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Haemato-biochemical Alterations in Cattle Suffering from Anaemia and Their Effect on Quality of Some Meat

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Abstract

Nowadays consumers are highly interested in the quality of the products they eat, especially when this refers to meat so this current analysis is a review of the anaemia as a factor affect meat quality in ruminants. Out of (135) cattle of different ages, sexes and breeds from different localities, (farms and abattoirs) in Ismailia Governorate found forty eight animals were anaemic. All these animals were examined clinically and laboratory to determine their situations of anaemia and parasitic infestation. Animals were classified into three groups, 1st group were healthy cattle free from blood parasite (n=25) used as control group, 2nd group were suffering from *Theileriosis* (n=28) and 3rd group were suffering from *Babesiosis* (n=20). Two blood samples were collected from each animal for determination of erythrogram and leukogram changes and some biochemical parameters in separated sera. The results of the hematological picture revealed a significant reduction in RBC, HB, PCV, MCV and MCH in cattle infected with *theileriosis*. *Babesiosis* induced significant decreases in RBC, HB and PCV with insignificant changes in MCV, MCH and MCHC (normocytic normochromic anaemia) while *theileriosis* induced significant increase in MCV and decrease in MCH and MCHC (macrocytic hypochromic anaemia). Bovine infected with *theileriosis* and *babesiosis* revealed leukopenia and neutropenia accompanied with lymphocytosis compared to control group. The result of biochemically analysis showed that cattle infected with *theileriosis* and *babesiosis* revealed significant reduction in total protein, albumin, globulin, glucose and iron levels associated with significant increase in the activities of liver enzymes AST, ALT, total bilirubin, urea and creatinine. The muscle samples which were taken from slaughtered anaemic cattle, examined physico-chemically and sensory properties, found that pH and (TVBN) values were significantly high whereas the moisture, protein and fat percent were decreased accompanied with reduction in (TBA) and iron percent. The muscle from the healthy control group had significantly higher scores for tenderness and overall likeness than those from the other anaemic groups. So it is recommended that the animal showing signs of systemic disturbance and elevated temperature should not be slaughtered but retained for treatment, preferably outside the meat plant.

Key words: Biochemical, Hematological examination, *Theileriosis* and *babesiosis*, Chemical analysis, meat quality, sensory property.

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Introduction

Anaemia in bovine is of incredible significance because its mortality and morbidity act as direct losses while indirect losses are represented in shape of decreased manufacturing **Zahid *et al.*, (2005). Goklaney *et al.*, (2012)** said that, anaemia is functionally defined as decreased oxygen interest capability of blood and this case is clinically characterized by low haemoglobin (Hb), haematocrit (PCV) or overall erythrocyte count (TEC) consistent with unit quantity of blood in a generally hydrated animal **(Kahn and Line, 2010).** Haemolytic anaemia is encountered within the haemoprotozoan infections such as *Theileriosis*, *Babesiosis* and *Rickettsial* infections which consist of *Anaplasmosis* **(Soulsby, 1986)**. Ticks are compulsory blood-sucking arachnid arthropods infecting mammals, birds, reptiles and amphibians. They're vectors of disease agents (such as *babesiosis*, *cowdriosis*, *anaplasmosis*), causing anaemia, dermatitis, paralysis, otocariasis, as well as the lack of production **(Schmidt and Roberts, 1989)**.

These days Piroplasmosis is a disease with an international distribution affecting many species of mammals with a prime impact on cattle and human. It has increasingly more been diagnosed throughout the sector as public health problems **(Zanet *et al.*, 2014).** *Babesia* spp. and *Theileria* spp. are protozoan parasites transmitted in particular with the aid of ticks and capable of infect erythrocytes and / or leukocytes of a huge form of domestic and wild animals **(Silva *et al.*, 2010).** *Babesia* is the second most commonplace parasites located within the blood of mammals after trypanosomes **(Yabsley and Shock, 2013).** *Babesiosis* and *Theileriosis* cause direct economic losses, inclusive of mortality, decrease in meat and milk yield, and indirectly through manipulating measures of ticks **(Gharbi *et al.*, 2011).** The main clinical signs in animals infected with blood parasites were fever, congested mucous membranes, anorexia, nasal discharge, lacrimation, haemogloinuria, anaemia, respiratory distress and eye lesions besides presence of ticks on the animal body **(Awadalla and El-Kholany, 1998).** *Theileriosis* and *babesiosis* cause severe economic losses and have the effect on the immune status of the body **(Urquhart *et al.*, 1996).**

Microscopy the use of Giemsa-stained blood smears has been considered the "gold trendy" for detecting *Babesia* and *Theileria* organisms inside the blood of infected animals, in particular in acute instances, but not in providers, in which the parasitemia is low, with small numbers of the protozoa within the peripheral blood **(Nayel *et al.*, 2012).** Hematology and serum biochemistry of infected animals are very touchy indicators for the degree of hepatic damage and the parasitic infection severity, wherein liver damage upsets the vital metabolic methods for regular health and most fulfilling productiveness of the animal. *Theileria annulata* infection in cattle led to anemia and other damaging effects at the hematological profile

(AbdEllah and AL-Hosary, 2011). Meat is one of the most important foods in the world. In fact, meat provides valuable amounts of protein, fatty acids, vitamins, minerals and other bioactive compounds. In other countries, meat is just a complement for an already balanced diet. Actually there are consumers that consider meat to be a healthy and important component in the diet **(Verbeke *et al*., 2010).** The intrinsic quality and components of beef (for instance, intramuscular fat content, fatty acid composition, flavor, juiciness or tenderness) may influence consumers´ acceptability more than price and quality tags **(Oliver *et al*., 2006).** Differences in meat characteristics are assessed in sensory analyses. Sensorial differences between species are detected by consumers, even when meat is seasoned, as **(Rhee *et al*., 2003).** In addition, chemical composition and total volatile base nitrogen determination was considered the most objective method for determining freshness **(Fontes *et al.*, 2007)** & thiobarbituric acid test which is a sensitive test for the decomposition products of highly unsaturated fatty acids **(Melton, 1983).** The shelf-life is the amount of time that passes before meat becomes unpalatable or unfit for human consumption because of the growth of spoilage organisms and may include appearance, texture, flavor, color and nutritive value **(Singh and Singh, 2005).** Therefore, the objective of this study was to investigate the physico-chemical, sensory properties and haemato-biochemical changes in cattle livestock suffering from anaemia and its relation with the public health significance.

Materials and Methods

1. Animals:-

The present work was carried out on (135) cattle of different ages, sexes and breeds from different localities and different breeding farms and abattoirs in Ismailia Governorate. These animals were examined clinically and laboratory to determine current epidemiological situation of anaemia and parasitic infestation while there were (25) out of them were apparently healthy (parasitologically and bacteriologically free) used as control group.

2. Clinical Examination:-

It was performed for all animals according to **Rosenberger, (1990)**. The clinical signs of anaemia were observed and recorded in **Table (1)**. Post mortem inspection was occurred to all animals after slaughtering. The anaemic cases found subcutaneous oedema, thin watery blood, hypertrophy of heart, fatty changes in liver, dark color of muscles, enlargement of superficial lymph nodes, not well bled carcass, enteritis and low intramuscular fat content.

3. Collection of sample:-

Samples of feces, blood and serum for studies became accumulated from livestock. Blood samples have been taken from jugular vein puncture, 1st sample on EDTA for erythrogram, leukogram and blood indices (MCV, MCH, and MCHC) examination,

the 2nd sample without anticoagulant (serum) for biochemical exam. Muscle samples from the loin (m. longissimus dorsi, LD) were collected from normal and anaemic animals after slaughtering in abattoir of Ismailia city. The obtained samples were weighted about 50 -100 g and immediately were transferred into a sterile polyethylene bags and placed in the ice-box without delay to the Laboratory of animal health institute in Ismailia to be examined.

4. 1. Hematological examination:-

Hematological research viz., Hb, TLC, differential leukocytic count, TEC, PCV, suggest corpuscular quantity (MCV), (MCH), and (MCHC) had been anticipated following the technique of Benjamin **(Benjamin, 2008)**.

4. 2. Blood films examination:-

Skinny blood smears were organized from the ear veins of all cattle according to **Zafar *et al.*, (2006)**. The parasites had been diagnosed in step with the characters defined with the aid of **(Soulsby, 1982).** The smears have been recorded as negative for piroplasms if no parasites have been detected in 50 oil-immersion fields in keeping with **(Moretti *et al.*, 2010).**

5. Serum biochemical examination:-

Serum biochemical parameters were determined through the use of Technicon Ames RA-50 chemistry analyzer using diagnostic kits of Bayer **(Anonymous, 1990)**. The tiers of the subsequent plasma components have been decided: total protein (TP), albumin, whole bilirubin and alanine aminotransferase (ALT) and aspartate aminotransferase (AST). Glucose furthermore decided in line with **(Siet *et al.*, 1981).** The albumin: Globulin ratio changed into calculated. Plasma iron was also estimated.

6. Chemical Analyses:

6.1. Determination of pH:-

Initial pH was measured within 45 min post slaughter. The pH was determined by using a portable needle-tipped combination electrode (NWKbinar pH-K2, Germany) in the center of the muscle until the muscle was judged to have reached ultimate pH.

6.2 Determination of moisture %, protein % and fat %:-

Proximate analysis of samples was measured according to the method of the Association of Official Analytical Chemists **(AOAC, 2006).**

6.3 Determination of total volatile basic nitrogen (TVBN):-

Protein deterioration was studied by determination of total volatile basic nitrogen (TVBN) as mg N/100g sample, according to **Pearson, (1981).**

6.4 Determination of thiobarbituric acid values (TBA):-

Lipid oxidation was assessed by 2-TBA method of **Vyncke, (1975)**. Thiobarbituric acid reactive substances (TBARS) values were expressed as mg MA/kg sample.

6.5 Determination of iron %:-

The collected samples were decomposed according to **Akan *et al.*, (2010).** Samples were performed directly on each of the final solutions by using Atomic Absorption Spectrophotometer (Perkin Elmer, 2380, USA). The obtained result of Fe was recorded ppm (mg /kg) on wet weight of the examined muscle. This analysis was done at Animal Health Research Institute, Dokky, Cairo.

7. Sensory evaluation:-

For sensory evaluation of the normal and anaemic round muscles, according to **(AMSA, 1995).**

8. Fecal examination:-

Faecal samples were examined according to **Anonymous, (1977).**

9. Statistical analysis:-

The obtained data were statistically analyzed according to **Petrie, and Watson, (1999).**

Results and Discussion

Clinical findings of cattle suffering from *theileriosis and babesiosis* are listed in **Table (1).** The infection was confirmed conventionally by the detection of the intra-erythrocytic (signet ring) stage of the protozoan parasite *Theileria annulata*. Haemogram and serum biochemical analysis in case of *theileriosis* and *babesiosis* infestations are summ-arized in **Tables (2, 3).** Out of 135 animals, 48 (35.55 %) were anaemic and 87 were non-anaemic on the basis of laboratory analysis (25) out of non anaemic used as healthy control. The presenting clinical signs as shown in **Table (1)** anaemic cattle were (Emaciated, Congested mucous membrane, Lacrimation and corneal opacity, body temp. was 40.5°C, the pulse was 73 beats / minute. Ruminal contraction was 3.85±0.46, respiratory cycle / minute were 38, lymph node appear Swollen, painful and hot during palpation. And the urine color was Straw yellow in case of *Theileriosis* (N= 28) these come agree with **Al-Emarah *et al.*, (2012)** reported that cows exhibited sings of fever, enlargement of superficial lymph nodes, respiratory signs with corneal opacity, with subcutaneous accumulation of fluid in *Theileria annulata* infestation. Increases of body temperature occur due to the liberation of endogenous progeny as results of cellular lysis and high level of parasitemia which lead to the stimulation of thermoregulatory center in the hypothalamus **(Glass *et al.*, 2003).** Enlargement of superficial lymph node may be due to lymphoid hyperplasia which occurs due to increases of proliferation of microschizonts inside the lymphocyte caused inflammatory reaction in the infected lymph node **(Jabbar *et al.*, 2008).** Paleness of mucous membranes due to reduction of hemoglobin concentration and the total erythrocytes count and the cornel opacity was explained by **(Osman and Al-Gaabary, 2007)** as a result of white blood cells infiltration. Respiratory signs occur due to the accumulation of edematous fluid inside the lung and thoracic cavity **(Muraguri *et al.*, 2006).** Clinical findings in (20)

cattle suffering from *babesiosis* such as thin, mucous membrane Pale in color, body temp. was 40.1°C, the pulse was 84 beats / minute. Ruminal contraction was 3.48±0.32, respiratory cycle / minute were 41, No swelling in lymph node urine appear dark brown to coffee in color with presence of tick on the animal body in *Babesiosis.* Same clinical signs were reported previously **(Fujinaga, 1981)** where cattle suffering from *babesiosis* show fever, anorexia, congested mucous membranes and dark brown to coffee urine and this brown urine may be due to severe haemolytic process associated with the presence of *Babesia* within red blood cells. Faecal examination and examination for ectoparasites revealed that out of 48 anaemic cattle, faecal samples of six animals were positive for ova infestation with *paramphostama*. Ectoparasites were present on 11 animals being ticks in eight and lice/ fleas in three cases. The major cause of anaemia in this study was blood parasite infestation followed by ectoparasite. It has been previously reported that anaemia generally occurs due to blood protozoa and endo- and ectoparaites **(Radostits *et al.*, (2010).**

The hematological values of *Theileria annulata* infected and healthy control crossbred cattle have been presented in **Table (2).** The infected group showed significantly lowered values of RBC $x10^6$/mm3 (6.46±0.51), HB g/dl (8.28±1.44), PCV % (29.71±0.88), MCV fl (57.13±2.66) and MCH pg (15.99±0.18) than healthy control animals indicating macrocytic hypochromic anaemia (increase in MCV and decrease in MCHC) come agree with **Al-Emarah *et al.*, (2012)** reported that The hematological parameter showed the hypochromic macrocytic anaemia with significant decreases in Hb, PCV %, MCHC %, RBC_C in *Theileria annulata* infestation. Similar findings have already been reported by **(Khan *et al.*, 2011 and Ghanem *et al.*, 2013).** All these changes occur as a result of anaemia which occurs due to toxic metabolites of *Theileria* spp. which have harmful effect on bone marrow as they interfere with the process of erythropossis. Persistent loss of blood was caused by permanent blood sucking ticks which played a role as well **(Durrani *et al.*, (2008).** The other importing cause to make the anaemia in bovine *theileriosis* infection was the hemolytic anaemia caused by an immune–mediated hemolytic which is indicated by the presence haemagglutinin **(Omer *et al.*, 2002).** Normocytic normochromic anaemia in *babesia bigemina* infested cattle have been presented in **Table (2)** were associated with significant decreases in RBC $x10^6$/mm3 (5.42±0.91), HB g/dl (9.89±1.52) and PCV % (28.24±2.17) with insignificant changes in MCV fl (41.30±0.71), MCH pg (14.58±0.68) and MCHC g/dl (34.41±0.71). The chronic loss of blood caused by continuous sucking of blood by the ticks may be behind this type of anaemia and could be attributed to intravascular haemolysis of red blood cells. Similar findings were described by **Corrier *et al.*, (1979)** and **Taha, (1991)** in tick infested cattle. The continuous itching caused by tick may unable the animal to intake the adequate feed resulting under nutritional condition and anaemia.

Normocytic normochromic anaemia with *babesiosis* was confirmed by **(Ibrahim *et al.,* 2009)**.

Leucogram in *theileriosis* and *babesiosis* revealed significant decrease in total leucocyte (8.51±0.94), (8.13±0.55) count and neutrophils (1.89±0.34), (1.61±0.28) while lymphocytes (7.93±0.82), (7.18±0.63) and monocytes respectively, showed significant increase in comparison with apparently healthy control animals. Such changes in leucogram might be attributed to persistent harmful effects of toxic metabolites of *Theileria* on the haemopiotic organs specially bone marrow and their interference with the process of leucogenesis. Increase in numbers of lymphocytes reflects compensatory mechanism as target cells in response to their invasion with *Theileria* protozoan as confirmed by results observed in *Theileria* infected cattle by **Abo-EL-Hassan, (1997)**. Breakdown of red blood cells by *Babesia spp*. stimulates the phagocytic cells such as lymphocytes and monocytes to clean up the body from the toxic remnants of ruptured red blood cells, as well as increase tissue demand of neutrophils that reduce the neutrophil in peripheral circulation. This is in agreement with **Guglielmone *et al.,* (1996)** who reported that *Babesia* infection lead to stimulation of body defense mechanism to produce antibodies against *Babesia* antigen.

Plasma biochemistry may be an indication of the severity of the infection, and a very good tool for diagnosis, prognosis, and evaluation of the therapy applied. Also, to understand the host-parasite relationship, biochemical results are illustrated in **Table (3).**The liver plays a central role in *babesiosis*, it is the site where the pre-erythrocytic stages of *babesia* parasites asexually multiply and where host immature mechanisms develop to fight these pre-erythrocytic stages **(Cohen *et al.,* 1982)**. In *theileriosis* and *babesiosis* our study showed significant increase in the levels of AST (42.62±1.27), (43.57±2.11), ALT (72.16±2.71), (74.95±3.83), urea (7.12±1.02), (7.94±0.81) and creatinine (97.68±4.87), (102.64±6.38), respectively. Significance harmful effect of toxic metabolites of *Babesia* sp. on liver cells lead to impairment and alterations of the liver and kidney enzymes these results agree with those of **(Saber *et al.,* 2008)**. **Hussein *et al.,* (2007)** reported the significant increase in aspartate aminotransferase (AST), alanine aminotransferase (ALT) in *babesiosis*. Furthermore, the significant rise in serum AST activities is due to muscle trauma caused by prolonged recumbency in *theileriosis* **(Omer *et al.,* 2002).** A significant increase in total bilirubin (0.65±0.03), (0.67±0.04) in *theileriosis* and *babesiosis* due to hepatic damage and the, presumably hemolytic anaemia was confirmed by **(Yeruham *et al.,* 2003)**. Overall, the degenerative changes in the internal organs as indicated by biochemical response may be due to anaemic hypoxia.

Significant decreased in serum total protein (6.89±0.45), (6.94±0.38), albumin (2.32±0.53), (2.12±0.25) concentration in *theileriosis* and *babesiosis* respectively these results were in agreement with **(Saber *et al.,* 2008)**. The hypoproteinaemia and

hypoalboumineamia is possibly due to the harmful effect of toxic metabolites of *Theileria, babesia bigmina infestation* and also due to liver failure. Increased serum globulins may reflect the body immune response to toxic metabolites of parasites.

The recorded hypoglycemia in *theileriosis* and *babesiosis* (52.13±1.96), (50.46±1.87) was attributed to severe depletion of stored glycogen and persistent feverish condition associated *theileriosis* and *babesiosis* resulting in anorexia and consequently hypoglycemia that described by **Sandhu *et al.*, (1998)** in *Theileria* infected cattle and **Fujinaga, (1981)** in *Babesia* infected cattle. The present results indicate that serum iron in *theileriosis* and *babesiosis* (117.26±3.54), (108.55±3.93) revealed a significant decrease in infected animals when compared with control. This agreed with **Lotfallah *et al.*, (2012)** who reported a significant decrease in iron concentration in cattle infected with *babesia bigmina* this may be explained that, oxidative damage to hemoglobin cause changes in its structure and function resulting in denaturation and precipitation of hemoglobin and methemoglobin formation inside erythrocyts. The decrease in plasma iron might be also due to rapid depletion of iron stores by the bone marrow for Hb production (**Khan *et al.*, 2011)**. Low iron could be likely due to secondary iron deficiency which might be attributed to blood loss due to parasitic infestation **(Radostits *et al.*, (2010)**.

The chemical analysis of meat in **(Table 4)** showed that, the moisture, protein and fat contents of the loin beef from normal and anaemic cattle are shown in **Table (4)**. The moisture, protein and fat contents decreased, according to the degree of severity of anaemic condition. The mean value of the moisture content of the anaemic loin muscle was (67.67%) while the normal (71-73%) according to **U.S. Department of Agricultural (2015).** While values of protein content ranged from 16.48% to 18.32% with mean value 17.40% at the anaemic loin muscle, this result was less than the **Egyptian Standards Specification (ESS 2005)**. The fat contents were ranged from 1.01% to 2.23 % with mean value 1.62 % for anaemic loin and 2 - 3% for normal one. The fat contents of the loin muscles of the anaemic animals were lowest than recorded by **Gracey *et al.*, (1999).** Although the visible intramuscular fat or marbling is an important meat characteristic that is appreciated by the consumer because of its positive effects on taste, juiciness, and tenderness **(Platter *et al.*, 2005)** had shown a poor correlation between intramuscular fat content and meat flavor and tenderness. pH values were significantly higher for anaemic loin muscle from(5.96) to (6.31) than normal pH of muscle which is (5.5) as mentioned by **Gracey *et al.*, (1999).** Muscles have been shown to vary in their rate of decline in pH post mortem. In anaemic lion muscle, a relatively slow pH decrease is observed, which has less impact on meat color than the pigment content. In contrast, the PM muscle demonstrates a rapid pH fall, affecting meat color to a larger extent than the pigment content **(Eikelenboom, 1988)**. Color was also correlated with the ultimate pH, such that lightness, redness, and reflectance decreased with an increase in the ultimate pH

(Guignot *et al*., 1993). Alterations in pH affects the appearance and eating quality of the meat, the most common manifestations being pale, firm and dry (DFD) beef. This is economically significant losses. TVBN values of meat according to the **ESS, (2005)** are not exceeding 20gm/100g samples. The mean value of anaemic loin muscle was 26.32 g/100mg, so the results higher than normal recommended limit of the **ESS, (1991)** and increased than results obtained by **Barile *et al*., (1985)**. These values indicate bad quality of meat. **Sharma and Goswami, (2010)** who stated that, the increase of TVBN values of market samples reflected their poor quality and unhygienic market conditions. Dealing to thiobarbituric acid (TBA) values of the examined anaemic loin muscle of cattle was ranged from 0.82 to 1.10 and mean value was 0.96 mg malonaldehyde /kg. TBA values of meat according to the **ESS, (2005)** was not exceed than 0.9 mg malonaldehyde / kg sample. Values of the examined muscle were within normal limit of the **ESS, (2005).** Concentration of Fe in all the samples under study has been summarized in **Table (1)** where the maximum concentration (14.87 mg/kg), minimum value was (9.54mg/kg) and the mean value (12.20 mg/kg). This agrees with that reported by **AbdEl-Salam *et al.*, (2013)** but higher than values which were detected by **Parekhan *et al.*, (2014).** The permissible limit of iron is generally 30-150 mg/kg, **(Demirezen and Uruc, 2006).** The results of the sensory evaluation are shown in **Table (5)**. There was significant difference in juiciness scores in the loin beef between control and anaemic slaughtering groups ($p>0.05$). The loin samples from the control group had significantly higher score in term of tenderness (70.25) while anaemic one was (55.70) and overall likeness (75.44 and 57.16) respectively. The flavor likeness was also significantly higher in the loin samples from the control group than the anaemic one which were (70.99 and 62.34) respectively. Tenderness consider as primary sensory trait when consumers was making purchasing decisions **(Mennecke *et al.*, 2007).**

Conclusions

The major cause of anaemia in this study was blood-parasitic infestation, especially by *Theileria annulata* and *Babesia bigemina*. Cattle were suffering from fever, and anorexia that usually occur as common clinical findings in cattle infected with *theileriosis* and *babesiosis*. Levels of Hb, PCV, TEC, MCH, MCHC and plasma iron were significantly lower in anaemic cattle than non anaemic cattle. Anaemia, cause poor quality and decrease shelf life of anaemic meat which has significant effect on sensory characteristics. So it is recommended that the animal showing signs of systemic disturbance and elevated temperature should not be slaughtered but retained for treatment, preferably outside the meat plant.

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Table (1): Main clinical findings of healthy and infested cattle

Clinical Findings	Healthy cattle Control (N= 25)	Anaemic cattle	
		Theileriosis (N= 28)	*Babesiosis* (N=20)
Body condition	Good	Emaciated	Thin
Mucous membranes	Bright red, moisted	Congested, Lacrimation and corneal opacity	Pale in color
Temperature	38 ° C	40.5° C	40.1° C
Pulse	61 beats / minute	73 beats / minute.	84 beats / minute.
Respiration	23 respiratory cycle/min.	38 respiratory cycle / minute	41 respiratory cycle / minute.
Ruminal contraction /2 min	5.24±0.36	3.85±0.46 *	3.48±0.32 **
Lymph nodes	No swelling, movable, hotless, painless	Swollen, painful and hot during palpation.	No swelling, movable, hotless
Urine	Light yellow	Straw yellow	Dark brown to coffee in color.

*** = P< 0.05 and ** = P < 0.01**

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Table (2): Mean values ±S.E of haematological parameters of clinically healthy and infested cattle

Parameters	Healthy cattle Control (N= 25)	Anaemic cattle	
		Theileriosis (N=28)	*Babesiosis* (N=20)
RBC x10^6/mm3	9.05±0.87	6.46±0.51**	5.42±0.91**
HB g/dl	13.91±1.22	8.28±1.44**	9.89±1.52*
PCV %	35.11±1.15	29.71±0.88*	28.24±2.17*
MCV fl	44.09±0.55	57.13±2.66*	41.30±0.71
MCH pg	17.50±0.88	15.99±0.18*	14.58±0.68
MCHC g/dl	39.04±0.54	27.30±1.42*	34.41±0.71
WBCs x10^3/mm3	10.49±0.58	8.51±0.94*	8.13±0.55*
Neutrophils (10^3/ µL)	3.15±0.16	1.89±0.34*	1.61±0.28*
Lymphocytes (10^3/ µL)	6.21±0.11	7.93±0.82*	7.18±0.63*
Eosinophils (10^3/ µL)	0.58±0.08	0.34±0.002*	0.79±0.004*
Basophils (10^3/ µL)	0.021±0.004	0.017±0.004	0.013±0.001
Monocyte (10^3/ µL)	1.07±0.40	1.05±0.022	1.09±0.019

*** = P< 0.05 and ** = P < 0.01**

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Table (3): Mean values and ± S.E of some biochemical parameters of anaemic and healthy cattle

Parameters	Healthy cattle Control (N= 25)	Anaemic cattle	
		Theileriosis (N=28)	*Babesiosis* (N=20)
Total proteins (gm/dl)	8.59±0.61	6.89±0.45**	6.94±0.38**
Albumin (gm/dl)	4.14±0.31	2.32±0.53*	2.12±0.25**
Globulins (gm/dl)	4.45±0.19	4.57±0.24*	4.82±0.14*
A/G ratio	1.08±0.19	0.87±0.08	0.87±0.09*
AST (U/l)	35.76±2.18	42.62±1.27*	43.57±2.11*
ALT (U/l)	60.44±2.79	72.16±2.71*	74.95±3.83*
T.bilirubin	0.43±0.08	0.65±0.03*	0.67±0.04*
Glucose (mg/dl)	67.18±3.07	52.13±1.96**	50.46±1.87**
Iron (mg/dl)	149.19±4.01	117.26±3.54**	108.55±3.93**
Urea (mg/dl)	4.61±0.28	7.12±1.02**	7.94±0.81**
Creatinene (mg/dl	91.20±7.61	97.68±4.87*	102.64±6.38*

*** = P< 0.05 and ** = P < 0.01**

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Table (4): Chemical composition of loin muscle from normal and anaemic slaughtered cattle.

Parameters	Normal values	Anaemic values		
		Min.	Max.	Mean
PH	5.5	5.96	6.31	6.13*
Moisture %	71-73	65.26	70.08	67.67
Protein %	20	16.48	18.32	17.40*
Fat %	3 – 4	1.01	2.23	1.62*
T.V.B.N g/100gm sample	≤ 20	22.52	30.13	26.32*
T.B.A mg malonaldehyde/ kg	≤ 0.9	0.82	1.10	0.96
Fe mg/kg	30-150	9.54	14.87	12.20*

T.V.B.N. = Total Volatile Basic Nitrogen **T.B.A= Thiobarbituric acid**

***** Significant difference ($p \leq 0.05$).

Table (5): Mean values and± S.E of sensory evaluation of normal and anaemic loin muscle of cattle

Type of muscle	Tenderness	Juiciness	Flavor-likeness	Overall-likeness
Normal	70.25 ± 2.22	65.18 ± 2.02	70.99 ± 1.91	75.44 ± 3.01
Anaemic	55.70 ± 2.81*	51.18 ± 1.88*	62.34 ± 2.64*	57.16 ± 1.89*

***** Significant difference ($p \leq 0.05$).

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