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EFFECT OF FERMENTED CINNAMON (*Cinnomomum zeylanicumon*) JUICE EXTRACT ON RED SOKOTO BUCKS THERMOREGULATORY INDICES, HAEMATOLOGY AND SERUM BIOCHEMISTRY

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ABSTRACT

This study assessed the effect of fermented cinnamon (Cinnomomum zeylanicunom) juice extract on Red Sokoto bucks thermoregulatory indices, haematology and serum biochemistry. A total number of twelve (12) apparently healthy pubertal Red Sokoto Buck of approximately the same age (7 months) categories and with average body weight of 15±05 Kg was selected for this study. The bucks were allotted into four dosage levels of 0ml, 15ml, 30ml and 45ml of fermented cinnamon juice extract per treatment in a completely randomized design (CRD). The thermoregulatory result revealed that there are significant (P<0.05) differences in rectal temperature (ºC) and pulse rate while respiratory rate (brpm) indicate non-significant (P<0.05) difference in bucks supplemented fermented cinnamon juice extract. The meteorological data determined in this study indicate that experimental animals were raised in high Temperature-humidity index which signifies thermal discomfort. The haematological profile measured in this study revealed a significantly different (P<0.05) of packed cell volume, red blood cell, and white blood cell among the treatments. Significant (P<0.05) differences were also observed in aspartate aminotransferase, total protein, albumin, serum phosphorus, calcium, cholesterol, triglyceride and high density lipoprotein with increases dosages of fermented cinnamon juice extract. It is therefore concluded that supplementing Red Sokoto bucks with fermented cinnamon juice extract up 45ml has a profound effect in modulating thermoregulatory indices during period of thermal discomfort thereby ameliorating thermal stress, and played a crucial role in stabilizing hematological and serum biochemical profiles of Red Sokoto bucks.

Key Words: Fermented, Cinnamon, Juice extract, Bucks

INTRODUCTION

The physiology of farm animals is affected by several factors, one of which is nutrition (Ajo *et al.*, 2013). Nutritional status of an individual is dependent on dietary intake and effectiveness of metabolic processes. These can be determined by either or combinations of chemical, anthropometric, biochemical or dietary methods (Bamishaiye *et al.*, 2009). Feed is an important aspect of livestock production. The importance of feed supplementation in animal production has increased in the last few years (Sharifi *et al.*, 2011). Increase in meat production and reproduction can be achieved through proper nutrition, inclusion of feed ingredients at normal or required levels (Etim and Oguike, 2010).

According to Rashid *et al.* (2020), blood pictures of animals might be influenced by certain factors, one of which is nutrition. Swenson (1970) and Addass *et al.*, (2012) posited that nutrition affects blood values of animals. Dukes (1995) also documented that haematological value of farm animals are influenced by nutritional status. Processing of feed could have effect on haematological parameters of farm animals (Aya *et al.*, 2013). Dietary content affect the blood profile of healthy animals (Odunsi *et al.*, 1999; Iheukwumere and Herbert, 2002; Kortuglu *et al.*, 2005). Isaac *et al.* (2013) stated that haematological components, which consist of red blood cells, white blood cells or leucocyte, mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration, white blood cell count, red blood cell count among others, are used in routine screening for the health and physiological status of livestock and even humans. Adejumo (2004) reported that haemoglobin (Hb) were correlated with the nutritional status of the animal. Isaac *et al.* (2013) stated that packed cell volume (PCV) is involved in transport of oxygen and absorbed nutrient. Other blood parameters like blood viscosity are often neglected in routine clinical and physiological investigation. Blood viscosities are however, also affected by nutrition, especially, when processed agro-industrial wastes are taken into consideration. Livestock blood, for instance, may be subjected to hyper viscosity syndrome consequent on the feed they consume which may ultimately affect other blood values like haematocrit and erythrocyte sedimentation rate (Aro *et al.*, 2013). Blood viscosity can also help to unravel clinical case of blood abnormalities like polycythemia and reduced plasma volume (Aro and Akinmoegun, 2012).

Cinnamomum (family of Lauraceae) species, also known as "Girfa in hausa" contain volatile oils, tannins, terpenoids, mucilage, oxalates and starch. Different chemical constituents of C. *zeylanicumare are* known to have significant germicidal, antiulcerogenic and cytotoxic effects. In a study, the extract of cinnamomum increased the weight of testes, cauda epididydimies and seminal vesicles in the treated animal, indicating a possible stimulation of hormonal levels in the animals. Also, the sperm count and motility of the treated animals were significantly higher than the control group (Khojasteh *et al.*, 2016).

Traditional fermented foods contain a great number of probiotic microorganisms (Psani and Kotzekidou, 2006; Todorov *et al.*, 2008). Some fermented fruits extract contain live lactic acid bacteria, which enhance rumen activity, affect the gastrointestinal infections, help with lactose metabolism, decrease serum cholesterol, stimulate immune system, possess anti-mutagenic properties, anti-carcinogenic properties, anti-diarrheal properties, alleviate the inflammatory bowel disease symptoms and suppress the infection caused by Helicobacter pylori (Shah, 2007).

Cinnamomum plant have diverse defense strategies in the fight against a huge variety of damaging biotic circumstance. It contains polyphenol compounds that are largely participate in many functions, such as colour, flavor, odour, bitterness, and astringency, and exhibit antioxidant properties that will help in scavenging, trapping, quenching and destroying the blood free radicals.

Cinnamomum has long been consumed as a spice for flavoring foods as well as in traditional remedies. Recently, studies have shown that cinnamomum bark has diverse bioactivities, including antioxidant, antimicrobial, anticancer, anti-inflammatory as well as pharmacological properties in the treatment of type II diabetes.

The aim of this study is to evaluate the effect of fermented juice extract from cinnamom plant on thermoregulatory parameters, haematology and serum biochemistry on red sokoto bucks.

MATERIALS AND METHODS

Experimental site

The experiment was carried out at Small Ruminant animal Unit of Professor Lawal Abdu Saulaw, Livestock Teaching and Research Farm, Department of Animal Science Federal University Dutsin-Ma, Katsina State. The Farm is situated within latitude 12°27'18' North and 7°29'29' East and 605 meters above sea level with an annual average rainfall of 700mm and situated in the Northern guinea Savannah zone (KTARDA, 2001)..

Experimental Animals

A total of twelve (12) apparently healthy pubertal Red Sokoto Buck of approximately the same age (7 months) and body weight was selected for this study. Prior to the commencement of the experiment, the experimental animals were quarantined and given a prophylactic treatment against internal and external parasite by subcutaneous injection of Ivomec (Ivomectin ® 0.5ml/buck) and a broad-spectrum antibiotic (Oxytetracycline L.A®) was given intra muscularly at the rate of 1ml/buck. After which buck was weighed balanced with an average weight of 15±05 Kg in each treatment and allotted into four dosage levels (0ml, 15ml, 30ml and 45ml) of fermented juice extract of molasses-cinnomumum consist of three buck per treatment in a completely randomized design (CRD).

Experimental feed

Concentrate diet was formulated with 13% crude protein containing maize offals, rice offals, Cotton seed meal, wheat offal, bone meal and salt. Fermented juice extract of molasses-cinnomumum was given orally at different dosage levels of 0 ml, 15 ml, 30 ml and 45 ml/buck daily for a period of 6 weeks and equally supplemented with the same quantity of roughages (groundnut hay) in each treatment.

Fermented Juice Extract preparations

Dry Cinnamom stem was obtained from Dutsin-Ma market. The stem was identified, sorted to remove inert materials and grinded using morter and pastel. The powdered material obtained was further grinded using electric grinding machine to obtained fine particles. One (1 kg) of the powdered Cinnamon was put in a basin and adds 1 kg of molasses was added to it and mixed thoroughly using paddle. The mixture was then poured into a plastic pail and tightly covered to prevent air from getting in so that fermentation will take place for a period of one week. Fermented juice was obtained by straining mix through fine cheese cloth. The fermented extract was store in plastic bottle and stored in refrigerator till time for use.

Data collection

Meteorological Observation

The ambient temperature and relative humidity of the internal and external environment of the experimental site was measured daily with the aid of digital thermometer and hygrometer in the morning and evening d throughout the experimental period. The temperature-humidity index (THI) for goat was calculated using the equation described by Fonseca *et al.* (2016) and Global temperature humidity index (GTHI) was used to determine the characterization of thermal comfort rate of the animals where higher GTHI Values of index indicate thermal discomfort.

THI= 0.8 x AT + (RH (%)/100) x [(AT-14.4) + 46.4)]
Where,
AT= Air temperature (ºC)
RH= Relative humidity (%)
Where values used for accessing heat severity are:

<82= Absence of heat stress, 82 - <84= Moderate heat stress, 84-<86= Severe heat stress; Over 86= Extreme severe heat stress.

GTHI= TBG + 0.36 x Tdp-330
Where,
TBG= Thermometer temperature of black globe (ºC)
Tdp= Temperature of the dew point (ºC)
330= Constant.

Haematological parameters determination

At the end of the experiment (8 weeks), blood samples were collected from the jugular vein early in the morning before feeding using sterile syringe and needle. The blood was collected and stored in well labelled sample bottles containing EDTA as anticoagulants. Immediately after blood collection, it was put in an ice park and transported into laboratory for haematological parameters determination such as haemoglobin, packed cell volume, red blood cell, mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration, white blood cell, lymphocyte, monocyte, neutrophils, basophils, and eosinophil

Serum biochemistry determination

Blood samples were collected at the end of experiment from jugular veins of red sokoto bucks early in the morning before feeding. A quantity of 5 ml of blood was collected into labeled sterile sample bottles without anticoagulant and was used for the serum biochemical analysis. The sample was centrifuged at 3000 rpm for 15 minutes. Separated sera was stored frozen at -20˚C in sample bottles until the time of analysis for serum Albumin, globulin, total protein, alkaline phosphate (ALP), Alanine aminotransferase (ALT), Aspartate amininotransferase (AST).

Thermoregulatory parameters determination

Rectal temperature (RT), respiratory rate (RR) and pulse rate (PR) was measured early in the morning between 7:00 to 8:00 am before sunrise from bucks of each treatment.

Rectal temperature

The sensory tip of a digital thermometer was inserted 0.5cm depth into the rectum of bucks at a display of L˚C by a thermometer (which is an indication that the thermometer is set for temperature reading). Each buck was restrained gently and calmly and the reading lasted until the thermometer beep.

Respiratory rate

The respiratory rate was determined while buck is resting by visually counting the flank movements for one minute using stop watch.

Pulse rate

This was measured using a stethoscope and stop watch. The stethoscope was placed on the left region of the thoracic vertebrae of the Red Sokoto bucks to count the heart contractions (rhythms) in one minute.

Statistical analysis

All data obtained was subjected to analysis of variance using Generalized Linear Model of Statistical Software System (SAS 2002). All means were separated using Duncan Multiple Multiple Range Test (DMRT) of the same software.

Table 1: Experimental Diet

Feed stuff	Percentage
Maize bran	20
Cotton seed meal	14
Guinea corn husk	34
Wheat offal	30
Bone meal	1.50
Salt	0.50
Total	100
Calculated Analysis	
Energy (KcalME/Kg)	956.18
Protein	14.02
Crude fibre	26.90

RESULT

Table 2 shows the meteorological information of the experimental site from the month of May to June 2021. The ambient temperature, humidity and temperature-humidity index values are higher with a slight numerical difference in the month of June than May. The temperature humidity index of the animal during this study indicate that they fall within the thermal discomfort zone meaning that they are raised within the period of heat stress of the year; these support the characteristics nature of the Sudan savannah ecological zone where severe heat condition were observed during the months of April, May and June of the year. These could be the tropical nature of the Sudan savannah zone of Nigeria and the meteorological factor exerts significant influence on domestic animal vital parameters. Bianca; (1976) reported that high ambient temperature and relative humidity plus solar radiation exert various effects on animal well-being which will be demonstrated in neuroendocrine, cardiorespiratory, and behavioral responses.

Table 2: Meteorological data of experimental Site

Parameters	May	June	SEM
Ambient temperature (ºC)	30.00	30.66	0.62
Humidity (%)	24.33	25.00	3.22
THI	86.24	87.45	1.10

THI-Temperature Humidity Index

Table 3 clearly show the effect of fermented cinnamom juice extract on Red Sokoto bucks thermoregulatory parameters. There are significant (P<0.05) differences in rectal temperature and pulse rate of Red Sokoto bucks in this study while non-significant (P>0.05) differences was observed in respiratory rate. The thermoregulatory values measured in this study were within all fall within the normal range of healthy goat. It was observed that there was decrease in rectal temperature with increased doses of fermented cinnamon juice extract and this may be due to the reasonable amount of vitamin E content in cinnamon (Yeh, *et al.,* 2003). Vitamin E decreases rectal temperature by directly altering the thermal set point by decreasing prostaglandin output, especially of prostaglandin E series, whose turnover increases during stress which has a direct effect on the hypothalamic thermoregulatory zone (Ganong, 2001).

Table 3: Effect of fermented cinnomum extract on Red Sokoto bucks' thermoregulatory parameters

Parameters	T1	T2	T3	T4	SEM	LOS
RT (ºC)	37.90^{ab}	37.65^{ab}	38.29^{a}	33.75^{a}	1.357	*
RR (brpm)	47.16	46.77	54.12	50.50	2.320	NS
PR (bpm)	71.27^{B}	63.61^{c}	73.55a	58.83^{c}	2.778	*

RT= Rectal temperature, RR=Respiratory rate, PR= Pulse rate, brpm= breath per minute, bpm= beat per minute

Table 4 shows that packed cell volume (PCV), red blood cell (RBC) and white blood cell (WBC) were all significantly different (P<0.05) across the fermented cinnamom juice extract group. The mean value for PCV was significantly (P<0.05) different with higher numerical values in treatment 4 (31.25%), followed by T3 (29.20%) while the control group (T1) had the lowest PCV values of 25.50%. Similarly, highest (P<0.05) values of RBC was observed in T4 (16.65 x 10^6/ul) and T3 (11.65 x 10^6/ul) with the lowest RBC values in T1 (10.40 x 10^6/ul). It is interesting in this study to know that linear increases in RBC values may be as a result of iron content of cinnamon. Since iron availability is plays an important role in the formation of blood, while its deficiency is the major precursor to anemia related disease conditions (Musa *et al*., 2016). All the haematological values observed in this study were within the normal haematological values of healthy Red Sokoto bucks reported by Tambuwal *et al*. (2002) who reported 21-35% PCV, 7-15g/dl Hb, 3.5-16.5 (10^6/ul) RBC, 6.8-20.1 (10^3/ul) WBC, 17-52% Neutrophils, 47-82% lymphocytes, 1-7% eosinophils and 0-10% monocytes with slight differences in Hb values and other differential counts which may be attributed to climatic condition, age of animal, nutritional status and/or haematological analysis tools. The higher Hb values of 16.60g/dl observed in T2 may suggest that they are healthy and thus adjusted favorably to the requirement of the diet as well as the study area of the habitat despite the higher THI observed in the study area and this further suggested that goat have wider tolerance ability to withstand harsh weather condition.

Also the significant increases in the level of PCV, RBC and Hb in fermented cinnamom juice extract groups compared to the T1 (control group) may be as

a result of anti-anemic properties of cinnamom while control group may be as a result of glycosylation process which will lead to anemia in animal. The extr act may not have adverse effects on the bone marrow, kidney and hemoglobin metabolism, since it has been reported that only substances which significantly affects the values of red blood cells and associated parameters would have effects on the bone marrow, kidney and hemogolobin metabolism (Longe and Momoh, 2015).

Table 4: Effect of fermented cinnomum extract on red sokoto bucks haematological indices

Parameters	T1	T2	T3	T4	SEM	LOS
PCV (%)	25.50^{c}	26.60^{bc}	29.20^{ab}	31.25^{a}	0.83	*
Hb (g/dl)	11.15	16.60	11.10	11.35	0.41	NS
RBC (10^6/µl)	10.25^{b}	10.40^{b}	11.65^{b}	16.65^{a}	0.60	*
WBC (10^3/ul)	10.95^{a}	9.65^{a}	6.50^{b}	4.15^{b}	0.60	*
Neutrophil (%)	35.15	21.20	33.10	26.10	5.30	NS
Lymphocyte (%)	44.95	36.40	20.20	17.95	8.66	NS
Monocyte (%)	0.75	0.05	0.05	0.10	0.22	NS
Eosinophil (%)	2.05	3.05	1.15	1.13	0.49	NS

PCV= Packed cell volume, Hb= Haemoglobin, WBC= White blood cell, RBC= Red blood cell, SEM= Standard error mean, LOS= Level of Significance

Table 5: Effect of fermented cinnomum extract on red sokoto bucks serum biochemistry

Parameters	T1	T2	T3	T4	SEM	LOS
AST (u/l)	19.40^{a}	19.70^{a}	18.90^{a}	17.35^{b}	0.34	*
ALT (u/l)	10.85	11.95	10.50	10.45	0.59	NS
ALP (u/l)	21.20	19.05	20.60	21.10	0.89	NS
Total Protein (g/l)	5.40^{a}	6.95^{ab}	7.05^{ab}	7.25^{a}	0.17	*
Albumin (g/l)	2.55^{b}	2.75^{ab}	3.00^{ab}	3.30^{a}	0.17	*
Total bilirubin (mm/l)	1.55	1.65	1.20	1.25	0.20	NS

AST= Aspartate aminotransferase ALT= Alanine aminotransferase, ALP= Alkaline phosphatase, SEM= Standard error mean and LOS= Level of significance

The serum biochemistry result observed in this study revealed that there are significantly ($P<0.05$) differences in aspartate aminotransferase (AST), plasma total protein (TP) and Albumin (ALB) while non-significant ($P>0.05$) differences were observed in alanine aminotransferase (ALT), alkaline phosphatase (ALP) and total bilirubin. These values are inconformity with the normal serum biochemical values of healthy red sokoto goat reported by Tambuwal *et al.* (2002). The normal serum biochemistry profile of Red Sokoto bucks obtained in this study precisely ALT, AST and ALP values implies that no damage to the liver and kidney and no negative influences on the functions of organs associated with blood metabolism in the animal body (Vakili *et al.*, 2013) while serum enzymes activities above the normal ranges are abnormal and indicate that animals might have suffered liver and/or kidney damage (Olafadehen *et al.*, 2014).

Table 6: Effect of fermented cinnomum extract on serum electrolyte and lipid profile of red sokoto bucks

Parameters	T1	T2	T3	T4	SEM	LOS
Urea (mm/l)	4.45	5.05	5.10	5.35	0.27	NS
Creatinine (mm/l)	1.50	0.90	1.25	1.70	0.32	NS
K (mg/dl)	2.18^{b}	2.20^{b}	3.55^{a}	2.88^{ab}	0.30	*
Ca (mg/dl)	2.75^{a}	2.25^{ab}	1.30^{b}	1.65^{ab}	0.29	*
Cholesterol	18.64^{a}	12.60^{b}	12.20^{bc}	11.05^{c}	0.38	*
Triglyceride	3.15^{a}	0.15^{b}	0.20^{b}	0.20^{b}	0.05	*
HDL	0.82^{ab}	0.88^{a}	0.39^{b}	0.75^{ab}	0.11	*
LDL	1.18	1.00	0.90	0.60	0.21	NS

K= Potassium, Ca= Calcium, HDL= High density lipoprotein, LDH= Low density lipoprotein, SEM= Standard error mean and LOS= Level of significance

There are significant ($P<0.05$) differences in serum K, Ca, cholesterol, triglyceride and high-density lipoprotein in this study while urea, creatinine and low-density lipoprotein values obtained in this study did not differ ($P>0.05$) statistically although numerical differences existed among the treatments.

The urea level in this study compared favorably with 5.6-8.1 mmol/L reported by Njidda *et al.* (2013). The high level of serum urea in T4 may be attributed to the tissue catabolism. Ebuzor et al. (2020) stated that high level of serum urea is attributed to excessive tissue protein catabolism associated with protein deficiency while low blood urea levels can result from a low protein diet or liver disease (Tumera *et al.*, 2005). It is interesting findings in this study that fermented cinnamom extract shows lowered plasma cholesterol, triglyceride, high density lipoprotein and low density lipoprotein concentrations with increase dosage of fermented cinnamon juice extract; and this could be account for its traditional uses for treatment of diabetes and hypertension. This results therefore, clearly indicate that the administration of fermented cinnamom extract produces hypoglycemic and hypolipidaemic effect and may prevent cardiovascular diseases.

The results of an experimental study by Blevins *et al.* (2007) showed that cinnamaldehyte which is the principle component of cinnamon possesses hypoglycaemic and hypolipidemic effects in STZ-induced diabetic rats (). This is in agreement with the present study. These results suggest that fermented cinnamon juice extract plays a regulatory role in reducing blood glucose level and lipid parameters. This may be due to blood glucose suppressing effect by improving insulin sensitivity or slowing absorption of carbohydrates in the small intestine.

CONCLUSION

It is therefore concluded that supplementing red Sokoto Red bucks with fermented cinnamon juice extract up 45ml has a profound effect in modulating thermoregulatory indices during period of thermal discomfort thereby ameliorating thermal stress, and play a crucial role in stabilizing the hematological and serum biochemical profile of the experimental animals..

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