 2011). Disease factors, which have continued to be limiting factors to improved livestock production in tropical Africa are common causes of alterations in haematological values (Useh et al., 2003; Hostetter and Andreasen, 2004; Adamu et al., 2007). Any significant changes in the haemogram could result in anaemia or polycythemia, leucopenia or leukocytosis, and thrombocytopenia or thrombocytosis, as the case may be (Useh et al., 2003; Hostetter and Andreasen, 2004; Adamu et al., 2007). Assessment of haematological parameters is a prerequisite to understanding how the body systems function in health and diseased state (Siros, 1995; Awah and Nottidge, 1998). The parameters include; red blood cell count (RBC), haemoglobin concentration (Hb), packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), total white blood cell count (WBC), and differential leukocyte count (lymphocytes, neutrophils, basophils, eosinophils, and monocytes). Blood is formed essentially in the mesenchyme, endothelium, liver, spleen, thymus and lymph nodes of an embryo; but as bone marrow develops, the formation of the blood cells is transferred to this organ (Coles, 1986).

Disease factors, which have continued to be limiting factors to improved livestock production in tropical Africa (Tarawali *et al.*, 1999; Adegbola, 2002; Useh *et al.*, 2003; Adamu *et al.*, 2007), are common

causes of alterations in hematological values such as those of erythrocytes, leucocytes and thrombocytes as well as their developmental forms (Sirois, 1995; Hostetter and Andreasen, 2004). Blood is used as one of the diagnostic vital parameters to detect any physiologic or pathologic disturbances in the body. The recognition of this clinical importance of the blood makes hematological and serum biochemistry analyses essential and routine diagnostic tools in medicine (Bush, 1993; Awah and Nottidge, 1998). Changes in haemogram could have serious clinical implications; often with attendant clinical implications irrespective of the cause. This paper attempts to predict the trend in the occurrence of diseases that cause changes in haematological parameters of animal patients presented to Ahmadu Bello University (ABU) Veterinary Teaching Hospital (VTH), Zaria for either routine checkup or with one clinical ailment or the other using clinical pathology laboratory records.

**Keywords:** low PCV, high PCV, low WBC, high WBC

## METHODOLOGY

In the present study, haemograms of animal patients presented to VTH, ABU, Zaria with one complaint or the other, were evaluated for abnormal values of PCV and WBC for a 10-yr period (2001 – 2010). Records of haematological values of Canine, Equine, Caprine, Ovine, and Bovine species were meticulously examined to crosscheck for their abnormal values of PCV and WBC. Haematological values either above, within or below the normal values of the different species were recorded. Normal values for the different species were those established by Coles (1974).

## Statistical Analysis

Values obtained were subjected to simple descriptive statistics such as percentages, means, and standard deviations, and by One-way Analysis of Variance (ANOVA) using Graph Pad Prism version 5. Differences between each group were compared by using Tukey's HSD Multiple Comparison Tests. Values of  $P < 0.05$  were considered significant. Trend lines were plotted to represent the percentages

## RESULTS

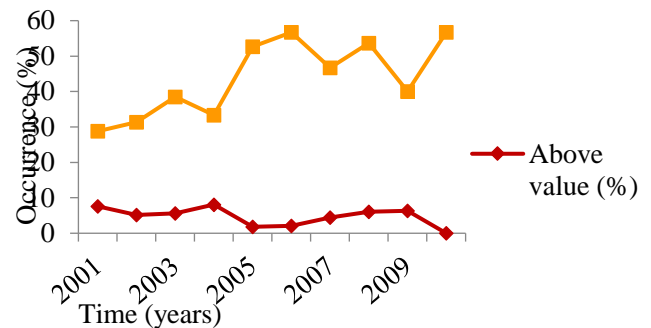
The percentage of canine patients presented with abnormally low PCV steadily increased from

28.8% (2001) to peak in 56.7% (2006) before relatively stabilizing up to 2010. On the other hand, the percentage of canine patients presented with abnormally high PCV was highest in 2001 (8.1%) and lowest in 2010 (0%) (Figure 1a). In Equine, the occurrence of abnormal values of PCV fluctuated between 0% (2001, 2002 and 2004) and 26.1% (2007), thereafter fall down to 0% (2010) for values above normal. For abnormally low equine PCV values, the peak was observed in 2001 (16.7%) before relatively retard to 2% (2006) and thereafter maintained 0% up to 2010 (Figure 2a). In caprine, the percentage of cases with abnormally low PCV fluctuated between 0% (2001 and 2004) and peaked at 40.7% in 2008 while the percentage of those with abnormally high PCV increased steadily from 0% in 2004 to 22.2% in 2010 (Figure 3a). For the ovine patients, percentage of patients with abnormally low PCV was highest (29.2%) in 2005 and lowest in 2001 and 2003 (0%), whereas percentage of those with abnormally high PCV was significantly high (50%) in 2003 and very low in other years during the 10-year period (Figure 4a). In the bovine, the percentage of patients with abnormally low PCV was high in 2001(32%), 2005(42.9%) and 2007(40%) while the percentage of those with abnormally high PCV (16.7%) peak in 2008. Similar fluctuations were observed in the occurrence of abnormal values of WBC during the period of study. The

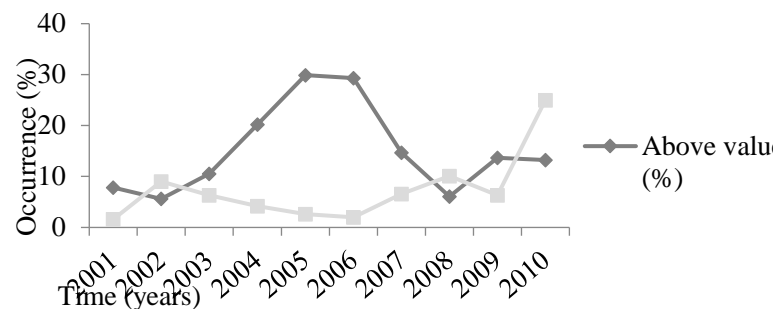
percentage of canine patients presented with abnormally high WBC steadily increased from 2001(7.8%) to peak in 2005 (29.9%) and then declined to 14.7% in 2007 before relatively stabilized up to 2010. On the other hand, the percentage of canine patients presented with abnormally low WBC fluctuated between 1.6% in 2001 and 25% in 2010 (Figure 1b). In Equine species, abnormal values of WBC fluctuated between 0% and 54.5% for values above normal, and 0% and 15.4% for values below normal (Figure 2b). In caprine, the percentage of cases with abnormally high WBC steadily increased from 2001 (0%) to peak in 2006 (63.3%) and then relatively declined to (7.4%) in 2010, while the percentage of those with abnormally low WBC fluctuated between 0% and 44.7% (Figure 3b). In Ovine species, abnormal values of WBC fluctuated between 8.0% (2007) and 54.2% (2005) for values above normal, and 0% and 10% for values below normal (Figure 4b). In Bovine species, abnormal values of WBC fluctuated between 0% (2001) and 69.2% (2005) for values above normal, and 0% and 14.3% for values below normal (Figure 5b). The summary of the percentage occurrence of cases (2001 – 2010) in all the species under study is shown in figure 6 below show.

Results obtained showed that the percentage of cases presented with abnormally low PCV was significantly ( $P < 0.05$ ) higher than those presented with abnormally high values of the parameter for each of the animal species in the period under review, except in the equine in which the contrary was observed. Percentage of canine, caprine, ovine and bovine with PCV values below normal were significantly ( $P < 0.05$ ) higher compared to those with PCV values above normal. Meanwhile, the results obtained showed that the percentage of cases presented with abnormally high WBC was significantly ( $P < 0.05$ ) higher than those presented with abnormally low values of the parameter for each of the animal species in the period under review. Significant higher percentage of ovine and bovine with higher

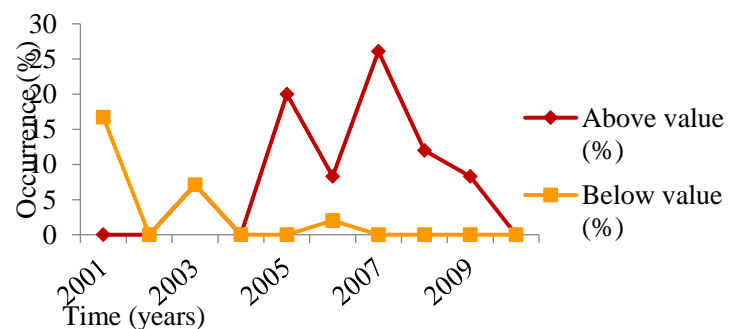
WBC values were observed compared to those with lowered WBC values (Figure 6).



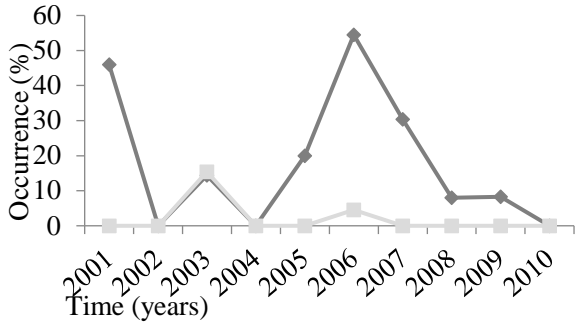
**Figure 1a:** Occurrence of abnormal PCV values in canine species



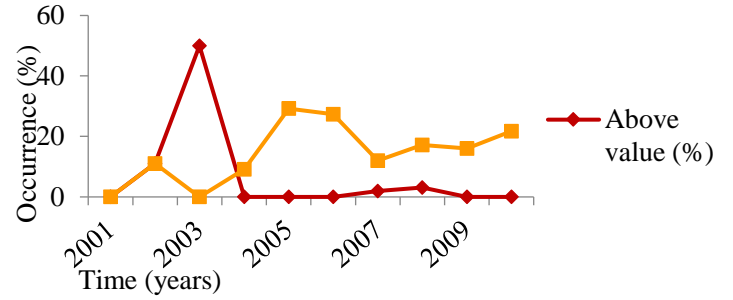
**Figure 1b:** Occurrence of abnormal WBC values in canine species



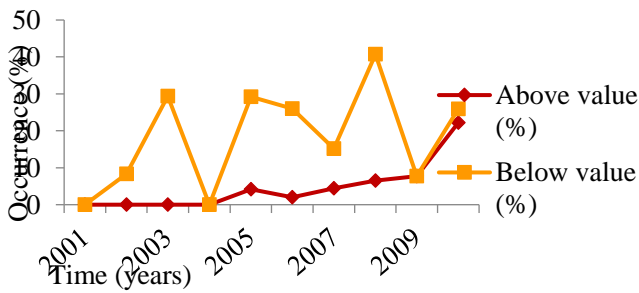
**Figure 2a:** Occurrence of abnormal PCV values in equine species



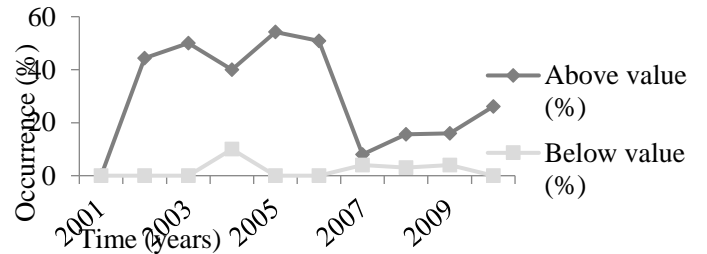
**Figure 2b:** Occurrence of abnormal WBC values in equine species



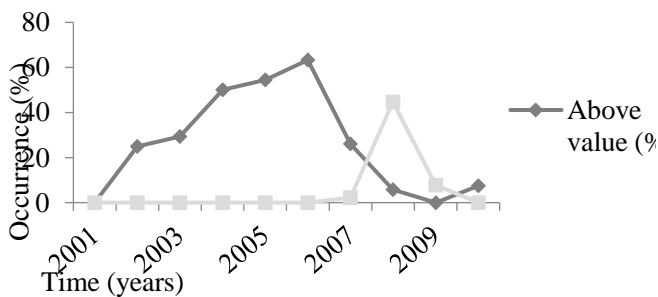
**Figure 4a:** Occurrence of abnormal PCV values in ovine species



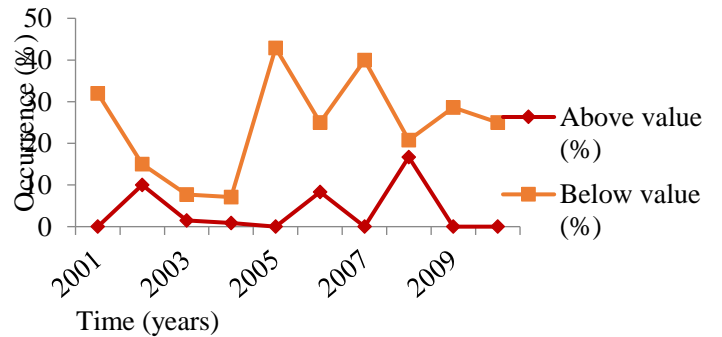
**Figure 3a:** Occurrence of abnormal PCV values in caprine species



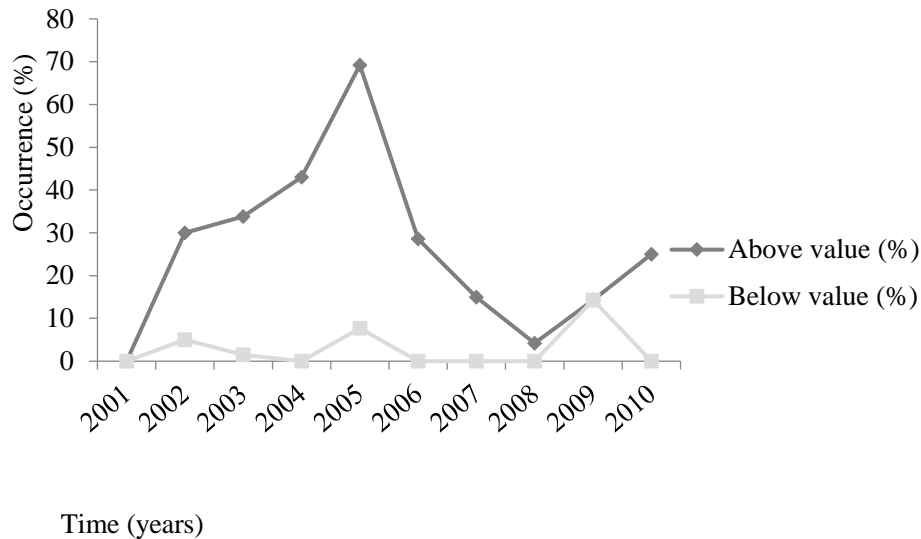
**Figure 1b:** Occurrence of abnormal PCV values in ovine species



**Figure 3b:** Occurrence of abnormal WBC values in caprine species



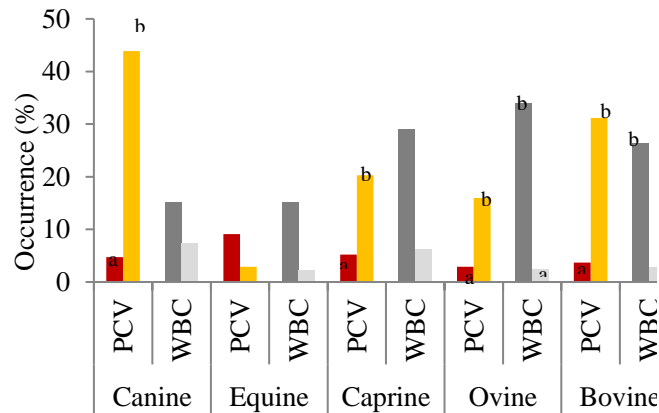
**Figure 5a:** Occurrence of abnormal PCV values in bovine species



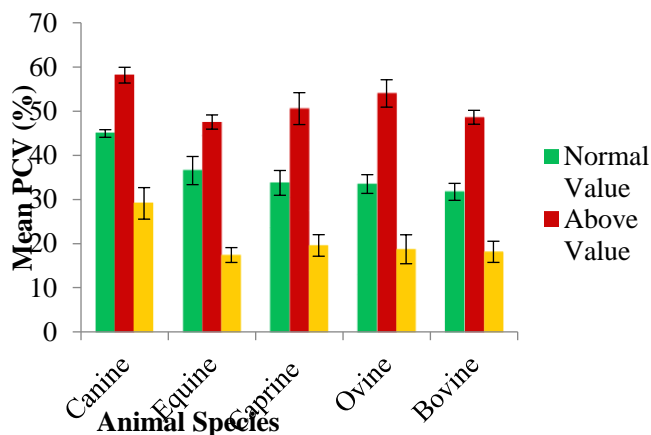
**Figure 5b:** Occurrence of abnormal WBC values in bovine species

Table 1: Summary of the percentage ranges of the abnormal haematological values of the various species under study, 2001 – 2010

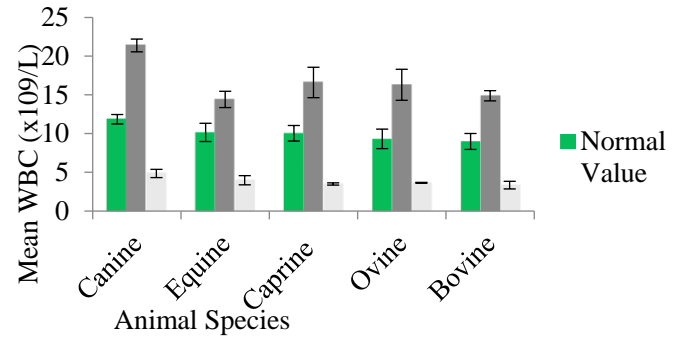
Species	PCV		WBC	
	Above value	Below value	Above value	Below value
Canine	0 – 8.1%	28.8 – 56.7%	5.6 – 29.9%	1.6 – 25.0%
Equine	0 – 26.1%	0 – 16.7%	0 – 54.5%	0 – 15.4%
Caprine	0 – 22.2%	0 – 40.7%	0 – 63.3%	0 – 44.7%
Ovine	0 – 11.1%	0 – 29.2%	8.0 – 54.2%	0 – 10.0%
Bovine	0 – 16.7%	7.1 – 42.9%	0 – 69.2%	0 – 14.3%



**Figure 6:** Summary of the occurrence of abnormal haematological values in the various species (2001 – 2010). PCV = packed cell volume, WBC = total white blood cell count, and cases with different superscripts (a and b) indicate significant differences ( $P < 0.05$ )



**Figure 7:** Summary of the mean abnormal packed cell volume in the various species, 2001 - 2010



**Figure 8:** Summary of the mean abnormal total white blood cells count in the various species, 2001 – 2010

## DISCUSSION

The findings in this study clearly show that diseases that cause significant alterations in hematological values are very endemic in our environment (Oduye and Otesile, 1977; Agbede, 1986; Useh *et al*, 2003). Abnormal decreases in PCV values are of common occurrence in all the animal species just as observed in this study, any significant decreases in PCV, RBC or Hb results in anemia. Relative anemia caused by dilutional effect is a rare occurrence but can be observed such as following aggressive fluid therapy or other cause of increased plasma volume such as pregnancy. The cause of absolute anemia, in which there is actual; reduction in erythrocyte mass are many and varied in our environment. Nutritional deficiency as an etiologic factor is only; significant in piglets that are raised on concrete floors without iron supplementation (Coles, 1986). Hemolytic crises such as may occur in bacterial, viral and parasitic infections occur commonly in our animals. Haemolytic anaemia of Leptospirosis (*Leptospira* species) occurs in canine, caprine, ovine and bovine species. With resultant deformed erythrocyte, icterus, haemoglobinuria, and erythrocyte sedimentation. Bacillary haemoglobinuria occurs in sheep and cattle; *Clostridium haemolyticum* encounter in a pasture with inadequate drainage and death may occur rapidly. Anaemia due to *Clostridium chauvoei*

occurs also in cattle through its neuraminidase production. Haemolytic anaemia is also encountered in Equine infectious anaemia in horses with a severe manifestation of jaundice, oedema and petechial haemorrhages in the mucosa (Esievo, 2017). Other causes of hemolytic anemia include protozoan infections (Babesiosis and Trypanosomiasis) (Mamo et al., 1977; Dargie et al., 1979b; Esievo et al., 1982), immune-mediated disorders (dogs, horses, and cattle), enzyme deficiency, metabolic diseases, poisonous plants (oak shoot, castor beans, broom, Wild onions and so on), chemical agents (copper, lead, phenylhydrazine, phenylthiazine etc), physical damage to erythrocytes (babesiosis, leptospirosis, thrombotic thrombocytopenic purpura, strenuous activities, such as running a marathon, preeclampsia or eclampsia etc), oxidative damage to the erythrocytes but are of rare occurrence. Blood loss commonly leads to abnormal decreases in PCV values. Some of the causes of blood loss include ecto- and endoparasitism (Useh et al., 2003), traumatic injuries, gastrointestinal tract ulcers or bleeding and poisoning due to sweet clover, warfarin or bracken fern or in coagulopathy generally. Rarely, deficiency in some of the blood clotting factors occurs and can lead to blood loss anemia. Idiopathic aplastic anaemia occurs in Familial hereditary anaemia of Basenji dogs and Porphyria hereditary anaemia in cattle, swine, and cats. Changes in RBC and Hb are caused by factors responsible for changes in PCV values.

Abnormal increases in PCV values may be absolute, for example, polycythemia vera and hypoxia-induced erythropoiesis or relative following dehydration most likely the result of animals suffering from diseases that are accompanied by diarrhea and or vomiting, depending on the animal species (Abdulkadir, 1989, Useh et al., 2005, Useh et al., 2012b). Diarrhea results in dehydration with resultant haemoconcentration, hence the apparent increases in the erythrocyte mass as shown by

increased values of PCV or HB (Bush, 1993; Sirois, 1995, Useh et al., 2005). Absolute increases in PCV or polycythemia are of fewer occurrences in animals (Bush, 1993). Polycythemia vera, a neoplastic hematopoietic stem cell disorder typified by excessive erythropoiesis, is of rare occurrence in animals (Cowell, 2004). Polycythemia vera of dog and cow (brisket disease), and primary familial polycythemia of Jersey calves; increase of PCV, RBC and Hb occur. Renal carcinoma in a dog may cause polycythemia, due to increased erythropoietin in the blood suggestive of the contributory role by juxtaglomerular apparatus (Esievo, 2017). Abnormal increases in PCV values could be the result of secondary polycythemia, which arises from increased secretion of erythropoietin. Increased erythropoietin levels and the resultant in polycythemia are appropriate in situations when hypoxia is present (Bush, 1993; Cowell, 2004).

Total white blood cell (leucocytes) refers to a group of blood cells which includes lymphocytes, granulocytes (neutrophils, basophils, and eosinophils) and monocytes. Alterations in WBC count could be caused by a variety of physiologic and pathologic factors (Coles, 1986). In most instances, increase in WBC count (leukocytosis) above the normal reference range occur as a result of an abnormal increase in circulating segmented neutrophilic granulocytes though may be accompanied by other cell types. Some of the infectious causes of leukocytosis include bacterial infections, which could be acute or generalized in nature, parasitic infections, rapidly growing neoplasms (Coles, 1986), leukemia, lymphocytes initiated immune response in some disease conditions and the later stages of viral infections. Leukocytosis could also be observed in intoxication due to metabolic disturbances, chemicals, drugs, and venoms. Eze and Nanji (2008), reported marked leukocytosis, as high as



237,300/mm due to neutrophilia in pyometra in Great Dane. Emikpe (2009) observed leukocytosis due to neutrophilia in an experimental Peste de Petits Ruminantes virus infection in West African Dwarf Goats. Other causes include stress (which causes increased glucocorticoids secretion), parturition (Eduve et al., 1984), apprehension, and excitement of a patient. Stage of maturation of the cells and the numerical alterations of the other cell types must be related to clinical examination or condition of the patient for a proper diagnosis. Generally, increase in WBC count depends on the susceptibility of the host, virulence of the infecting agent, immune status of the host and the ability of the host to localize the infectious process.

Decreases in WBC count (leukopenia) may be due to a decrease in all the cellular elements or as a result of a single cellular component such as lymphopenia, neutropenia, eosinopenia or monocytopenia though very rare. Leukopenia is observed in the initial stages of viral infections (infectious canine hepatitis, canine distemper, mucosal disease, and rinderpest), overwhelming bacterial infections (Esievo, 2017), acute phase of viral trypanosomiasis (Esievo and Saror, 1983), intoxication and bone marrow irradiation. Useh et al., 2011 reported marked decrease in WBC count in Zebu cattle experimentally infected with *Clostridium chauvoei*

## CONCLUSION

It is instructive to note that an increase or decrease in the percentage of animals with abnormal haematological parameters suggests increase or decrease in the occurrence of diseases that cause such alterations in any particular year. The study also demonstrated that diseases that cause changes in haematological values are still endemic; there is the need to identify them with the view to re-designing our control strategies

## RECOMMENDATION

There is the need to establish the specific aetiologies of these abnormal values so that we can re-design our disease control strategies.

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