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Original Research Article

Effect of Methanol Leaf Extract of *Duranta erecta* in Rats Induced with Benign Prostatic Hyperplasia

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ABSTRACT

A common disease among elderly men is benign prostatic hyperplasia (BPH) of which oxidative stress plays important role. The present research evaluates the effect of methanol leaf extract of *Duranta erecta* (MLEDE) on testosterone-induced BPH in rats. The toxicity level of the extract was examined. Thirty male rats were used for the research, 5 animals served as normal control, 25 animals were induced with BPH using subcutaneous injection of testosterone for four weeks. After induction, they were grouped into five (group 2: BPH untreated, group 3 received finasteride: 3 mg/kg, group 4-6 received MEDE: 200, 400 and 600 mg/kg). Treatment lasted for three weeks. As the treatment protocol elapsed, all the animals were anesthetised. Blood were obtained via cardiac puncture for the determination of some biochemical parameters. The prostate was weighed, assayed for antioxidant activities and histologically examined. The extract was nontoxic at a dose up to 5000 mg/kg. MLEDE (at all doses) and finasteride significantly reduced the increases in prostate weight and index, serum testosterone, dihydrotestosterone, PSA and acid phosphatase caused by testosterone induction relative to the BPH rats. Testosterone induction led to increase in MDA and decreases in GSH, SOD, CAT and GPx activities that were significant but were reversed following the administration of MLEDE at all doses. The disruption of prostate histoarchitecture was improved by MLEDE. MLEDE reduced the effect of testosterone-induced BPH conceivably through enhancement of antioxidant defence system. Thus, *Duranta erecta* could be a promising source of herbal medicine for the management of BPH in men.

Keywords: Antioxidant, Benign Prostatic Hyperplasia (BPH), *Duranta erecta*, Oxidative stress, Phytotherapy.

Introduction

The prostate gland is one of the parts that make up the male reproductive system. It is located at the base of the urinary bladder where it aids in the production of fluid that is alkaline in nature. This fluid helps to protect the sperm.[1] When there is an overgrowth of the prostate gland; it results in Benign Prostatic Hyperplasia (BPH).[2] BPH is one of the most frequent diseases in ageing men. Benign prostatic hyperplasia manifests in 30–40% of men within the age of 40 years, and its prevalence increases linearly to 70–80% in men older than 80 years.[3] BPH disease is depicted by a non-controllable and rapid increase of the prostate epithelial cells and stromal cells, which results in enlargement of the prostate size.[4] As prostate increases, it narrows the urethra, thus decreasing the rate of urine outflow. The retention of urine in the bladder could lead to lower urinary tract symptoms (LUTS).[5] The disordered physiological processes associated with the disease are still unclear. However, several researchers have proposed that any of the following; oxidative stress, suppression of apoptosis and uncontrollable increase in cell proliferation play vital roles in the initiation and progression of BPH.[6]

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Increase in reactive oxygen species generation or impairment of the antioxidant defence mechanisms may result in oxidative stress. Oxidative stress in turn may lead to rapid production of cells resulting in overgrowth of prostatic tissues.[7] Furthermore, transcription factor NF-κB can be activated by oxidative stress. Nuclear factor kappa B cells (NF-κB) has a regulatory effect on inflammatory responses and cell proliferative pathways.[8]

α1-blockers and 5α-reductase inhibitors are drugs commonly used in the management of BPH in men. These drugs are not without side effects. A good number of the individuals in developing nations depend mostly on herbal medicines for their medications.[9] These herbal medicines are cheaper and mostly with lesser side effects compared with synthesised medicines, hence, they could form better alternative sources for the management of BPH.

Duranta erecta is a light green coloured plant which bears orange fruits. It is used as ornamental plants.[10] It has been reported that the plant possesses various bioactive compounds like alkaloids, flavonoids, saponins, tannins and terpenoids.[10] Prior studies have shown that it has been used for the management of headache, toothache, wound healing, liver protection,[11] and as diuretics.[12] Its anti-malarial activity have been reported.[12] *Duranta erecta* has been reported to be effective in the treatment of Urolithiasis in an animal model.[13] It has also been shown to be efficacious as an antiulcer agent and had anxiolytic effect in the experimental animal model.[14] The antioxidant[10] and antimicrobial activities of the leaf extract of *Duranta erecta* has been studied by researchers.[10,15] Due to the reported antioxidant properties of the plant, this study was therefore designed to investigate the effect of the methanol leaf extract of *Duranta erecta* on testosterone-induced benign prostatic hyperplasia.

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Materials and Methods

Experimental animals

Eighteen (18) albino mice (aged 8 weeks 21- 30 g) and thirty (30) adult male albino rats (aged 12 weeks, 203-305 g) were used for the acute toxicity (LD_{50}) and BPH studies, respectively. Animals used in the studies were procured from the zoology animal house at the University of Nigeria, Nsukka. The rats had free access to mash rat pellets (rat feed) and water during their acclimatization. The animals were managed following the guideline stipulated for use and care of Laboratory animals. The Ethical Committee of Faculty of Biological Sciences, University of Nigeria Nsukka approved this research with approval number: UNN/FBS/EC/1039.

Plant material

Fresh leaves of *Duranta erecta* were obtained From Amagu-uwani village in Nguru Nsukka on 14th August, 2019 and were identified by Mr. Felix Nwafor, a Botanist in the University of Nigeria Nsukka. The plant was assigned the voucher number: PCG/UNN/0344: *Duranta erecta*.

Drugs and chemicals

Testosterone propionate (TESTOST, Laborate Pharmaceuticals Ltd, India), testosterone ELISA kit (ALPCO Diagnostics, USA), PSA ELISA kit (BIOS, USA), dihydrotestosterone ELISA kit (ALPCO Diagnostics, USA), and absolute Methanol (BDH, Poole England).

Extraction of plant material

The leaves were air-dried and pulverized into powder using Tigmax Petrol Engine Grinding Mill. A known quantity (837.11 g) of pulverized leaves was soaked in methanol (2.5 L) for 48 h. The mixture was shaken within 12 h interval. It was then filtered using muslin fabrics. The filtrate gotten was further filtered using a filter paper and later concentrated into a semi-solid residue with the aid of a Hightech Rotary Evaporator.

Acute toxicity test

This study was carried out by following an already reported method.[16] Eighteen (18) albino mice weighing 21-30 g were used for the study. The experiment was divided into two phases. Nine mice were used in the first phase and were randomly grouped into three with three animals per group. The groups were given 10, 100, 1000 mg/kg body weight (*po*), respectively. From the result obtained in phase I, the remaining nine mice were then grouped in to three; three animals per group (phase II). The three groups were given a higher doses which include 1600, 2900 and 5000 mg/kg body weight (*po*) respectively. The mice were monitored for 24 hours for any signs of toxicity and death.

Animal treatment

BPH Induction

Thirty (30) male rats (203-305 g) were used for the BPH study. Upon completion of acclimatization (seven days), the rats were randomly divided into two groups; the first group made up of five animals served as a normal control group throughout the experiment and the other group made up of twenty-five rats. Briefly, BPH was induced in the second group by subcutaneous injection of testosterone propionate (3 mg/kg b.w) daily for 28 days.[17] On day 29, blood samples were collected via ocular puncture by a trained technician for the determination of serum PSA level that will serve as the baseline. All induced animals had a serum PSA level ≥ 1.70 ng/mL. The BPH induced rats were randomly separated into five experimental groups with five animals in each namely; positive control group i.e. the untreated (group 2), group treated with 3 mg/kg of b.w of finasteride (standard drug) (group 3), groups that were administered the different doses of the extract, that is, 200, 400, 600 mg/kg b.w and served as groups 4, 5 and 6, respectively. The animals were treated daily for 21 days via oral administration of the extract and the standard drug. On day 22, all the animals were anesthetised via chloroform inhalation following an overnight fasting. Samples of the blood were collected through cardiac puncture. The blood samples were quickly transferred into a plain sample bottles. A centrifugation maintained at 5000 rpm for 10 min was used to separate the serum of each blood sample. The prostates were carefully dissected out and weighed.

Determination of prostate weight and prostatic index

The prostate gland of all the experimental animals was harvested and weighed at the end of the experiment. The prostatic index was determined using the formula:[18]

$$\text{Prostatic index} = \frac{\text{Prostate weight}}{\text{Total Body Weight}}$$

Determination of serum prostate specific antigen, testosterone and dihydrotestosterone levels

The serum levels of PSA, testosterone and dihydrotestosterone were determined using ELISA kits following the guidelines of the manufacturers.

For PSA determination, the required numbers of wells were placed in a rack. A 25 µL each of samples, standards and test controls was added in adequate wells, and then 100 µL of the enzyme conjugate reagent was added followed by incubation for 45 min. The contents of each well were emptied and rinsed with washing buffer solution. To each of the wells was added 100 µL of TMB solution and then incubated for 15 min after which reactions in each wells were stopped by adding 100 µL of Stop Solution. The optical density was then read within 15 minutes using microtiter plate reader at 450 nm.

For testosterone and dihydrotestosterone determination, the required numbers of microwell strips were placed in a holder. To each of the labelled walls was added 50 µL each of standards, control and samples plus addition of 100 µL of conjugate working solution to each wells. The mixtures were incubated for 1 h at a room temperature. Diluted wash buffer (300 µL) was used to wash the wells for three times, then 150 µL of TMB was added to each well followed by 15 min incubation after which reactions in each wells were stopped by adding 50 µL of Stop Solution. The optical density was then read within 20 minutes using microtiter plate reader at 450 nm.

Assay for serum acid phosphatase (ACP)

Serum acid phosphatase (ACP) level was determined following an already reported method;[19] as outlined in Randox Kit, UK.

To 100 µL of the serum in a test tube was added 1.0 mL of reagent solution and incubated for 5 min at 37°C. Absorbance was read at 405 nm on a minute interval for 3 min.

Assay for oxidative stress markers

The prostate tissues were homogenized and the homogenate used for the assays of oxidative stress markers.

Assay for superoxide dismutase activity

A prior reported method[20] was followed to assay for the activity of SOD. An aliquot of the homogenate (0.1 mL) was introduced into a test tube already containing 0.2 mL of 0.1 M ethylenediaminetetraacetic acid, 0.1 mL of 1.5 mM nitro blue tetraazolium (NBT) and 2.2 mL of 67 mM phosphate buffer at a pH of 7.8. Riboflavin (0.05 mL) was then introduced and absorbance read at 560 nm against distilled water.

Assay for catalase activity

An earlier described method[21] was followed to assay for the catalase activity in the sample. The homogenate (0.1 mL) was mixed with 1.9 mL of 0.5 M phosphate buffer at a pH of 7.0. The absorbance was read at 240 nm, at a minute interval after the addition of 1.0 mL hydrogen peroxide (11 mM) maintained in a buffer solution. Catalase activity was computed using the milimoles extinction coefficient;

$$\frac{40\ \text{cm} - 1 \times \text{micromoles of hydrogen peroxide decomposed}}{\text{min} \times \text{mg protein}}$$

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Assay for glutathione peroxidase activity
An earlier described method[22] was used to determine the activity of glutathione peroxidase (GPx). To the homogenate (0.5 mL) was added 0.1 mL of 5 mM glutathione, 0.1 mL of 25 mM sodium nitrite, 0.1 mL of 1.25 mM hydrogen peroxide, and 1.3 mL of 0.05 mM phosphate buffer at a pH of 7.0, and the mixture incubated for 10 min at 37^{o}C. A 2 mL of 1.65% hydrogen phosphite was introduced to stop the reaction and then centrifuged at 1500 rpm for 10 min. To the supernatant (2.0 mL) was added 0.4 M sodium hydrogen phosphate (2.0 mL) and 1 mL of 1 mM 5,5'dithio-bis (2-nitrobenzoic acid). This was followed by 10 min incubation at a temperature of 37^{o}C, then absorbance was read at 412 nm against distilled water.

Determination of reduced glutathione (GSH) concentration
An already reported method[23] was used to determine the concentration of glutathione in the prostate tissue. To 0.5 mL of the homogenate in a test tube was added 0.1 mL of 25% tricarboxylic acid and maintained on ice and then centrifuged at 3000 rpm for 5 min. To 0.3 mL of the supernatant was added 0.7 mL of 0.2 M sodium phosphate buffer at a pH of 8.0 and 2.0 mL of 0.6 mM 5,5'dithio-bis (2-nitrobenzoic acid) (DTNB) prepared with the buffer. The absorbance was read at 412 nm after 10 min.

Determination of tissue malondialdehyde concentration
Malondialdehyde (MDA) was determined following a prior method.[24] To 1.0 mL of the homogenate was heated with 1.0 mL of thiobarbituric acid (TBA) reagent for 20 min in a water bath after which it was cooled and centrifuged for 10 min at 2000 rpm. The absorbance of the upper portion was determined at 532 nm against a blank.

Prostate tissue histology
The prostate tissues were harvested and the histology was carried out according to the method already described.[25]

Statistical analysis
The results obtained from this research were expressed as means ± SD and tests of statistical significance were carried out using student t-test and one-way analysis of variance (ANOVA). The Statistical Product and Service Solutions (SPSS) IBM version 20 was used to analyse all data from this research. P values less than 0.05 were statistically significant.

Results and Discussion

Acute toxicity (LD_{50}) study of methanol Leaf extract of Duranta erecta
The acute toxicity study (Table 1) revealed that the methanol leaf extract of *Duranta erecta* was neither toxic nor lethal at a dose up to 5000 mg/kg b.w, indicating that the leaves of *Duranta erecta* are relatively safe for oral consumption. This finding is consistence with an earlier report that *Duranta erecta* at high dose of 5000 mg/kg b.w was safe in experimental animal.[26]

Effect of methanol leaf extract of Duranta erecta on Serum Prostate Specific Antigen (PSA)
Administration of testosterone propionate for 28 days via subcutaneous injection impacted an increase in the serum level of PSA in the test animals which was significant ($p < 0.05$) relative to the normal rats confirming the induction of benign prostatic hyperplasia. The serum PSA levels which were elevated after BPH induction were noticed to have reduced significantly ($p < 0.05$) after 21 days of treatment with different doses of the extract and finasteride (standard drug) when compared with the BPH untreated animals (Table 2). The high levels of serum PSA observed in groups 3, 4, 5 and 6 reduced significantly ($p < 0.05$) after treatment. PSA, a glycoprotein found in the serum serves as a quantifiable determinant of prostatic cancer and benign prostatic hyperplasia.[25] The right interpretation of PSA levels to correctly differentiate between benign and malignant prostatic hyperplasia remains unknown. PSA level has been shown to increase in both cases but is more pronounced in prostatic cancer.[27]

Effect of methanol leaf extract of Duranta erecta on prostate weight and prostatic index.
The subcutaneous injection of testosterone propionate led to an increased weight of the prostate as well as the prostatic index in the untreated animals which was significant ($p < 0.05$) relative to the non-induced rats of group 1 as shown in Table 3. On the other hand, groups treated with the extract at all doses and finasteride (standard drug) showed a reduction in the weight of the prostate and as well, the prostatic index which was significant ($p < 0.05$) relative to the positive control. Increases in prostatic weight and index are one of the important indicators of BPH in men.[18,28] BPH is characterized by an overgrowth of stromal and epithelial cells, resulting in prostate enlargement.[2]

Effect of methanol leaf extract of Duranta erecta on serum testosterone, serum dihydrotestosterone levels and acid phosphatase (ACP) activity
The effect of the extract on serum testosterone and serum dihydrotestosterone level as well as the ACP activity was presented in Table 4. The induction of BPH with testosterone led to increases in the serum levels of testosterone, dihydrotestosterone and ACP activity in the BPH untreated animals which were significant ($p < 0.05$) relative to that of the non-induced animals of group 1. Treatment with *Duranta erecta* leaves extract impacted some decreases in the levels of testosterone, dihydrotestosterone as well as ACP activity in all the treatment groups which were significant ($p < 0.05$) relative to that of the BPH untreated animals. The level of testosterone in the blood plays a crucial role in BPH development. Testosterone is changed to a more powerful androgen; dihydrotestosterone (DHT) by the catalysis of the enzyme type II 5α reductase, which in turn favours the proliferation of prostatic cells (stromal and epithelial cells).[25,29] Androgens play essential role in BPH pathogenesis. DHT can easily bind to androgen receptors (ARs) due to its higher affinity to the ARs. The binding of DHT to AR stimulates the proliferation of the prostate cells.[30] Dihydrotestosterone is primarily responsible for the prostatic overgrowth of the prostate cells.[31] In this study, the positive control group had elevated levels of testosterone and dihydrotestosterone while those treated with the extract had a considerable decrease in the hormonal levels. This suggests that the extract may have facilitated the uptake of free testosterone within the system, thus reducing the amount of testosterone that could be converted to dihydrotestosterone which is the potent form of the hormone responsible for the development of benign prostatic hyperplasia.
Acid phosphatase (ACP) is prostatic secretion that is also used as a marker of benign prostatic hyperplasia. It also helps to monitor the treatment progress of BPH.[32] Its elevation has been reported in animals treated with testosterone and the reason for the increase may be as a result of increase in lysosomal activity.[33]

Table 1: Phase I and II of the acute toxicity (LD_{50}) study

	Dosage (mg/kg body weight)	Mortality
Phase I		
Group 1	10	0/3
Group 2	100	0/3
Group 3	1000	0/3
Phase II		
Group 1	1600	0/3
Group 2	2900	0/3
Group 3	5000	0/3

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Effect of methanol leaf extract of Duranta erecta on prostate antioxidant enzymes, glutathione concentration and lipid peroxidation

The reduction in antioxidant enzymes activities as well as the concentration of GSH in the tissue homogenate of the BPH untreated group and other test groups were significant ($p < 0.05$) relative to that of the group 1 animals. Treatments with different doses of the extract and finasteride were able to increase the activities of SOD, CAT, GPx and GSH concentration significantly ($p < 0.05$) relative to that of the BPH untreated animals (Table 5). Malondialdehyde (MDA) concentrations increased significantly ($p < 0.05$) in the prostate homogenate of the BPH untreated group when compared with the normal control animals of group 1.

Groups 3, 4, 5 and 6 had reductions in the MDA concentrations in the prostate homogenate which was significant ($p < 0.05$) relative to that of the BPH untreated group. Group 6 however, showed a non-significant ($p > 0.05$) difference in the concentration of MDA when compared with that of the non-induced animals in group 1 (Table 5). Benign prostatic hyperplasia is characterized by increased oxidative stress associated with ageing.[34] There is a rapid cell turnover rate in the human prostate tissue with few DNA repair enzymes available thereby making the DNA prone to oxidative damage.[35] Decreases in antioxidants and increased lipid peroxidation are observed in BPH patients due to oxidative stress.[7] It has been reported that plant with antioxidant potentials effectively reduces the risk of BPH.[1] *Duranta erecta* has been reported to possess antioxidant properties due to its rich content of antioxidant phytochemicals.[14,15] Many medicinal plants rich in antioxidant property have been shown to be effective in improving oxidative stress in BPH.[25]

Effect of methanol leaf extract of Duranta erecta on the histology of the prostate gland

The prostate tissues of rats in the normal control group (Plate 1a) showed normal histological features characterized by adequate micro acini. It has small-sized acini with thin epithelium (EP), little or no prostatic secretion (S) was observed in the acini. The general feature of the tissue was adequate with no sign of dysfunction. The prostate of the positive control group (BPH-induced but untreated) (Plate 1b), showed ectasia (dialation) of the prostate associated with enlarged acini with thick epithelium (EP). The ectasia of the acini appeared cystic. Haemorrhagic (H) condition associated with blood vessel rupture was observed within the fibromuscular stroma, which could lead to adenoma of the epithelium. More prostatic secretion was also observed. Plate 1c showed the photomicrograph of the prostate tissue of the standard control group. It had small sized acini with thin epithelium. Little or no prostatic secretion was observed in the lumen. The prostate tissue of rats in group 4 (Plate 1d) showed reduced prostatic secretion (S) relative to the untreated group. Minor passive haemorrhages (H) (black arrow) were observed. Group 5 animals (Plate 1e) showed slightly large acini with little prostatic secretion. Plate 1f (Group 6 animals) showed small-sized acini, moderate prostatic secretions and thin epithelium. Testosterone has effects on several body organs including the prostate gland,[36] therefore the impact of hypertestosteronemia on histology of prostate glands implicated in this research were examined. The BPH untreated animals recorded more histological disruption than the finasteride and extract treated groups. The changes observed in the histology of the prostate of the animals could be due to testosterone-induced oxidative stress-mediated damage. The finasteride and the extract treated groups recorded a reduced serum testosterone level when compared to the untreated animals; this could have led to the minimization of testosterone-mediated histological changes in the extract treated groups.

Table 2: Effect of methanol leaf extract of *Duranta erecta* on serum prostate specific antigen (PSA)

Group	PSA (ng/ml) Before Treatment	PSA (ng/ml) After Treatment
Normal Control	0.40 ± 0.09^{a}	0.39 ± 0.13^{a}
Positive Control	1.94 ± 0.07^{b}	2.03 ± 0.06^{e}
Standard Control (finasteride)	1.89 ± 0.12^{b}*	0.98 ± 0.12^{b}*
BPH+200 mg/kg b.w of extract	2.06 ± 0.10^{b}*	1.48 ± 0.16^{d}*
BPH+400 mg/kg b.w of extract	2.00 ± 0.16^{b}*	1.25 ± 0.20^{c}*
BPH+600 mg/kg b.w of extract	2.01 ± 0.62^{b}*	1.10 ± 0.38^{bc}*

Values are presented as mean ± SD (n = 5). Groups with different superscripts down the column are significantly different from each other at $p < 0.05$. Groups bearing * across the row are significantly different from one another at $p < 0.05$.

Table 3: Effect of methanol leaf extract of *Duranta erecta* on prostate weight and prostatic index

Group	PW (g)	PI (mg/g)
Normal Control	0.20 ± 0.02^{a}	0.91 ± 0.06^{a}
Positive Control	1.41 ± 0.18^{d}	5.71 ± 0.29^{e}
Standard Control (finasteride)	0.49 ± 0.02^{b}	2.35 ± 0.10^{b}
BPH+200 mg/kg b.w of extract	0.69 ± 0.11^{c}	3.10 ± 0.22^{c}
BPH+400 mg/kg b.w of extract	0.53 ± 0.11^{b}	2.50 ± 0.40^{b}
BPH+600 mg/kg b.w of extract	0.45 ± 0.04^{b}	1.65 ± 0.21^{d}

Values are presented as mean ± SD (n = 5). Groups with different superscripts down the column are significantly different from each other at $p < 0.05$. **Key:** BPH = Benign prostate hyperplasia**.** PW = Prostate weight**.** BW = Body Weight**.** PI = Prostatic Index.

Table 4: Effect of methanol leaf extract of *Duranta erecta* on serum testosterone, serum dihydrotestosterone levels and Acid Phosphatase (ACP) Activity

Groups	Testosterone (ng/mL)	Dihydrotestosterone (ng/mL)	ACP (U/L)
Normal Control	1.39 ± 0.23^{a}	8.35 ± 0.65^{a}	23.60 ± 1.12^{a}
Positive Control	3.95 ± 0.56^{e}	18.59 ± 1.16^{d}	42.23 ± 4.64^{c}
Standard Control (finasteride)	2.23 ± 0.13^{bc}	14.35 ± 0.47^{c}	31.75 ± 1.25^{b}
BPH+200 mg/kg b.w of extract	3.18 ± 0.59^{d}	14.63 ± 0.69^{c}	30.39 ± 1.94^{b}
BPH+400 mg/kg b.w of extract	2.86 ± 0.77^{cd}	14.30 ± 1.02^{c}	33.14 ± 3.90^{b}
BPH+600 mg/kg b.w of extract	1.72 ± 0.39^{ab}	12.60 ± 0.89^{b}	30.70 ± 1.27^{b}

Values are presented as mean ± SD (n = 5). Groups with different superscripts down the column are significantly different from each other at $p < 0.05$.

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Table 5: Effect of methanol leaf extract of *Duranta erecta* on prostate antioxidant enzymes and lipid peroxidation product (MDA)

Group	SOD (U/mg protein)	CAT (U/mg protein)	GSH (n Mol/mg protein)	GPx (U/mg protein)	MDA (n Mol/mg protein)
Normal Control	42.28 ± 2.38^{d}	10.83 ± 0.78^{c}	21.66 ± 1.73^{c}	21.58 ± 0.81^{d}	1.80 ± 0.26^{a}
Positive Control	22.50 ± 3.20^{a}	5.49 ± 1.02^{a}	12.50 ± 1.41^{a}	13.79 ± 0.55^{a}	7.76 ± 0.73^{c}
Standard Control (finasteride)	32.87 ± 2.10^{b}	8.07 ± 0.86^{b}	17.45 ± 1.59^{b}	19.86 ± 1.12^{bc}	3.04 ± 0.77^{b}
BPH+200 mg/kg b.w of extract	36.05 ± 1.87^{c}	8.48 ± 0.36^{b}	19.17 ± 1.60^{b}	19.26 ± 2.08^{bc}	3.07 ± 0.27^{b}
BPH+400 mg/kg b.w of extract	32.02 ± 1.87^{b}	7.86 ± 0.60^{b}	18.83 ± 0.92^{b}	18.53 ± 0.97^{b}	2.99 ± 0.92^{b}
BPH+600 mg/kg b.w of extract	34.26 ± 1.32^{c}	8.25 ± 0.70^{b}	18.01 ± 1.07^{b}	20.44 ± 0.99^{cd}	2.47 ± 0.57^{ab}

Values are presented as mean ± SD (n = 5). Groups with different superscripts down the column are significantly different from each other at $p < 0.05$. **Key:** BPH = Benign prostatic hyperplasia**,** SOD = Superoxide dismutase**,** CAT = Catalase**,** GSH = Reduced Glutathione**,** GPx = Glutathione peroxidase**,** MDA = Malondialdehyde.

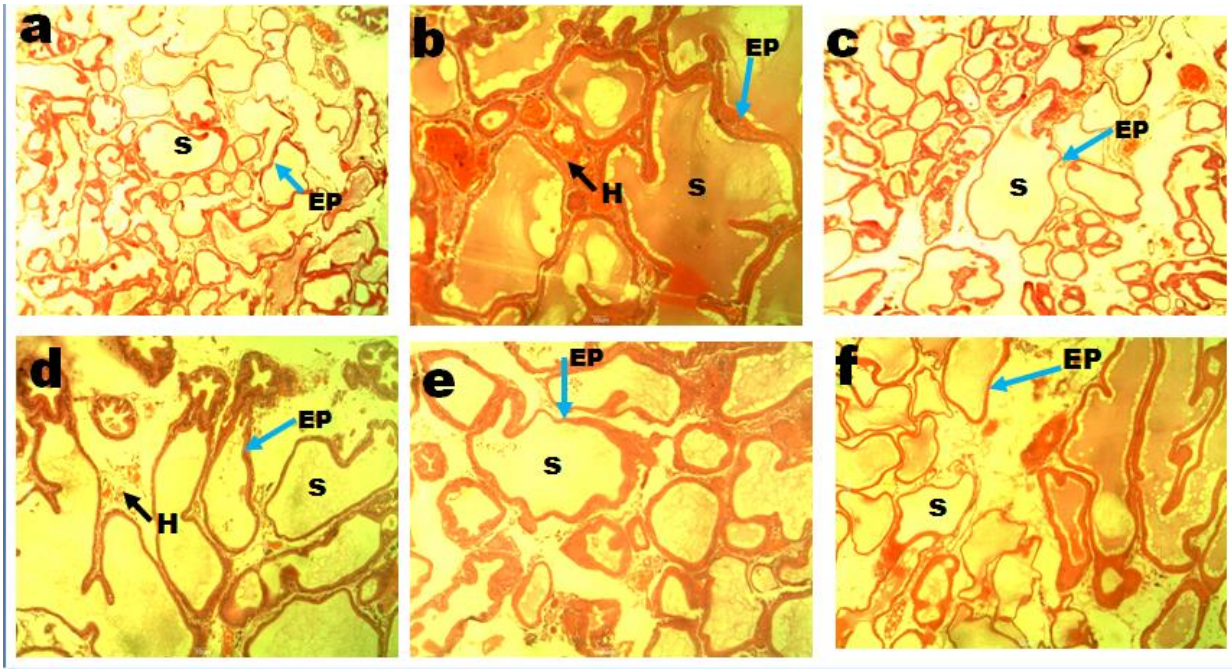

Plate 1: Photomicrographs of prostate glands of experimental groups: **(a)** Normal Control; **(b)** Positive Control; (c) Standard Control (finasteride); **(d)** BPH + 200 mg/kg of the extract; **(e)** BPH + 400 mg/kg of the extract; **(f)** BPH + 600 mg/kg of extract Haematoxylin & Eosin. mag. 400X. S = Prostatic Secretion, EP = Epithelium (blue arrow), H = Haemorrhage (black arrow).

Conclusion

This study was able to show that the methanolic leaf extract of *Duranta erecta* effectively improved testosterone induced benign prostatic hyperplasia possibly by the antioxidant property it exhibited. The oral consumption of *Duranta erecta* leaves may serve as a therapy in the management of BPH in men.

Conflict of Interest

The authors declare no conflict of interest.

Authors' Declaration

The authors hereby declare 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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