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Ethanol extract of *Ceiba pentandra* leaf ameliorates some lipids profile indices of Wistar rat's induced benign prostatic hyperplasia

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Abstract

Benign prostatic hyperplasia (BPH) is a considerable public health problem prevalent among older men. Despite its eminent prevalence, the etiology of BPH is not well understood. Accumulating evidence indicates that modifiable risk factors of cardiovascular disease may also increase the risk of BPH and potentially contribute to BPH development. This study evaluated the ameliorative effect of *Ceiba pentandra* leaf on some lipids profile indices of rats induced BPH. Thirty six Wistar rats were divided randomly into six groups (n = 6). All the experimental groups except the normal control were induced benign prostatic hyperplasia using testosterone propionate and estradiol valerate at a dose of 400 µg and 80µg respectively, for 21 days. After induction, rats in the negative control (BPH Control) group received no treatment. Rats in the standard control group received finasterides (1mg/kg body weight), while rats in the low dose extract, medium dose extract and high dose extract groups received the plant extract according to their body weights in kilogram at 500 mg/kg, 1000 mg/kg, and 1500 mg/kg respectively. Normal Control group received only feed without any special treatment. The animals in all the groups were allowed access to water and feed *ad libitum* for 28 days. The rats were anaesthetized after treatment period. Blood samples were collected and serum harvested for analyses using standard methods. Result showed that *Ceiba pentandra* leaf had ameliorative effect on the lipids profile analyzed.

Keywords: *Ceiba pentandra*; Benign Prostatic Hyperplasia; Total cholesterol; Low density lipoprotein cholesterol; High density lipoprotein cholesterol

1. Introduction

Benign prostatic hyperplasia (BPH), commonly referred to as benign enlargement of the prostate, is an age- and hormone-related condition that causes varying enlargement of the prostate and histological alterations in the prostate gland. Urinary urgency, slow stream, nocturia, and increased daytime frequency are only a few of the symptoms brought on by prostate enlargement (Djavan, 2003; Lee *et al*., 2012). The quality of life for BPH sufferers is severely impacted by these symptoms (Sagnier *et al*., 1995; Lee *et al.*, 2016). The mechanism underlying the pathogenesis of BPH remains largely unidentified, however, a number of overlapping and complementary theories have been proposed. The pathophysiology of BPH involves hormonal changes in an aging man, albeit the exact mechanism is not yet entirely understood (Veeresh et al., 2010).The development and growth of normal prostate mainly depends on androgen stimulation, by dihydrotestosterone (DHT), which is produced from the prostrate by 5α-reductase enzyme (Cho *et al.*, 2013; Carson and Rittmaster, 2003).

There are two primary types of treatment for BPH patients: α1-adrenergic receptor antagonists to reduce smooth muscle tone in the prostate and the bladder neck, and 5α-reductase inhibitors to reduce prostate size (Fine and Ginsberg, 2008). The most often prescribed drugs for treating BPH historically have been tamsulosin and finasteride (Lee, 2003). Only 64% of men receiving both medications, according to McConnell *et al.* (2003) showed a decreased risk of clinical progression, which is indicated by symptoms getting worse, acute urine retention, and incontinence and

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urinary tract infection. Additionally, these medications caused unpleasant side effects including low libido, erectile dysfunction, postural hypotension, asthenia, and occasional syncope (Akiyama *et al.*, 1999; Lee eta l., 2014). It is highly desirable to develop a α1-adrenergic antagonist or other medication that can selectively suppress the smooth muscle tone of lower urinary tract without vascular effects and decrease prostate volume without sexual dysfunction for the treatment of urinary outlet obstruction in BPH (Akiyama *et al*., 2002)

Natural compounds produced from plant sources have long been the primary sources of novel medications for the treatment of a variety of ailments (Dharmani *et al.*, 2006). The multi-purpose *Ceiba pentandra plant*, which is native to northern Nigeria, and other tropical West African locations, has been found to have a variety of pharmacological applications. It is a plant from the *Bombacaeae* family. The presence of secondary metabolites like polyphenol, flavonoids, alkaloids, and saponins in *Ceiba pentandra plant* is responsible for its promising medicinal properties. Some of these compounds have been identified to possess antioxidant properties; scavenging free radicals produced by oxidation –reduction reactions (Nandeesh *et al.*, 2008). Previous research on the plant's morphology in different areas has confirmed that the plant is also utilized as a hypoglycemic agent and has been proven to be a successful treatment for rheumatism, headaches, and vertigo (Ngounou *et al.*, 2000). Typically, monitoring the progression of BPH involves evaluating specific biochemical markers (Kellogg, 2007). This study evaluated how extract of *Ceiba pentandra* leaf affected some lipids profile indices in testosterone propionate and estradiol valerate- induced benign prostatic hyperplasia in male Wistar rats.

2. Material and methods

2.1. Materials

Ceiba pentandra leaves were purchased from Okuku in Ogoja Local Government Area of Cross River State and authenticated by a Botanist, Prof. S. Udoh of the Department of Biology, Cross River University of Technology (CRUTECH), Calabar.

2.2. Preparation of extract

The leaves were plucked, washed and allowed to dry at room temperature (25 ^{o}C – 29 ^{o}C) for three weeks. The dried leaves were crushed to powder form and suspended in absolute ethanol in the ratio of 1:2, sample to solvent. The suspension was thoroughly agitated in an electric blender and thereafter allowed for about 48 hours at room temperature, then filtered firstly with a cheese material and afterwards with Whatman No. 2 filter paper. The filtrate was then concentrated in a rotary evaporator (45 ^{o}C – 50 ^{o}C) to about 1/10 of the original volume, after which the concentrate was allowed to evaporate to complete dryness in a water bath (45 ^{o}C – 50 ^{o}C).

2.3. Experimental animals

Thirty six male Wistar rats weighing 230 – 280 grams were ordered from the Department of Medical Biochemistry, Cross River University of Technology, Okuku Campus. These animals were maintained in standard conditions according to the procedure of the Animal Ethics Committee with approval number/code: CRUTECH/FBMS/IREC/2022-A1102 housed in well-ventilated standard cages and allowed to acclimatize, and on Chikun feed (rat chow) and clean water for seven days. The development of experimental protocols and procedures were performed in accordance with the Public Health Service (PHS) Policy on Humane Care and Use of Laboratory Animals.

2.4. Experimental design

The rats were divided randomly into six groups (n = 6). All the experimental groups except the normal control were induced benign prostatic hyperplasia using testosterone propionate and estradiol valerate (3 mg/Kg body weight) concurrently for 21 days. After induction, rats in the Benign Prostatic Hyperplasia Control (BPHC) group received no treatment after induction. Rats in the standard control, low dose of extract, medium dose of extract and high dose of extract groups received finasterides (1 mg/kg body weight) 500mg/kg, 1000 mg/kg and 1500 mg of extract of *Ceiba pentandra* leaf respectively. Normal Control group received only feed without any special treatment. The animals in all the groups were allowed access to water and feed *ad libitum* for 28 days.

2.5. Collection of blood sample analysis of some lipids profile indices

At the end of the experiment, rats were knocked off using ketamine hypochlorite and blood samples were obtained from rats by cardiac puncture. Blood samples were collected into sterile, plain bottles. Relevant organs were harvested and their respective weights were estimated for every rat sacrificed. The blood samples collected for biochemical analyses

were spinned in a centrifuge at 3000rpm for 10 minutes to harvest the serum. Sera were also collected in dry sample container, stored in a refrigerator and used for biochemical assay using Randox test kits.

Serum concentrations of total cholesterol (TC), high density lipoprotein cholesterol (HDL-C), and low density lipoprotein cholesterol (LDL-C) were assayed with spectrophotometric assay kits (Sigma-Aldrich, USA) (Assmann *et al.,* 1984).

2.6. Statistical analysis

Data obtained were analyzed using one-way ANOVA followed by least square difference (LSD) post-hoc comparison test to evaluate significant difference between the mean values of the experimental and control groups. Differences at $P < 0.05$ were regarded as significant. Graphpad prism version 7 and SPSS software package version 23.0 were used for the statistical analyses.

3. Results

3.1. Effect of *Ceiba pentandra* leaf on some lipids profile indices of rats induced BPH using testosterone propionate and estradiol valerate

The outcome of 28 days administration of *Ceiba pentandra* leaf on some serum lipids profile indices of rats induced benign prostatic hyperplasia is presented in *figure 1.* The result showed significantly ($p< 0.05$) decreased levels of total cholesterol and low density lipoprotein cholesterol in the groups administered 500mg/kg body weight (low dose) and 1500mg/kg body weight (high dose) of *Ceiba pentandra* leaf compared to the BPH negative control group as shown in fig. 1. The High density lipoprotein cholesterol of the group administered 500mg/kg body weight of *Ceiba pentandra* leaf had the highest level compared to other groups.

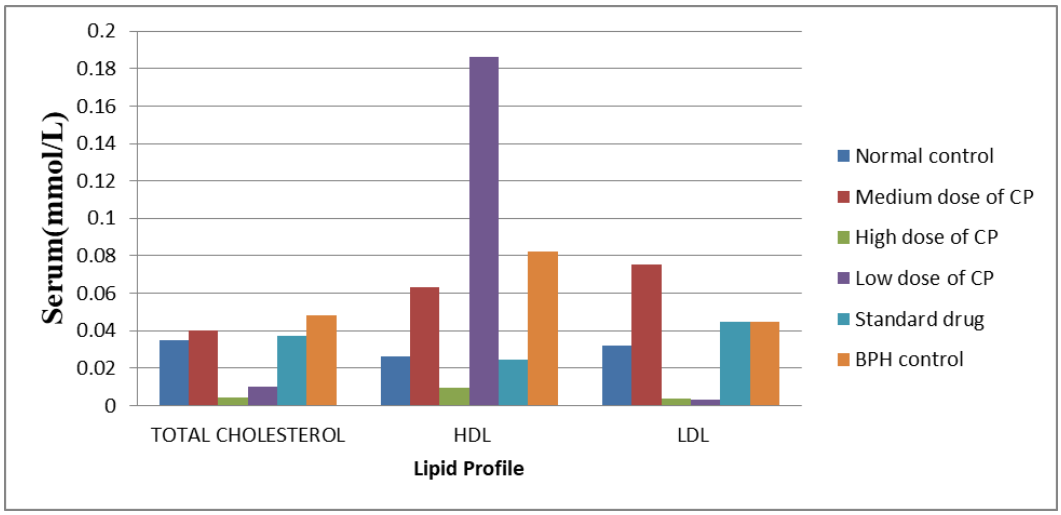

Figure 1 Effect of *ceiba pentandra* leaf on some lipids profile oindices of rats induced benign prostatic hyperplasia using testosterone and estradiol valerate.

4. Discussion

Benign Prostatic Hypeplasia has been variably defined as prostatic enlargement, histologic hyperplasia, lower urinary tract symptoms, diminished uroflow or urodynamic obstruction. The more acceptable clinical definition of BPH in the literature is prostate volume greater than 20 ml (Garraway *et al.*, 1991).Whether defined pathologically or clinically, BPH is a common process, eventually occurring in older men. Age is the dominant determinant of BPH occurrence (Berry *et al*., 1984) Although, Obi-Abang *et al*., (2022) deduced that high serum lipid levels might predict benign prostatic enlargement. Studies on the relationship between lipids profile and BPH are conflicting. Here, we evaluated the effect of *Ceiba pentandra* leaf on some lipids profile of rats induced benign prostatic hyperplasia using testosterone propionate and estradiol valerate.

Results showed that extract of *Ceiba pentandra* leaf significantly ($p<0.05$) decreased serum total cholesterol and low density lipoprotein levels compared to the BPH control group. This is consistent with the findings of Ahmed et al; Obi-

Abang *et al*.. Abnormal concentrations of lipids and lipoproteins are well-described risk factors for cardiovascular disease and include elevated serum low density (lipoprotetin cholesterol LDL-c) (usually defined as ≥ 130–140 mg/dL), decreased serum high density lipoprotein (HDL) cholesterol (< 40 mg/dL), and increased serum triglycerides (≥150 mg/dL) (Kellogg *et al*, 2008). These factors are components of the metabolic syndrome and frequently occur in association with other cardiovascular risk factors, including diabetes. This observation raises the possibility that abnormal lipids and lipoproteins also connect to BPH pathogenesis. The decreases in serum total cholesterol and low density lipoprotein cholesterol witnessed here testify the potential of *Ceiba pentandra* to ameliorate abnormal lipids concentrations in BPH conditions.

The High density lipoprotein cholesterol (HDL-c) of the group administered 500mg/kg body weight (low dose) of *Ceiba pentandra* leaf had the highest level compared to other groups (Giammanco *et al*., 2021). High density lipoprotein cholesterol promotes reverse cholesterol transport and modulates inflammation. The likely mechanism by which the extract exerted the increased levels of HDL-c could be due to rich phenolics present in *Ceiba pentandra* leaf. Phenolic compounds act as antioxidant by reacting with a variety of free radicals.

5. Conclusion

Ceiba pentandra leaf reduced serum concentrations of total cholesterol and low density lipoprotein cholesterol in rats induced benign prostatic hyperplasia. There was an increase in the high density lipoprotein cholesterol in the group administered low dose of the plant extract. This reveals its ability to ameliorate abnormal lipids concentration in BPH condition.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare no conflict of interest.

Statement of ethical approval

Ethical approval for the treatment and handling of experimental animal and human subjects was obtained from the Faculty Animal Research Ethics Committee on Use and Care of Experimental Animals, Faculty of Basic Medical Sciences, Cross River University of Technology, Okuku Campus with the approval number/code; CRUTECH/FBMS/IREC/2022-A1102.

Authors' Declaration

The authors hereby affirm that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

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