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Haematology and Serum Biochemistry of *Peste Des Petits Ruminants* Infected West African Dwarf Goats Treated with Honey Bee Venom

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Abstract

The study was conducted to determine the therapeutic effects of different levels of bee venom (BV) administration on the hematological profile and serum biochemical status of Peste des petits ruminants infected West African Dwarf goats. Twenty-five animals were randomly allotted into five treatments: T1, T2, T3, T4 and T5 with five animals per treatment, each treatment replicated five times with one animal per replicate. T1 served as the control experiment with the use of antibiotics(L/A), while T2, T3, T4 and T5 were administered with 0.60mg, 0.90mg 1.20mg and 1.5 BV intramuscularly per animal through direct stinging for four (4) alternate days respectively. An apiary was established very close to the study location to ensure accessibility and availability of the therapeutic material (bee venom). High performance liquid chromatography machine was used to determine the level of melittin present in each load of honey bee sting. All the data generated from this study were subjected to analysis of variance (ANOVA) using SAS Analytical software. The study revealed that honey bee venom has therapeutic effect on West African Dwarf goats infected with Pestes de petits ruminants' disease without any negative implication on hematology and serum biochemistry of the experimental animals. It is therefore suggested that honey bee venom at five stings (1.50mg intramuscularly on four alternate days) will be adequate as a curative dose.

Introduction

Goat keeping as an integral aspect of livestock production in Nigeria has been researched into at different times and results abound its potential to contribute immensely to the upliftment of socio-economic status of the resource- poor farmers. It also occupies a very important biological and socio-economic niche in farming systems making significant multifunctional contributions especially to food, nutrition and financial security, stability of farm households, and survival of the poor in the rural areas, its importance in research activities is also unquantifiable.

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Blood is a major index in the analyses of physiological, pathological and nutritional status of any animal, hence the analysis of blood is important biochemically because it provides means of assessing the health status of animals.

Peste des petits ruminants (PPR) also referred to as ovine rinderpest, goat plague, plague of small ruminants, Kata or stomatitis-pneumo enteritis complex, is an acute, highly contagious and infectious viral disease of small ruminants, which is closely related antigenically to rinderpest in goats and sheep (Pastoret *et al.*, 2006). The morbidity and mortality rates can be as high as 90 – 100% in virgin population outbreaks, dropping to about 20 - 40% in endemic areas (Banyard *et al*., 2010). It has become a major threat to small

ruminant existence and food security in Africa and neighboring continents; vaccination remains the most effective and viable tool for the tool for the prevention of this infection, but the vaccines are relatively scarce (Baazizi *et al.,* 2017).

Honey bee venom contained antiviral properties, its use in other animals is known to increase the immune system (Bolarinwa *et al.,* 2013). However, work on its therapeutic effect on *Peste des petits Ruminants* infected goats has not been documented.

Materials and Method

Study location

This study was carried out at the Teaching and Research Farm, College of Agricultural Sciences, Olabisi Onabanjo University, Ayetoro Campus, Ogun State, Nigeria. The University is located in a deciduous/derived savannah zone of Nigeria on latitude 7° 5' N and longitude 3° 3' E. The climate is sub-humid tropical with an annual rainfall of 1,909 mm. Rainy season is between early April and late October. Rainfall pattern is bimodal with two peaks in June and September. Maximum temperature varies between 29°C during the peak of the wet season and 34°C at the onset of the dry season and mean annual relative humidity is 81% (Onakomaiya *et al.,* 2002).

Experimental animals and management

Twenty-five growing West African Dwarf goats between 5 - 6 months of age purchased from nearby goat markets were used for this experiment. On arrival, animals were kept in a well-constructed ruminant unit holding, intensely managed and placed on basal diet (*Panicum maximum*) and concentrates. Animals were allowed to acclimatize for a period of three weeks prior to commencement of the study, during this period the animals were dewormed using 300g aqueous extract from pawpaw seeds per animal by drench as described by Ameen *et al*., (2010) and treated against ectoparasite by topical application of neem seed oil (5ml/animal). Following acclimatization, the animals were experimentally challenged with *Peste des petits ruminants* (PPR) virus, closely observed and monitored until infection was fully established through manifestation of PPR clinical symptoms.

Establishment of apiary

An apiary of two bee hive colonies were established very close to the study location to ensure accessibility and availability of the therapeutic material- the bee venom. Following this, extraction of bee crude venom and characterization was carried out to determine contents of the various components of the venom using high performance liquid chromatography (HPLC) method as described by Anaspec (2016).

Extraction and purification of crude bee venom

The bee venom extraction and purification process included the following steps, dissolving the coarse bee venom to form suspension, filtering to eliminate propolis, honey and other impurity, centrifuging the filtrate and eliminating liquid phase, dewatering the precipitate with anhydrous alcohol, leaching the precipitate in water at 10 ± 2 degree centigrade for 12 - 15 hours, precipitating the leached liquid with alcohol, eliminating water from the solution of alcohol, extracting the precipitate in ammonium hydroxide and n-butanol solution, distilling the extracted liquid, concentrating and freeze drying to obtain refined/pure bee venom (Yoonmi *et al.,* 2018).

Experimental diet

Guinea grass (*Panicum maximum*) was harvested from field around the experimental location and wilted to reduce the moisture. *Vernonia amygdalina* (bitter leaf) and *Tithonia diversifolia* (sunflower) leaf forage were also harvested from wild stands doting the compound of the experimental site. The stems were removed to ensure uniformity of the forage and air dried for 7 days in a well-ventilated iron roof shed to avoid

bleaching, the dry forages were milled to prepare *Vernonia amygdalina* and *Tithonia diversifolia* leaf meal. This was mixed in a 1:1 ratio and then stored in jute bags for use in the experiment.

Cassava peels were collected from nearby gari processing plant located at Orile Ilugun, Ogun State, sun dried and then milled. *Vernonia amygdalina/Tithonia divesifolia* leaf meal was then incorporated to the milled cassava peel at 10% inclusion level as reported by (Abegunde *et al.,* 2017).

Experimental design

Twenty-five animals were allotted to five treatments, balanced for weight and designated as T1, T2, T3, T4 and T5 respectively using completely randomized design. Each treatment comprises of five animals and was replicated five times with one animal per replicate. T1 was the control (antibiotics + other conventional drugs), T2 (0.6mg Bee venom), T3 (0.9mg Bee venom), T4 (1.2mg Bee venom) and T5 (1.5mg Bee venom) injection (sting) respectively. The BV was administered intra muscularly four times at 48 hourlies.

The Virus inoculum

The inoculum used in this study was prepared from swabs harvested from oral and nasal mucosa of goats that were naturally infected with PPR. Fifty grams (50g) of inoculum was homogenized in 100mls of distilled water and centrifuged at 1500 rpm for 10 min, the supernatant was then collected into buffer solution, kept in a refrigerator for use in inoculating the animals. However, baseline study of all animals was observed daily before inoculation for any signs of disease and findings were recorded.

Experimental animal's inoculation

Each animal in the treatment groups T1 to T5 were inoculated with 2 ml of the inoculum through intranasal route. Swab soaked in the inoculum suspension was placed in the nasal cavity of each animal for 5 minutes. Each animal was held with the head inclined upwards so as to avoid sneezing out the swab while allowing it to take deep breaths. Animals were then examined twice daily for the development of PPR signs.

Collection of blood samples for hematological and serum biochemistry analysis

Blood samples were collected through jugular venipuncture from each goat. The first set of blood was collected after acclimatization and before inoculation with PPRV, the second set of blood was collected seven (7) days post inoculation prior to commencement of BV administration immediately PPR infection was diagnosed within the experimental animals through manifestation of typical clinical signs of the disease while the third set was collected on the last day of the experiment following bee venom administration using a sterile 10ml needle and hypodermic syringe. A 2ml of blood was put in a well labeled tube containing anticoagulant (Ethylene Diamine Tetra Acetic acid) for hematological indices while 3ml was put into two separate plain tube without an anticoagulant to obtain serum for serological and Enzyme Linked Immunosorbent Assay (ELISA) analytical test procedures respectively, these were sent to the laboratory in an ice pack immediately for indicated analysis.

Hematology and serum biochemistry

Blood samples were analyzed for hematological parameters: packed cell volume (PCV), hemoglobin concentration (Hb), red blood cell (RBC), White blood cell (WBC), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), lymphocytes (LYM), Neutrophils, Monocytes, Eosinophils, Platelets and serum biochemical parameters: albumin, globulin, creatinine, aspartate aminotransferase (AST), alanine aminotransferase (ALT). Total protein and albumin: globulin ratio was determined using appropriate calculations.

Packed cell volume (PCV) and hemoglobin (Hb) concentration were determined by microhematocrit methods. The hematocrit was done by filling a capillary tube with blood, centrifuging it, and measuring the percentage of the blood that consists of red blood cells. Blood was spread on a microscope slide, stained with a Romanowsky stain, and examined under a microscope. The appearance of the red and white blood cells and platelets was assessed and qualitative inferences are reported while White blood cell (WBC) counts were performed using a hemacytometer technique. White blood cell differential was carried out by counting 100 cells on the blood smear and classified based on appearance. This gives the percentage of each type of white blood cell, and by multiplying these percentages by the total number of white blood cells, the absolute number of each type of white cell were obtained. Total blood protein and albumin were measured using the biuret method and bromocresol green method, respectively. The globulin was estimated by difference.

Statistical analysis

All data generated from this study were subjected to analysis of variance (ANOVA) using SAS Analytical software (2004). The Turkey Highly Significant Difference Test (Turkey HSD) of the same software was used to separate all means at $p < 0.05$ (5%) level of significance.

Results and Discussion

Table 1 showed the blood profile of the animals at pre- infective and pre bee venom administration phase of the study. Results obtained across all parameters fell within the normal range as reported in the veterinary handbook, 1999. Packed cell volume (31.00 – 38.80%), Hemoglobin (9.88-12.56g/dl), Red blood cells (12.21-13.55), White blood cells (5700-7240), Platelets (1030-12170). Lymphocytes, Neutrophils, Monocytes, Eosinophils, Mean corpuscular hemoglobin concentration followed the same trend. This indicates that these animals were healthy and nutritionally stable prior to the commencement of the study.

Table 1. Blood profile of West African dwarf goats prior to inoculation with *Peste des petits ruminants' virus*

Variables	Treatments					Normal range
	T1	T2	T3	T4	T5	
PCV %	38.80±5.12^{a}	36.20±7.26^{b}	31.40±2.51^{ab}	33.60±9.83^{c}	31.00±5.70^{bc}	22-38
Hb g/dl	12.56±1.51a	11.66±2.43^{b}	9.92±0.88^{ab}	10.96±3.37^{c}	9.88±1.84^{bc}	8-12
Rbc x 10^{6u}	13.55±0.50^{a}	13.44±0.75^{b}	12.90±0.92^{c}	12.82±2.07^{ab}	12.21±0.95^{ac}	8-18
Wbcx10^{3ul}	7140±3818^{b}	7240±5048^{a}	6490±1643^{c}	5700±2150^{bc}	6080±1650^{ab}	4-13
Platelets %	1084±168^{ac}	1170±130^{b}	1030±224^{bc}	1270±638^{a}	1136±173^{c}	300-600
Lymphocyte%	67.00±4.47^{a}	64.00±6.20^{ab}	57.60±5.46^{bc}	64.20±12.64^{c}	65.80±3.70^{b}	50-70
Neutrophil %	29.60±5.22^{ac}	33.80±6.42^{c}	40.20±7.53^{a}	33.80±12.87^{b}	33.40±4.93^{ab}	30-48
Monocytes %	1.60±0.55^{c}	1.00±0.71^{bc}	2.00±1.00^{a}	1.40±0.55^{ab}	1.60±0.71^{b}	0-4
Eosinophils %	1.80±0.84^{b}	1.40±0.55^{c}	2.20±0.84^{a}	0.60±0.55^{a}	0.80±0.84^{a}	1-8
MCV fl	28.58±2.80^{a}	26.77±3.91^{c}	24.32±0.51^{ab}	28.07±3.77^{b}	25.08+2.94^{a}	16-25
MCHC %	32.41±0.70^{b}	32.17±0.28^{c}	31.58±0.72^{bc}	32.44±0.80^{a}	31.87±0.58^{ab}	30-36
MCH p/g	9.25±0.80^{a}	9.00±1.71^{b}	7.68±0.33^{bc}	8.05±0.95^{c}	8.05±0.95^{ab}	2-8

Treatment means with the same letter(s) in superscripts do not differ significantly (p>0.05)

PCV- Packed cell volume, Hb- Haemoglobin, Rbc- red blood cell, Wbc- White blood cell, MCV- Mean cell volume, MCHC- Mean cell haemoglobin concentration, MCH- Mean cell haemoglobin

The blood profile at the infective phase is as shown in Table 2. Highest value for White blood cell was recorded in T3 although there are variations in the concentrations of these cells across treatments. White blood cells are part of the immune system that help the body to fight infection. The sudden increase in the level of WBC concentration in T3, T4 and T5 is indicative of the PPR infection and immunomodulatory response of the animals to the antigen aided by administration of bee venom during this challenging phase. However, there was no significant difference ($p<0.05$) among all the parameters at this phase. Table 3 showed the therapeutic effect of honey bee venom on blood profile of *Peste des petits ruminants* infected West African goats. Results indicated that White blood cells (8560x103ul) concentration was highest in T3. However, this is lower than what was obtained at the infective stage and the trend followed the same reducing pattern. This was as a result of the antiviral effect of bee venom administered on the viral load on the animals which directly influenced the rate of WBC production by the immune system of the body.

Table 2. Blood profile of Peste *des petits* ruminants infected West African dwarf goats

Variables	Treatments					Normal
	T1	T2	T3	T4	T5	range
PCV %	28.40±4.39^{ab}	30.80±7.26^{a}	28.20±2.86^{bc}	29.40±2.61^{b}	28.60±4.09^{c}	22-38
Hb g/dl	9.08±1.27^{bc}	10.02±2.23^{a}	9.14±0.87^{ab}	9.48±0.73^{b}	9.28±1.36^{c}	8-12
Rbc x 10^{6u}	12.75±0.64^{bc}	12.75±1.05^{ab}	12.80±0.60^{c}	12.90±0.46^{b}	13.02±0.51^{c}	8-18
Wbcx10^{3ul}	6930±2181^{ab}	6320±9690^{bc}	12590±1533^{a}	6980±1691^{c}	7420±2042^{b}	4-13
Platelets %	89600±9684^{bc}	126200±2202^{c}	119400±3086^{ab}	136600±50287^{b}	158400±5588^{a}	300-600
Lymphocyte%	60.20±5.81^{bc}	63.80±7.05^{b}	60.80±3.77^{ab}	64.00±4.18^{a}	63.20±3.42^{c}	50-70
Neutrophil %	37.20±5.54^{a}	33.40±7.30^{c}	35.80±4.85^{b}	33.20±4.44^{ab}	33.20±1.92^{bc}	30-48
Monocytes %	1.40±0.55^{c}	1.60±0.55^{b}	2.20±0.84^{a}	1.40±0.55^{ab}	1.40±0.55^{bc}	0-4
Eosinophils %	1.20±1.10^{ab}	1.60±1.14^{b}	2.00±1.00^{a}	1.40±1.14^{c}	0.60±0.55^{bc}	1-8
MCV fl	22.21±2.46^{c}	23.97±3.66^{a}	21.99±1.27^{ab}	22.77±1.35^{b}	21.93+2.70^{bc}	16-25
MCHC %	30.04±3.62^{bc}	32.53±0.37^{a}	31.63±2.08^{ab}	32.28±0.63^{c}	32.44±0.82^{b}	30-36
MCH p/g	7.11±0.68^{bc}	7.80±1.23^{a}	7.13±0.39^{c}	7.34±0.32^{b}	7.1205±0.94^{ab}	2-8

Table 3. Therapeutic effect of honey bee on blood profile of *Peste des petits* ruminants infected West African dwarf goats

Variables	Treatments					Normal
	T1	T2	T3	T4	T5	range
PCV %	22.80±6.30^{ab}	27.80±5.63^{a}	26.00±4.18^{b}	25.40±1.14^{c}	21.80±3.49^{bc}	22-38
Hb g/dl	7.62±2.24^{ab}	9.14±1.78^{a}	8.92±1.60^{b}	8.54±0.72^{c}	7.30±1.51^{bc}	8-12
Rbc x 10^{6u}	10.13±2.65^{bc}	12.25±1.16^{b}	12.23±0.68^{c}	12.53±0.08^{a}	11.96±0.61^{ab}	8-18
Wbc x10^{3ul}	7280±32762^{c}	7030±1575^{ab}	8560±3489^{a}	8280±4249^{b}	6030±1225^{bc}	4-13
Platelets %	187200±1690^{a}	122800±1814^{a}	128400±3370^{c}	123200±39839^{a}	152000±4461^{b}	300-600
Lymphocyte%	54.20±5.91^{ab}	58.80±9.01^{a}	56.40±4.77^{c}	57.60±3.65^{b}	50.20±6.61^{b}	50-70
Neutrophil %	43.20±5.07^{b}	38.00±9.11^{bc}	30.80±4.55^{c}	39.00±3.16^{ab}	47.00±7.78^{a}	30-48
Monocytes %	1.40±1.14^{b}	1.40±0.55^{c}	1.40±0.55^{b}	1.60±0.55^{a}	1.40±0.55^{bc}	0-4
Eosinophils %	1.20±0.45^{bc}	1.80±1.30^{a}	1.40±0.89^{ab}	1.40±1.14^{b}	1.40±1.14^{c}	1-8
MCV fl	22.52±2.63^{a}	22.47±2.88^{b}	21.18±2.55^{c}	20.27±0.82^{ab}	18.15+1.97^{a}	16-25
MCHC %	33.23±1.21^{ab}	32.91±1.06^{bc}	34.21±0.77^{a}	33.58±1.45^{b}	33.29±2.07^{c}	30-36
MCH p/g	7.49±0.97^{a}	7.40±0.99^{b}	7.26±1.01^{c}	6.81±0.55^{ab}	6.06±0.96^{bc}	2-8

Treatment means with the same letter(s) in superscripts do not differ significantly ($p>0.05$)

Serum biochemistry profile measures a variety of chemicals and enzymes in the blood. This provides general information about the status of organ especially the liver, kidney and pancreas health and function at a given time (Ekan and Udosen, 2013. There were variations amongst the values recorded across the treatments from Albumin 2.88g/dl in T5 to 3.36g/dl in T3. Highest value of Albumin/Globulin ratio were recorded in T3 as shown in Table 4. These results were all within the normal range indicating that the organs are physiologically in good condition prior to commencement of the experiment.

There was a drastic fall in the levels of globulin, Total protein, AST, ALT and Creatinine respectively when compared to values obtained at non infective stage in Table 5. Statistically, there were no significant ($p>0.05$) differences amongst the treatment groups.

Table 4. Serum biochemistry of West African dwarf goats prior to inoculation with *Peste des petits ruminants' virus*

Variables	Treatments					Normal
	T1	T2	T3	T4	T5	range
Albumin g/dl	3.16 ± 0.36^{b}	3.00 ± 0.27^{c}	3.36 ± 40.30^{a}	2.92 ± 0.22^{ab}	2.88 ± 0.74^{bc}	2.4-4.4
Globulin	4.92 ± 0.36^{a}	4.56 ± 0.39^{b}	4.42 ± 0.51^{bc}	4.42 ± 0.82^{c}	4.74 ± 0.61^{ab}	2.7-4.4
Total protein g/dl	8.08 ± 0.68^{a}	7.56 ± 0.65^{ab}	7.78 ± 0.80^{b}	7.34 ± 0.78^{bc}	7.62 ± 1.29^{c}	6.4-7.8
A/G ratio	0.64 ± 0.05^{ab}	0.66 ± 0.02^{c}	0.76 ± 0.04^{a}	0.68 ± 0.14^{b}	0.60 ± 0.03^{a}	1-2
AST^{ul}	188.60 ± 9.42^{a}	185.80 ± 7.53^{ab}	187.00 ± 11.81^{b}	182.80 ± 10.66^{bc}	186.00 ± 15.23^{c}	66-230
ALT^{ul}	45.80 ± 8.90^{a}	44.80 ± 5.00^{c}	44.40 ± 6.58^{b}	38.20 ± 7.95^{bc}	43.20 ± 9.65^{ab}	15-52
BUN mg/dl	18.12 ± 2.14^{a}	16.28 ± 1.88^{ab}	16.36 ± 2.08^{c}	$15.54+2.31^{bc}$	16.54 ± 3.77^{b}	12.6-28
Creatinine mg/dl	1.08 ± 0.13^{a}	0.98 ± 0.08^{bc}	1.02 ± 0.22^{c}	1.00 ± 0.17^{ab}	1.02±0.27b	0.9-1.8
T. Bilirubin mg/dl	0.26 ± 0.09^{b}	0.22 ± 0.08^{ab}	0.28 ± 0.15^{a}	$0.16+0.09^{bc}$	0.24 ± 0.15^{c}	0.01-0.50

Table 5. Serum biochemistry of Peste des petits ruminants infected West African Dwarf goats

Variables	Treatments					Normal
	T1	T2	T3	T4	T5	range
Albumin g/dl	2.90 ± 0.21^{c}	2.64 ± 0.11^{bc}	2.94 ± 0.31^{b}	2.84 ± 0.25^{ab}	3.10 ± 0.29^{a}	2.4-4.4
Globulin	3.82 ± 0.30^{c}	3.76 ± 0.21^{bc}	3.80 ± 0.44^{ab}	3.94 ± 0.19^{b}	4.02 ± 0.73^{a}	2.7-4.4
Total protein g/dl	6.72 ± 0.50^{ab}	6.40 ± 0.20^{bc}	6.74 ± 0.71^{c}	6.78 ± 0.23^{b}	7.12 ± 0.97^{a}	6.4-7.8
A/G ratio	0.76 ± 0.02^{c}	0.70 ± 0.57^{bc}	0.77 ± 0.05^{b}	0.72 ± 0.09^{ab}	0.78 ± 0.09^{a}	1-2
AST^{ul}	182.40 ± 4.77^{a}	178.00 ± 2.12^{ab}	179.00 ± 6.20^{c}	177.80 ± 2.38^{bc}	181.80 ± 10.66^{b}	66-230
ALT^{ul}	40.40 ± 4.88^{ab}	37.60 ± 2.07^{bc}	42.20 ± 4.49^{b}	43.60 ± 3.97^{a}	41.80 ± 6.76^{c}	15-52
Creatinine mg/dl	1.00 ± 0.11^{b}	0.94 ± 0.05^{ab}	0.84 ± 0.43^{bc}	1.00 ± 0.12^{b}	1.06 ± 0.26^{a}	0.9-1.8
T. Bilirubin mg/dl	0.18 ± 0.08^{c}	0.14 ± 0.05^{bc}	1.12 ± 0.11^{a}	0.18 ± 0.05^{bcab}	0.20 ± 0.07^{b}	0.01-0.50

Treatment means with the same letter(s) in superscripts do not differ significantly ($p>0.05$)

AST- Aspartate aminotransferase, ALT- Alanine aminotransferase, A/G ratio- Albumin: Globulin ratio, T.Bilirubin – Total bilirubin

Table 6 revealed an increase in Albumin, Globulin, A/G, ALT, Creatinine and Total bilirubin respectively across the treatment group when compared to what was obtained at infective stage. This implies that bee venom has positive and recuperative influence on liver and other essential organs of infected animals following its administration. It aided the liver in resumption of protein and enzyme synthesis in recuperating animals. There were no significant ($p<0.05$) differences amongst the treatments. The results on the blood variables, serum and liver proteins suggested that, hematopoiesis process was not adversely affected by the test materials (bee venom), there were no damages caused to the liver and kidneys which is the main organ that produces enzymes and proteins that trigger immunological responses against foreign substances in the body. Variations in haematology parameters in this study agrees with Robert and Daryl (2000) which reported variability in blood profile amongst animals, this could be ascribed to physiological, drug and or genetic composition of tested animals. Haematological indices are important indicators of the health status of animals and has been an indispensable tool in the diagnosis of many diseases, Scam et al, it could also be used in measuring the nutritional, physiological and response of animals to its immediate environment at a particular time. There was also sharp increase in the value of platelets across the treatment groups at infective stage. This finding did not agree with earlier report (Sahinduran et al., 2012) which stated that Peste des petits ruminant's infection in kids causes significant thrombocytopenia (low platelet level) and increases the activated partial thromboplastin time. All these values fell within the normal range and there was comparative improvement on animals treated with the bee venom at varying levels over those placed on antibiotics.

Conclusion

It is therefore suggested that honey bee venom at five stings (0.9mg) four times intramuscularly on alternate days could be used in the treatment of goat infected with Pe*stes des petit ruminants* disease as curative dose without any deleterious effect on haematology and serum characteristics of *Pestes des petits ruminants* infected animals.

Table 6. Therapeutic effect of honey bee venom on serum biochemistry of Peste desx petits ruminants infected West African Dwarf goats

Variables	Treatments					Normal
	T1	T2	T3	T4	T5	range
Albumin g/dl	2.92 ± 0.28^{b}	2.78 ± 0.18^{bc}	3.06 ± 0.23^{a}	2.80 ± 0.19^{ab}	2.90 ± 0.23^{c}	2.4-4.4
Globulin	3.64 ± 0.21^{bc}	3.70 ± 0.73^{c}	3.80 ± 1.19^{b}	3.68 ± 0.24^{ab}	3.94 ± 0.21^{a}	2.7-4.4
Total protein g/dl	6.56 ± 0.46^{c}	6.48 ± 0.85^{ab}	6.86 ± 0.40^{a}	6.48 ± 0.40^{bc}	6.84 ± 0.36^{b}	6.4-7.8
A/G ratio	0.80 ± 0.05^{a}	0.78 ± 0.17^{c}	0.80 ± 0.03^{b}	0.76 ± 0.03^{ab}	0.74 ± 0.06^{bc}	1-2
AST^{ul}	184.80 ± 7.43^{a}	186.80 ± 8.41^{c}	190.60 ± 4.62^{a}	180.60 ± 1.52^{bc}	187.00 ± 5.66^{b}	66-230
ALT^{ul}	46.40 ± 4.04^{c}	49.20 ± 1.64^{a}	42.20 ± 2.95^{a}	42.20 ± 2.17^{a}	47.20 ± 3.70^{b}	15-52
Creatinine mg/dl	1.02 ± 0.13^{ab}	1.00 ± 0.12^{bc}	1.08 ± 0.13^{a}	1.04 ± 0.11^{c}	1.04 ± 0.15^{b}	0.9-1.8
T. Bilirubin mg/dl	0.14 ± 0.05^{c}	0.16 ± 0.05^{b}	0.18 ± 0.04^{a}	0.10 ± 0.00^{ab}	0.14 ± 0.0^{ac}	0.01-0.50

Treatment means with the same letter(s) in superscripts do not differ significantly ($p>0.05$)

AST- Aspartate aminotransferase, ALT- Alanine aminotransferase, A/G ratio- Albumin: Globulin ratio, T.Bilirubin – Total bilirubin

References

Abegunde, T.O., Ajayi, F.T., Olona, J.F. and Balogun, F. (2017). Supplemental value of leaf based concentrates and Panicum maximum hay on performance of West African Dwarf goats. *Afri. Journal of Agricultural Research,* 12:723–729.

Ameen, S.A., Adedeji, O.S., Ojedapo, L.O., Salihu, T. and Fabusuyi, C.O. (2010). Anthelmintic potency of pawpaw (Carica papaya) seeds in West African dwarf (WAD) sheep. *Global Vterinaria*, 5 (1): 30-34.

Anaspec-EGT Group (2016). Separation of bee venom components with high performances chromatography method. Operating protocol p 1-2.

Baazizi, R., Mahapatra, M., Clarke, B.D., Ait-Oudhia, K. Khelef, D., Parida, S. (2017). *Peste des petits* ruminants (PPR): A neglected tropical disease in Maghreb region of North Africa and its threat to Europe. *PLoS ONE*, 12(4):

Banyard, A.C., Parida, S., Batten, C., Oura, C., Kwiatek, O., Libeau, G. (2010). Global distribution of *Peste des petits* ruminants virus and prospects for improved diagnosis and control. *J. Gen Virol*., 291: 2885–2897.

Bolarinwa, M.O., Popoola, M.A., Ijadunola, T.I and Sodeeq, A.E. (2013). Evaluation of the effect of bee venom administration on the serology and hematology of broiler chicken. *Inter J Appl Sci Engr*., 1(1): pp 23 – 24.

Ekan, V. S. and Udosen, E.O. (2013). Total protein, Albumin and Globulin levels following the administration of acidity directed fractions of *Vernonia amygdalina* during acetaminophen induced hepatotoxicity in Wistar Albino rats. *Global Journ. Pure and Appl. Sci.*, 18 (1& 2): pp 25–28.

Robert, K.M and Daryl, K (2000). Harper's. Illustrated Biochemistry. 26th Ed. McGrawHill pub. New York, USA pp 22-23

Onakomaiya, S.O., Oyesiku, K.A. and Jegede, S.J. (2002). Ogun State in Maps. First ed. Rex. Charles publication, Ibadan. Pp 4-5

Pastoret, P., William, P.T and Gordon S (2006). Rinderpest: A general introduction. In Rinderpest and Peste des petits ruminants virus: Plague of large and small ruminants; biology of animal infections, 20 Academic Press, London, UK, pp 2-12

SAS (Analytical software) 2004. User's Guide (release 8.03) SAS Institute, Cany North 6

Sahinduran, S., Albay, M.K., Sezer, K and Ozme, O (2012). Diseases in farm ruminant animals. Turkish Journal of veterinary and animal Sciences. 30, pp 219-222.

Yoonmi, L., Sung-Geun, K. and Hwa-Dong, L. (2018) Standardization of the manufacturing process of bee venom pharmacopuncture containing melittin as the active ingredient. Hindawi Journal Menu. vol.2 2018, ID 2353280 pp 32-35