ISSN:
Print - 2277 - 0593
Online - 2315 - 7461

Journal of Natural Sciences, Engineering and Technology

PLASMA LIPID PROFILE AND SOME BIOCHEMICAL INDICES IN DOMESTICATED GREATER CANE RAT (*Thryonomys swinderianus temminck*)

***F.C. THOMAS[1], A.O. ADEBAYO[2], O.E. ADELEYE[1] AND B.S. OKEDIRAN[1]**

[1]Department of Veterinary Physiology and Pharmacology,
[2]Department of Veterinary Anatomy,
College of Veterinary Medicine, Federal University of Agriculture Abeokuta.
***Corresponding author:** eraforosi@yahoo.com **Tel**: +2348034946177

ABSTRACT

Some serum biochemical parameters and lipid profile indices were determined in eight male adult greater cane rats *Thryonomys swinderianus* Temminck, raised under intensive management system. Activities of alanine aminotransferase (ALT), aspartate aminotransferase (AST) and alkaline phosphatase (ALP) in plasma were assayed spectrophotometrically, following venopuncture-blood collection and subsequent separation of plasma. Glucose, total protein, albumin and bilirubin as well as lipid profile indices such as total cholesterol, HDL-cholesterol, LDL-cholesterol, VLDL-cholesterol, triglycerides and phospholipids concentration were also determined. In comparison with data from previous studies on wild and captive cane rats, our results indicate lower lipid profile indices and total protein. Activities of hepatic enzymes (AST and ALT) were also lower, while plasma glucose concentration was higher in this third generation greater cane rats. It is concluded that certain aspects of management system in domestication may have a profound influence on biochemical parameters most especially the lower LDL-cholesterol that reduces the risk of atherosclerosis (cardiac disease). This study, therefore offers baseline data for third generation intensively raised greater cane rats.

Key word: Biochemical parameters, Cane rat, Domestication, Lipid profile.

INTRODUCTION

Haematological and biochemical analysis of the blood plays a vital role in the assessment of physiological and nutritional states as well as a veritable diagnostic aid for pathological conditions in man and animals (Ogunsanmi *et al.,* 2002; Awah and Nottidge, 1998; Bush, 1991). Blood lipid profile has been a useful aid in the diagnosis of atherosclerosis and cardiovascular diseases (Ginsberg, 1994). According to Coles (1986) however, management factors such as environment, housing and stress are known to affect haematological and biochemical parameters and are said to be majorly responsible for the differences in these parameters observed between tropical and temperate animals (Ogunriade *et al*., 1981; Bush, 1991; Ogunsanmi *et al*., 1994).

The greater cane rat (*Thryonomys swinderianus)*, also known as grasscutter, is an herbivorous mammal belonging to the order Rodentia, suborder *Hystricomorpha* and to the family *Thryonomidae*, with a single genus, *Thryonomys*. It is only found in Africa but mostly in the

sub-Saharan part where it is vigorously hunted and exploited for food (Opara, 2010). As observed by Alarape (2002) this prolific, tractable and easy-to-handle animal can produce more protein in a given area than goats at much less cost in terms of labour and habitat. The food conversion rate is higher than most domestic animals and the meat yield is greater than most species of livestock with a higher average dress weight of 63% than that of rabbit (51%), African giant rat (51.6%), cattle (38.8%), Sheep (49.3%) and goat (50.1%) (Ajayi, 1994). Its meat has an excellent taste and a comparatively high nutritive value (Asibey and Eyeson, 1975). The mineral content of the tissue is similar to mutton (Ajayi and Tewe, 1980) with a comparably better carcass quality and high quality lean meat which is low in fat.

The cane rat is currently undergoing domestication and captive rearing in the West African sub-region and the recent trend in its farming is towards increased stock levels and intensification of production practices (Adu *et al.*, 2005). Although some haematological and biochemical parameters of the wild and captive reared cane rats have been characterized and reported (Opara, *et al.,* 2006), scanty information about these parameters are available on those that are raised under intensive management.

In this work, we attempt to characterize the lipid profile and some other biochemical parameters in third-generation domesticated male cane rats as well as compare these values with those of the wild and captive reared already determined.

MATERIALS AND METHODS

Animals

A total of eight (8) matured, apparently healthy third-generation domesticated greater cane rats were used for this study. The rats were reared in domestication unit of the Good health Farm, Igbesa, Ogun State. They were fed on Elephant grass and a combination of corn, palm kernel cake, ground nut meal, chopped cassava and salt with water given *ad libitum.* The experimental protocol followed the ethical principles in animal research adopted by the Council on Animal Experimentation.

Sample collection and analysis

The animals were fasted overnight and blood samples were collected by veni-pucture of the tail vein after carefully restraining the rats by firm grip without the use of anaesthetic agents since the animals are fairly getting use to handling. 2mls each of the collected blood was stored in sterile tubes with some containing lithium heparin for plasma biochemistry and the others sodium oxalate fluoride for blood glucose determination. The blood samples were centrifuged at 2,000 g for 10 minutes to separate the plasma and erythrocytes. The plasma was then decanted into clean tubes for analysis.

The activities of plasma alanine aminotransferase (ALT) and aspartate aminotransferase (AST) were measured by the procedures of Reitman and Frankel (1957) as described in Randox® biochemical kit (Randox laboratories Ltd, United Kingdom). The total plasma triglyceride concentration was determined as described by Buccolo and David, (1973) while total cholesterol concentration was determined as described by Allain *et al.,* (1974) using Randox® biochemical kits.

Plasma creatinine concentration was determined colorimetrically using the method of Bartels and Bohmers, (1972) as described in creatinine Randox® biochemical kits. Plasma

total protein concentration was determined spectrophotometrically by the method of Tietz, (1995) as described in total protein Randox® biochemical kit. The blood glucose was determined as described by Barham and Trinder (1972) using Randox® kit.

Plasma lipids was extracted using chloroform-methanol mixture (2:1 v/v) as described by Folch *et al. (*1957). After lipid extraction, phospholipids portion of the extracted lipid were determined spectrophotometrically as described by Stewart (1979). The method is based on the complex formed between ammonium ferrothiocyanate and phospholipids.

Plasma very low density lipoprotein (VLDL) was separated by the method of Ononogbu and Lewis (1976). The VLDL was precipitated by sodium dodecyl sulphate. Lipids was extracted from the VLDL by the procedure of Rose and Oklander (1965), using chloroform-isopropanol mixture (7:11,v/v) after which the cholesterol concentration of this lipoprotein was determined as described by Allain *et al.* (1974) using Randox® biochemical kit.

High density lipoprotein (HDL) fraction of the plasma was isolated by the method of Gidez *et al.* (1982) after precipitating VLDL and low density lipoprotein (LDL) with heparin-manganese chloride solution. HDL-cholesterol concentration was determined as described by Allain *et al.* (1974) using Randox® biochemical kit.

LDL-cholesterol was calculated by the modification of Friedewald formular (Sandkamp *et al.,* 1990) as: LDL-cholesterol= Total cholesterol – (HDL-cholesterol + VLDL-cholesterol).

Statistical analysis

All analyses were done using statistical package for social sciences (SPSS) version 16. Values are expressed as Mean± Standard deviation. The accepted significant level is $p < 0.05$ in the analysis of all data.

RESULTS

The mean values and standard deviation of the investigated plasma lipids in the greater cane rat which includes: total cholesterol, triglycerides, high density lipoprotein (HDL), low density lipoprotein (LDL), very low density lipoprotein (VLDL) and phospholipids are shown in Table 1. While Table 2 shows the comparison between the plasma lipid profiles of the domesticated, captive reared (Ogunsanmi *et al.,* 2002) and the wild (Opara *et al.,* 2006) greater cane rats, Table 3 presents the Mean ± Standard deviation of some biochemical parameters in domesticated greater cane rat. Table 4 reveals the comparison of mean values of some biochemical parameters in domesticated, captive reared and wild greater cane rats.

Table 1: The plasma lipid profiles in the domesticated greater cane rats (*Thryonomys swinderianus*)

Parameters	Mean ± SD
Total Cholesterol (mg/dl)	105.95 ±25.06
Triglycerides (mg/dl)	68.01 ±25.10
HDL (mg/dl)	13.75 ±3.68
LDL (mg/dl)	77.36 ±20.92
VLDL (mg/dl)	13.67 ±5.00
Phospholipids	158.29 ±54.50
Total cholesterol: LDL ratio	7.83 ±0.95
LDL: HDL ratio	5.70 ±1.20
Cholesterol: phospholipids ratio	0.69± 0.25

Table 2: The comparison between the plasma lipid profiles of the domesticated, captive-reared and wild greater cane rats

Parameters	Domesticated (present study) N=8	Captive reared (Ogunsanmi *et al.,* 2002) N=10	Wild (Opara *et al.,* 2006) N=100
Triglycerides	68.01 ±25.10	106.8 ±5.5	ND
Cholesterol	105.95 ±25.06	124.4 ±8.9	194.00 ±4.99
HDL	13.75 ±3.68	18.4 ±2.70	ND
LDL	77.36 ±20.92	106.2 ±6.40	ND
VLDL	13.67 ±5.00	ND	ND
Phospholipids	158.29 ±54.50	ND	ND

Table 3: Some biochemical parameters in the domesticated greater cane rat

Parameters	Means ±SD
Glucose (mg/dl)	125.00 ±23.62
Total protein (g/l)	52.26 ±7.73
Albumin (g/L)	36.52 ±2.80
Bilirubin (mg/dl)	0.53 ±0.07
Creatinine (mg/dl)	0.81 ±0.11
AST (iu/L)	32.30 ±11.11
ALT (iu/L)	6.70 ±3.17

Table 4: Comparison of some biochemical parameters (Mean± SD) in wild, captive reared and domesticated greater cane rats

Parameters	Wild (Opara *et al.*, 2006) N=100	Captive-reared (Ogunsanmi *et al.*, 2002) N=10	Domesticated (present study) N=8
Glucose (mg/dl)	92.65 ±9.03	137.60 ±25.92	125.00 ±23.62
Total protein (g/L)	7.25 ±0.33	5.00 ±0.20	5.20 ±0.77
Albumin (g/L)	ND	2.30 ±0.10	36.52 ±2.80
Bilirubin (mg/dl)	ND	0.61 ±0.12	0.53 ±0.07
Creatine (mg/dl)	1.20 ±0.14	1.29 ±0.15	0.81 ±0.11
AST (Iu/L)	10.54 ±1.98	9.60 ±2.75	32.30 ±11.11
ALT (Iu/L)	8.66 ±0.88	167.60 ±10.90	6.70 ±3.17

DISCUSSION

In the present study, plasma biochemical parameters were determined in the domesticated male greater cane rats (*Thryonomys swinderianus*) and these values were compared with those of the wild (Opara, 2006) and captive-reared (Ogunsanmi *et al.*, 2002) already determined.

From our results we noticed that the lipid parameters - Triglycerides, cholesterol and the lipoprotein fractions such as the high density lipoprotein (HDL), low density lipoprotein (LDL) and very low density lipoprotein (VLDL) cholesterols of the domesticated cane rat were lower when compared with both the captive-reared and the wild species. Our result was consistent with the

findings of Byanet *et al.* (2008) who reported low plasma triglyceride and cholesterol in the reared young cane rat. This observation may be due to the dietary constituents and feeding pattern of the domesticated cane rat. It has been reported that feeds with high level of animal fat and oil cause high serum cholesterol in animals (Abrams, 1980). Since the feeding pattern of the domesticated species is controlled and low in fat, the low lipid parameter is expected.

The observed relatively lower LDL cholesterol when compared with the captive-reared cane rat is of biological importance. HDL, VLDL and LDL are group of lipoproteins that are involved in lipid metabolism and exchange of cholesterol, cholesterol esters and triglycerides between tissues (Sviridiv, 1999). While elevated concentration of total or LDL-cholesterol in the blood had been reported to be a powerful risk factor for cardiac diseases (Law, 1999), the findings of Opara, (2010) showed that cardiac disease is one of the leading causes of losses of the captive cane rat. Our observation of lower LDL-cholesterol in the domesticated species which might be due to controlled nutritional diets low in fat suggest that with domestication the risk of atherosclerosis in the cane rat can be reduced and hence preventing losses in these animals.

The major function of the HDL-cholesterol is to enhance reverse cholesterol transport by scavenging excess cholesterol (including LDL-cholesterol) from the peripheral tissues, followed by esterification through lecithin: cholesterol acyltransferase and delivering it to the liver and steroidogenic organs for subsequent synthesis of bile acids and lipoproteins for eventual elimination from the body (Stein and Stein, 1999). The low HDL-cholesterol observed in the domesticated cane rat is expected since there is also relatively low cholesterol to clear from the system. Phospholipids are of great biological importance and are widely distributed either as membrane constituent or as surfactants in body fluids (Stein and Stein, 1999). Although the plasma phospholipids levels were yet to be determined in the wild and captive-reared cane rats, this report present its normal range of values for the domesticated cane rat.

We observed from the results that the plasma glucose of the domesticated greater cane rat is higher than those of the wild type but a little lower when compared with that of the captive-reared. This shows that the rate of glucose utilization in the wild is higher than those of the captive and domesticated type. This observation is similar to that of the Opara *et al.* (2006) who reported that the wild cane rat had lower glucose level than their captive-reared counterpart due to the fact that the captive-reared being confined, expend comparatively less energy. Also, the total plasma protein of the wild type is higher than those of the captive-reared and domesticated cane rats. This might be due to higher synthetic activities of the liver and access to other sources of proteins in the wild than in the captivity and/or domestication. However, Byanet *et al*. (2008) reported higher total protein values in young cane rat than those documented for adult captive-reared cane rat and adult wild African giant rat which was attributed to differences in their nutritional compositions. Albumen and globulin have direct physiological relationship to each other in maintaining normal blood osmolarity and as such a change in one often result in a change in the other (Stephen *et al*., 2008).

The AST in the domesticated cane rat is higher than those of the wild and captive-reared while ALT and Creatinine are lowest in the domesticated than in the wild and captive-reared. This might be due to the sampling techniques or the type of restraint method on the animal. While in this study no anaesthetic agent was used as in Ogunsanmi *et al.* (2002) who used the combination of Ketamine/Xylazine for restraint.

In conclusion, evaluation of health status requires comparison to known healthy individuals. The data obtained in the domesticated cane rat was compared with those of the wild and captive-reared. These data obtained in this study could form a baseline data for this third generation domesticated cane rat in comparison to the captive-reared and wild.

REFERENCES

Abrams, H.L. 1980. Vegetarianism: An anthropological / Nutritional Evaluation. *J. Appl. Nutri.,* 32: 2

Adu, E. K, Otsyina, R.H., Agyei A. D. 2005: The efficacy of different dose levels of albendazole for reducing fecal worm egg count in naturally infected captive grasscutter (*Thryonomys swinderianus*, Temminck). *Livestock Research and Rural Development,* 17(11): 1-6.

Ajayi, S.S. 1994: Ensuring sustainable management of wildlife resources: The case of Africa: FAO Forestry Paper No. 122, Rome 1994. 133 – 140.

Alarape, A.A. 2002: Cane rat (*Thryonomys swinderianus*) production – An effective source of income for the household. OBECHE, 24: 2 – 6.

Allain, C.C., Poon, L.S., Clau, C.S.G, Richmond, W., Fu, P.D. 1974: Enzymatic determination of total serum cholesterol. *Clin. Chem.*, 20: 470 – 578

Asibey, E.O.A., Eyeson K. K. 1975: Additional information on the importance of wildlife animals as food source in Africa south of the Sahara. *Bongo Journal of the Ghana Wildlife Society* 1: 13-17

Awah, J. N., Nottidge H. O. 1998: Serum biochemical parameters in clinically healthy dogs in Ibadan. Trop. Vet., 16: 123.

Barham, D., Trinder, P. 1972: Procedure for Glucose GOD-PAP assay without deproteinization. *Analyst*, 97: 142

Bartels, H., Bohmers, M. 1972: Colorimetric method of Creatinine determination. *Clin. Chem. Acta*, 37: 193

Buccolo, G., David, H. 1973: Quantitative determination of serum triacylglycerol by the use of enzymes. *Clin. Chem*. 19: 476 – 482

Bush, B. M. 1991: Interpretation of Laboratory Results for Small Animal Clinicians. Blackwell scientific publication, London

Byanet, O., Adamu, S., Salami, S.O., Obadiah, H.I. 2008: Haematological and plasma biochemical parameters of the young Grasscutter (*Thryonomys swinderianus*) reared in Northern Nigeria. *Journal of cell and Animal Biology*, 2(10): 177 – 181

Coles, E. H. 1986: Veterinary Clinical Pathology. 4th ed. W.B. Saunders Co., Philadelphia, U.S.A.

Folch, J., Lees, M., Sloane S.G.H. 1957: A simple method for the isolation and purifica-

tion of total lipids from animal tissues. *J. Biol. Chem*., 226: 497 – 509

Gidez, L. T, Miller, G.H, Burnstein M., Slagle, S., Eder, H.A. 1982: Separation and quantitation of sub-classes of human high density lipoproteins by a simple precipitation procedure. *J. Lipid Res*., 23: 1206 – 1223.

Ginsberg, H.N. 1994: Lipoprotein metabolism and its relationship to atherosclerosis. *Med Clin North Am.,* 76: 1-20

Law, M.R. 1999: Lowering heart disease risk with cholesterol reduction: evidence from observational studies and clinical trials. *Eur. Heart J suppl.,* 1: 53 – 58

Ogunsanmi A. O., Akpavie S.O., Anosa V.O. 1994: Serum biochemical changes in West African Dwarf sheep experimentally infected with Trypanosoma brucei. *Rev. Elev. Med. Vet. Pays. Trop*. 47(*2*): 195

Ogunsanmi A.O., Ozegbe P.C., Ogunjobi O., Taiwo V.O., Adu J.O. 2002: Haematological,plasma biochemistry and whole blood minerals of the captive adult African grasscutter (*Thryonomis swinderianus Temminck*). Trop. Vet., 20*(1)*: 27

Ogunrinade A, Fajimi J, Adenike A. 1981: Biochemical indices in the White Fulani (Zebu) cattle in Nigeria. *Rev. Elev. Med. Vet. Pays. Trop.*, 34(*4*): 41.

Ononogbu, I.C., Lewis, B. 1976: Lipoprotein fractionation by a precipitation method - A simple quantitative procedure. *Clin. Chem Acta.* 71: 397 – 402

Opara, M. N., Ike, K. A., Okoli, I. C. 2006: Haematology and Plasma Biochemistry of the Wild Adult African Grasscutter (*Thryonomis swinderianus*, Temminck). *The Journal of American Science*; 2(2): 17-22

Opara, M.N. 2010: The grasscutter : A livestock of tomorrow. *Res. J. For.,* 4: 119-135.

Reitman, S., Frankel, S. 1957: A colorimetric method for the determination of serum glutamic oxaloacetic and glutamic pyruvic transaminases. *Am. J. Clin. Path*., 28: 56

Rose, H.G., Oklander, M. 1965: Improved procedure for the extraction of lipids from human erythrocytes. *J. Lipids Res*., 6: 428 – 431

Sandkamp, M., Funlce, H., Schulter, M., Kahlar, E., Assman, G. 1990: Lipoprotein is an independent risk factor for myocardial infarction at a young age. *Clin. Chem*., 36: 20 – 23.

Stewart, J.C.M. 1979: Colorimetric determination of phospholipids with ammonium ferrothiocyanate. *Anal. Biochem.* 104: 10 – 14

Stein, O. and Stein, Y. 1999. Arthroprotective mechanisms of HDL. *Arterosclerosis* 144: 285 – 303.

Stephens, B.H., Pavla, M.K., Maria, T.C., Martha, A.H. 2008: Haematology and plasma chemistry reference intervals for mature laboratory Pine Voles (*Microtus pinetorum*) as determined by using the Non-parametric rank percentile method. *Journal of the American Association for laboratory Animal Science,* 47(4): 35 – 40.

Sviridiv, D. 1999. Intracellular cholesterol trafficking. *Histol. Histopathol*., 14: 305 – 319.

Tietz, N.W. 1995: Clinical guide to laboratory texts. 3rd edition. W.B Saunder company Philadelphia PA. 518 - 519.

(Manuscript received: 31st May, 2011; accepted: 27th June, 2011).