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EFFECT OF COCONUT (*COCOS NUCIFERA*) WATER EXTRACT ON THE SERUM LIPID PROFILE OF WISTAR ALBINO RATS

***Mba O. J., Uhuo E. N., and Umeh V. A.**

Department of Biochemistry, College of Natural Sciences, Michael Okpara University of Agriculture Umudike, Abia State, Nigeria.

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***Corresponding Author**
Mba O. J.
Department of Biochemistry, College of Natural Sciences, Michael Okpara University of Agriculture Umudike, Abia State, Nigeria.

ABSTRACT

This study was designed to evaluate the effect of Coconut (*Cocos nucifera*) water extract on the serum lipid profile of wistar albino rats. The parameters assessed were the serum levels of cholesterols, triacylglycerol, very low density lipoprotein (VLDL), high density lipoprotein (HDL), and low density lipoprotein (LDL) in the normal control group and the test groups after 28 days of extract administration. Twenty five (25) rats of mean weight 128 g were divided into five groups of 5 rats per group (1- 5). Group 1 served as the normal control group that received only feed and water, while groups 2, 3, 4 and 5 served as the test groups that were orally given 10 ml, 20 ml, 30 ml, and 40 ml of the coconut water extract respectively for 28 days. Treatment lasted for 28 days and after which the animals were sacrificed under mild anesthesia (10% formasaline). Blood samples were collected in the plain bottle for the analyses on the serum lipid profile effects of coconut water extract in wistar albino rats by assessing biochemical parameters such as total cholesterol, high density lipoprotein (HDL), low density lipoprotein (LDL), triacylglycerol, very low density lipoprotein (VLDL). From the result obtained, there was a significant ($p< 0.05$) decrease between the normal control group and the test groups that received 10 ml, 20 ml, 30 ml and 40 ml of the coconut water extract in the lipid profile status (total cholesterol, triacylglycerol, LDL and VLDL), whereas there was a significant increase ($p< 0.05$) between the normal control group and the test groups for high density lipoprotein (HDL). The study indicates that coconut water extract may have exerted hypolipidemic effects in wistar albino rats, and may also be used pharmacologically in the management and treatment of cardiovascular diseases.

KEYWORDS: Lipid profile; High density lipoprotein; Low density lipoprotein; Very low density lipoprotein; Triacylglycerol; Total cholesterol.

INTRODUCTION

Lipids are heterogeneous group of compounds related more by physical rather than chemical properties. They have the common property of being relatively insoluble in water and soluble in non-polar solvent.[1] Plasma lipids consist of triacylglycerol, phospholipids and cholesterol.[2] They are important dietary constituent, not only because of the fat soluble vitamins and essential fatty acids contained in fat of natural food. They are the major cellular components, which play roles such as storage, metabolites, light capturing pigments and natural colourations.[3]

Triacylglycerol (TAG) is another type of fat found in the blood. The blood level of TAG is most affected by diet. Increased TAG level as well as high LDL-cholesterol level according to studies increases the chances of an individual suffering from a heart disease.[4]

Arteriosclerosis or coronary artery disease is a condition characterized by deposits of lipids, mainly cholesterol on the inner walls of the arteries. These deposits narrow the arterial channels and partly block the normal flow of blood through them.[5] The decrease in blood flow and oxygen can result in stroke, partial paralysis, loss of speech and sometimes death.[6] Arteriosclerosis is the main cause of mortality and morbidity in western countries and progressively increasing in developing countries.[7] Low fat diet is often prescribed for the management of arteriosclerosis as there are no specific treatments for the ailment.[8]

The liver plays a key role in lipid metabolism, including lipid biosynthesis, lipoprotein secretion and reverse cholesterol transport. Lipid biosynthesis in the liver is regulated by a family of transcription factors, the sterol regulatory element binding proteins (SREPs), which include SREP-1 and SREBP-2.[9] SREP-1 preferentially regulates enzymes involved in fatty acid synthesis, including stearoyl-CoA desaturase-1 (SCD-1). SREBP-2 regulates cholesterol biosynthesis and uptake, especially through the regulation of 3-hydroxy-3-methylglutaryl (HMG) CoA reductase.[10]

Lipid alterations are strongly associated with cardiovascular risk, which was found to be exacerbated in intermittent hypoxia conditions where higher levels of triglycerides (TG) and cholesterol can ultimately lead to atherosclerosis.[11]

The present study was undertaken to study the serum lipid profile effects of Coconut (*Cocos nucifera)* water extract in wistar albino rats.

2. MATERIALS AND METHODS

2.1 Plant Material

The coconut fruit (*Cocos nucifera*) was purchased from Umuahia market, Abia state, Nigeria and was identified by Dr. Garuba Omosun of the Plant Science and Biotechnology Department, Michael Okpara Uiversity of Agriculture, Umudike.

2.2 Experimental Animals

Twenty five (25) male wistar albino rats of mean weight (128 g) purchased from the laboratory animal unit of the department Biochemistry, Michael Okpara University of Agriculture Umudike was used for this study. They were housed in aluminum cages of five rats per cage and were fed ad libitum with standard commercial pelleted growers feed (vital, Nigeria) with free access to clean drinking water. They were kept at normal environmental temperature and natural light/ dark daily cycle. They were maintained in accordance with the recommendation of the guide for the care and use of laboratory animal (DHHS, 1985). They were allowed two weeks to acclimatize before the commencement of the experiment.

2.3 Chemicals and Reagents

Hydrochloric acid (HCl), sulphuric acid solution, phosphate buffer, disodium hydrogen phosphate, potassium permanganate, sodium dihydrogen carbonate (NaH_2CO_3) ethylene diamine tetracetate (EDTA), sodium citrate, sodium hydroxide, trichloroacetic acid (TCA), Thiobarbituric acid (TBA) were purchased from Sigma-Aldrich (Steinhelm, Germany). All other chemicals were of analytical grade.

2.4 Preparation of Coconut Water Extract

The coconut fruits obtained were punctured at the holes using a sterilized nail. It was then placed over a container and the water was allowed to drain. The coconut water was obtained fresh and used immediately.

2.5 Experimental Design

Animals were grouped into six animals each.

Group A - vital feed and water only (normal control group).

Group B - 10 ml coconut water + 150 g vital feed.

Group C - 20 ml coconut water + 150 g vital feed.

Group D - 30 ml coconut water+ 150 g vital feed.

Group E - 40 ml coconut water + 150 g vital feed.

Treatment lasted for 28 days, after which the animals were sacrificed on day 29 under mild anesthesia (10% formal saline). Blood samples were collected in the plain bottle for the analyses of the effects of the coconut water extract on the antioxidant parameters in wistar albino rats.

2.5 Evaluation of The Various Parameters Studied

2.5.1 Determination of total cholesterol

Total cholesterol was determined according to.[12]

2.5.2 Determination of Triacylglycerol

Triacylglycerol was determined using enzymatic test glycerol-phosphate oxide method.[13]

2.5.3 Determination of High Density Lipoprotein (HDL)

HDL-Cholesterol was determined using method of. [14]

2.5.4 Determination of Low Density Lipoprotein (LDL) and Very Low Density Lipoprotein (VLDL) Cholesterol

LDL and VLDL- cholesterol was calculated from Friedewald equation as stated by.[15]

2.6 Statistical Analysis

The data were expressed as mean ± standard deviation and analyzed using statistical package for the social sciences (SPSS 22.0). Comparison was made between the test groups and the control groups using One way Anova and $p \leq 0.05$ was considered statistically significant.

Effects of coconut water extract on Total cholesterol.

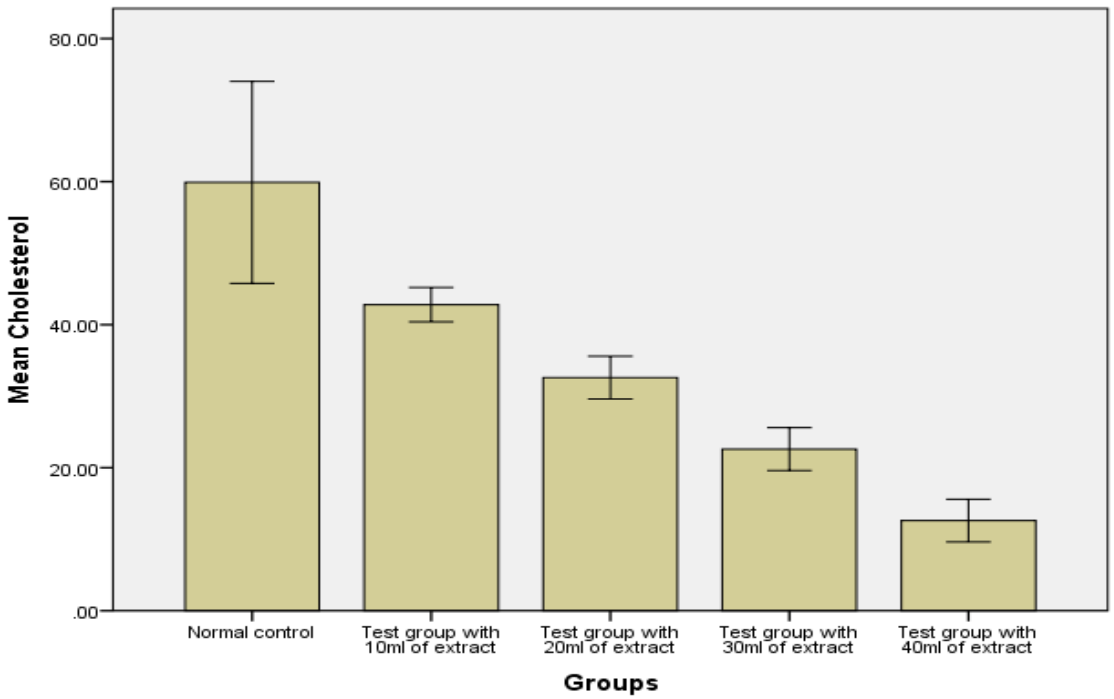

Fig. 1: Mean comparison of the Normal control group and the Test groups that received 10 ml, 20 ml, 30 ml and 40 ml of the coconut water extract.

There is a significant decrease ($p < 0.05$) between the normal control and the test groups that receive 10 ml, 20 ml, 30 ml and 40 ml of the coconut water extract.

Effects of coconut water extract on Triacylglycerol

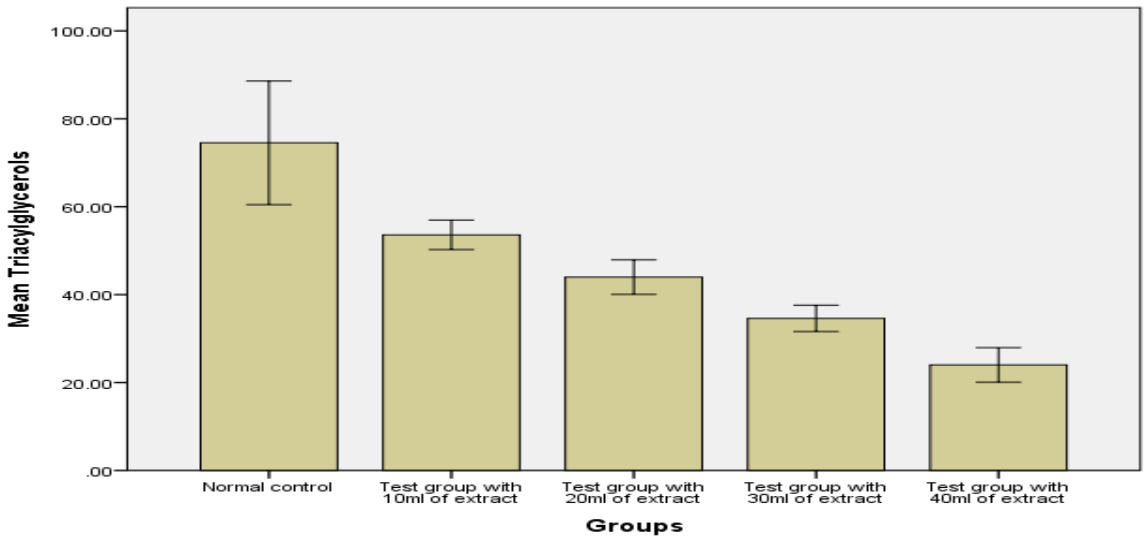

Fig. 2: Mean comparison of the Normal control group and the Test groups that received 10 ml, 20 ml, 30 ml and 40 ml of the coconut water extract.

There is a significant decrease ($p < 0.05$) between the normal control and the test groups that receive 10 ml, 20 ml, 30 ml and 40 ml of the coconut water extract.

Effects of coconut water extract on very low density lipoprotein (VLDL)

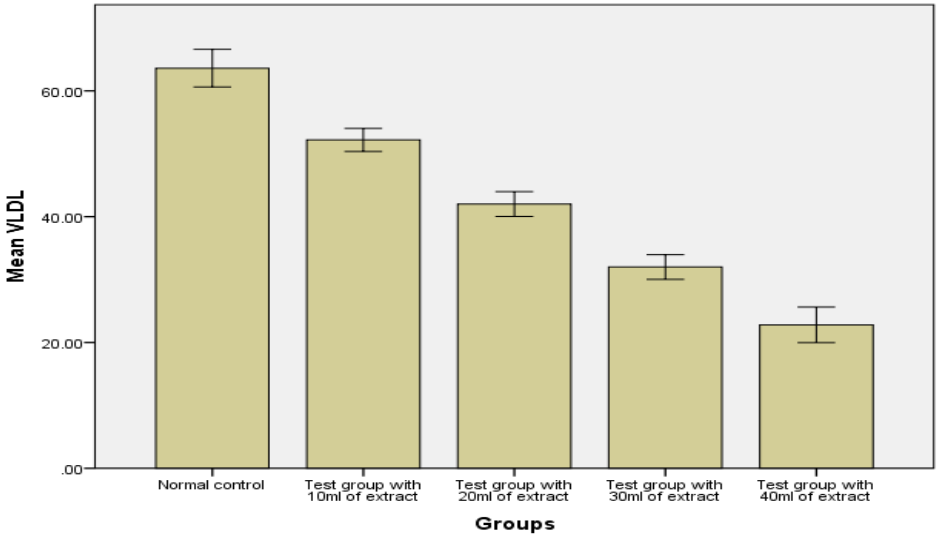

Fig. 3: Mean comparison of the Normal control group and the Test groups that received 10 ml, 20 ml, 30 ml and 40 ml of the coconut water extract.

There is a significant decrease ($p < 0.05$) between the normal control and the test groups that receive 10 ml, 20 ml, 30 ml and 40 ml of the coconut water extract.

Effects of coconut water extract on high density lipoprotein (HDL)

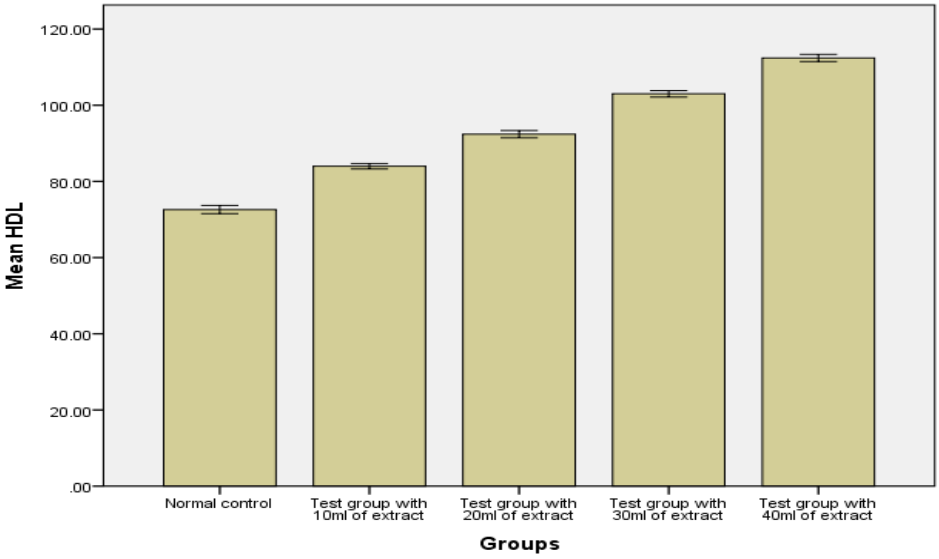

Fig. 4: Mean comparison of the Normal control group and the Test groups that received 10 ml, 20 ml, 30 ml and 40 ml of the coconut water extract.

There is a significant increase ($p < 0.05$) between the normal control and the test groups that receive 10 ml, 20 ml, 30 ml and 40 ml of the coconut water extract.

Effects of coconut water extract on low density lipoprotein (LDL)

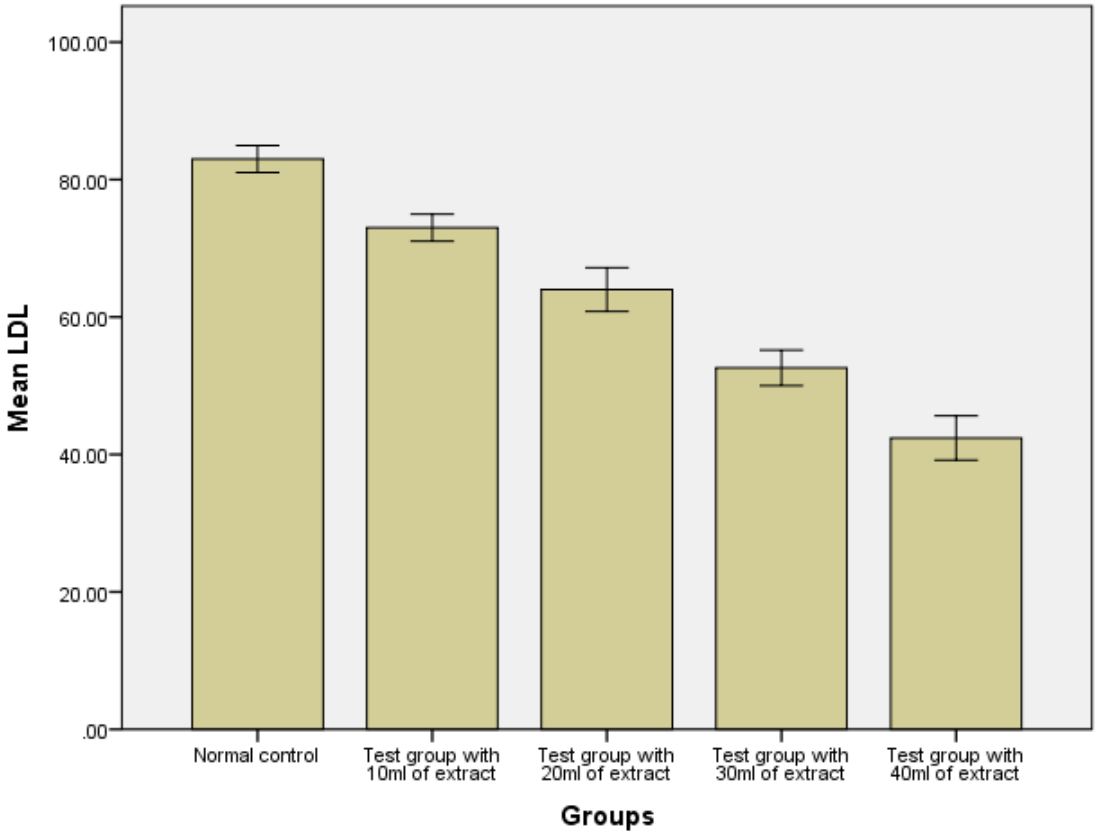

Fig. 5: Mean comparison of the Normal control group and the Test groups that received 10 ml, 20 ml, 30 ml and 40 ml of the coconut water extract.

There is a significant decrease ($p < 0.05$) between the normal control and the test groups that receive 10 ml, 20 ml, 30 ml and 40 ml of the coconut water extract.

3. DISCUSSION

Lipids are a class of biological molecules defined by low solubility in water and high solubility in non polar solvents. As molecules that are largely hydrocarbon in nature, lipids represent highly reduced forms of carbon and upon oxidation in metabolism, yield large amounts of energy. Lipids are thus the molecules of choice for metabolic energy storage.[16] Lipoprotein classification is based on differences in density. Generally, lipoproteins serve as an index for lipid profile estimation.

The result of the serum lipid profile showed a decrease in low density lipoprotein (LDL), very low density lipoprotein (VLDL), total cholesterol and triacylglycerol (TAG) value as the oral dose of the coconut water extract increases while high density lipoprotein (HDL) result on the other hand increases as the dose level of the extract increases ($p< 0.05$).

Triacylglycerol (TAG) is another type of fat found in the blood. The blood level of TAG is most affected by diet. Increased TAG level as well as high LDL-cholesterol level according to studies increases the chances of an individual suffering from a heart disease.[17]

An elevated serum triacylglycerol can result to liver diseases, coronary heart diseases, diabetes mellitus. Since the extract result in the increase in concentration of HDL and a decrease in the concentration of TAG, LDL, VLDL and total cholesterol, then the extract could be used for the treatment of cardiovascular diseases. High concentration of cholesterol leads to formation of plaque in the arterial wall, which serves as a cardiovascular risks factor.[18]

HDL cholesterol referred to as good cholesterol is protective against heart disease. A major function of the HDL is to act as a repository for the apo C and apo E required in the metabolism of chylomicron and VLDL. They transport cholesterol from the tissues to the liver. Reverse cholesterol transport is mediated by HDL via HDL cycle. HDL contains a high percentage by weight of protein and low percentage of lipid.[19] High levels of HDL cholesterol have been considered as a good indicator of a healthy heart. There is a significant increase ($p< 0.05$) between the normal control group and the test groups that received 10 ml, 20 ml, 30 ml and 40 ml of the coconut water extract. The increase in HDL suggests that the extract can be used to treat heart failure due to coronary arteries, which is a leading cause of death in industrialized societies.

Low density lipoprotein (LDL) is commonly known as the bad cholesterol, which is produced by the liver and carry cholesterol and other lipids from the liver to different areas of the body such as muscles, heart and other parts. The high levels of LDL indicate much more cholesterol in the blood stream than necessary and hence, increase the risk of heart disease.[20]

The significant decrease ($p< 0.05$) between the normal control group and the test groups showed that the plant extract was able to reduce the level of LDL in the rat which could reduce the risk of heart disease, since LDL is regarded as a bad cholesterol.

Reduction of low density lipoprotein concentration by the coconut water extract decrease as the rises of DNA oxidative through damage by per oxidation while LDL oxidation lead to fat accumulation in the arteries, which cause atherosclerosis and other cardio vascular diseases.[21,22] There is a negative correlation between the HDL and LDL. Atherosclerosis is due to high level of cholesterol and LDL in the blood. The plant *Cocos nucifera* extract has the ability to lower the cholesterol and the LDL levels and increase in the HDL level. The HDL is responsible for the clearance of cholesterol from the blood which addition could inhibit the oxidation of HDL antioxidant.

Cholesterol is undoubtedly the most publicized lipid in nature, because of the strong correlation between high levels of cholesterol in the blood and the incidence of diseases of the cardiovascular system in the humans. It is not only an important component of some cell membranes and of plasma lipoprotein but also the precursor of many other biologically important steroids, such as bile acids and various steroid hormones. It is the principal sterol of higher animal and is especially abundant in nerve tissues and gallstones.[23] The result from the analysis showed that there is a significant decrease ($p< 0.05$) in the level of total cholesterol (T. Chol) between the normal control group and extract at the various concentrations, indicating that the plants extracts was able to lower the level of total cholesterol in the rats.

CONCLUSION

The present study indicates that coconut water extract exhibits hypolipidemic properties in the serum lipid profile of wistar albino rats and could be used in the management and treatment of diseases implicated by hyperlipidemia.

Recommendation

It is advised that further detailed investigation is necessary to find out it´s mechanism of action and establish its therapeutic potential in the treatment of cardiovascular diseases.

Limitation of The Study

The duration of this study was not more than 28 days. Moreover, our present findings were in rats and therefore cannot be directly interpreted that these effects observed in rats will be exactly and/or physiologically the same in humans. Therefore, our findings are subject to further research and verification especially in humans.

Ethical Approval

All authors hereby declare that "Principles of laboratory animal care" (NIH publication No. 85- 23, revised 1985) were followed, as well as specific national laws where applicable. All experiments have been examined and approved by the appropiate ethics committe.

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Competing Interests

Authors have declared that no competing interests exist.

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