European Journal of Medicinal Plants
12(1): 1-11, 2016, Article no.EJMP.22856
ISSN: 2231-0894, NLM ID: 101583475

SCIENCEDOMAIN *international*
www.sciencedomain.org

Telfairia occidentalis Leaf and Seed Extracts as Possible Preventive and Therapeutic Agents for Induced Benign Prostatic Hyperplasia

Rotimi Sunday Ajani[1*] and Akinsola Raphael Akinyemi[1]

[1]Department of Anatomy, College of Medicine, University of Ibadan, Nigeria.

Authors' contributions

This work was carried out in collaboration between both authors. Author RSA designed the study, supervised the experiment, wrote the protocol, performed the statistical analysis and wrote the final draft of the manuscript. Both authors RSA and ARA did the literature search. Author ARA performed the experiment and managed the results. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/EJMP/2016/22856
Editor(s):
(1) Marcello Iriti, Professor of Plant Biology and Pathology, Department of Agricultural and Environmental Sciences, Milan State University, Italy.
Reviewers:
(1) Abrao Rapoport, Sao Paulo University, Brazil.
(2) Anthony Cemaluk C. Egbuonu, University of Agriculture Umudike, Nigeria.
Complete Peer review History: http://sciencedomain.org/review-history/12411

Original Research Article

Received 1st November 2015
Accepted 12th November 2015
Published 24th November 2015

ABSTRACT

Aim: The efficacy of *Telfairia occidentalis* leaf and seed as herbal extracts in the management of induced benign prostatic hyperplasia (BPH) in Wistar rats was investigated.
Methodology: Fifty adult male Wistar rats in 10 equal groups were utilized for the study. BPH was induced in nine groups. One group, (CN) served as normal control and the last, (CI) as positive control. Groups ALC and ELC respectively had aqueous and ethanolic extracts of the leaf while ASC and ESC groups had the respective seed extracts. All these four groups had concurrent administration of the extracts. The groups ALP, ELP, ASP and ESP had the respective extract administered after induction of BPH. At the expiration of the experiment, blood samples were collected for leukocyte count and estimation of levels of antioxidants. The animals were subsequently sacrificed and the harvested prostate glands were processed for light microscopy.
Results: Groups ELC and ESP had significantly lower body weight change when compared with CI. The mean prostate weights (g) of ALP, ALC, ELC, ASC and ESC (0.09±0.02, 0.19±0.01, 0.17±0.02, 0.25±0.05 and 0.21±0.03) were significantly higher than that of CN. The MDA levels

**Corresponding author: E-mail: rsaajani@yahoo.co.uk;*

(µmol/mg) of ALP, ELP, ASP, ESP, ELC and ASC (9.51±1.20, 9.51±0.42, 10.21±1.03, 9.64±1.11, 7.85±0.66 and 9.06±1.37) were significantly lower than the positive control (CI) value (10.32±1.92) but markedly higher than that of CN (6.80±0.15). The glutathione peroxidase activities (µmol/mg) of ALP, ELP, ASP, ESP, ALC, ELC, ASC and ESC (5.80±0.25, 6.01±0.37, 5.95±0.17, 5.96±0.20, 6.07±0.11,6.12±0.14,6.07±0.10 and 6.10±0.25) were significantly higher than that of group CI (5.66±0.19) but lower than CN (6.71±0.09). The catalase activities (µmol/mg) of ALP, ELP, ASP, ESP, ALC, ELC, ASC and ESC (1.60±0.12, 1.56±0.17, 1.68±0.13, 1.68±0.13, 2.40±0.45, 4.28±0.37, 2.42±0.42 and 2.40±0.40) were significantly higher than that of group CI (1.20±0.16) but lower than CN (4.70±0.20). For superoxide dismutase (µmol/mg); the groups ALP, ELP, ASP,ESP, ALC,ELC ,ASC and ESC levels were significantly higher than CI but lower than CN (0.21±0.03, 0.21±0.02, 0.22±0.03, 0.18±0.04, 0.33±0.01, 0.33±0. 04, 0.28±0.02 and 0.21±0.00; vs 0.03±0.01; vs 0.53±0.10).
The histology of the prostate gland of the CI group showed marked epithelial and stromal hyperplasia typical of BPH. Similar degree of hyperplasia could be seen in the ELC while the remaining three concurrent groups (ASC, ESC and ALC) showed lesser degree of epithelial and stromal hyperplasia.
Conclusion: The study findings are: (1) *Telfairia occidentalis* extracts shrink the enlarged prostate gland. (2) *Telfairia occidentalis* extracts reduce the severity of the associated prostatitis. (3) *Telfairia occidentalis* (seed and leaf) ameliorate the testosterone effects. (4) *Telfairia occidentalis* (extracts) reduce the size of prostate with Benign Hyperpasia by prevention of oxidative stress. The seed and leaf of *Telfairia occidentalis* thus appear to have a positive role to play in the non surgical management of benign prostatic hyperplasia.

Keywords: Telfairia occidentalis leaf and seed; benign prostatic hyperplasia; oxidative stress.

1. INTRODUCTION

The use of plants in the treatment of human ailments and diseases is as old as human existence [1,2]. A large number of pharmaceuticals in use for the management of diverse human diseases are extracts of various compounds of plant origin [3,4]. Herbal medicine is a key component of traditional medicinal practices such as ayurvedic, homeopathic, naturopathic, traditional oriental and native American - Indian medicine [5]. Studies have documented lower incidences of cardiovascular, neurological and malignant lesions amongst vegeterians [6-9]. The protective effects of plants are due to the presence of polyphenols and flavonoids.

Telfairia occidentalis, a tropical leafy vegetable locally known as fluted gourd, fluted pumpkin and ugu is a member of the cucurbitaceae family and is indigenous to southern Nigeria, where it is used primarily in soups and herbal preparations [10,11] The leaf and seed of the plant are rich in antioxidants especially vitamins A and C [10,12-14].

BPH is a common problem that affects the quality of life in one out of every three men aged 50 years and above. By the ninth decade of life, 95% of men would have histologically diagnosed BPH. In the United States of America, about 14 million men have symptoms related to BPH. Globally, approximately 30 million men have BPH symptoms.

The prevalence of BPH in white and African-American men is similar. However, BPH tends to be more severe and progressive in African-American men, possibly because of the higher testosterone levels, 5-alpha-reductase activity, androgen receptor expression and growth factor activity in this population. The increased activity leads to an increased rate of prostatic hyperplasia and subsequent enlargement and its sequelae [15].

In the USA, as at year 2000, BPH accounted for $1.1 billion dollars in direct health-care expenditures, 4.4 million office visits, 117,000 emergency room visits, 105,000 hospitalizations and with a loss of 21-38 million man hours. Minimum of $3.9 billion dollars is spent annually on the treatment of BPH in the United States of America [16].

Although the similar data for developed/ developing Nations of the world could not be assessed, the pattern may parallel that of the USA. Thus the disease burden of BPH globally is enormous. The developed nations may be able to cope with its management, but it is very

unlikely that the developing countries will be able to cope with the financial burden of the disease. Thus any measure or findings that will significantly reduce the cost implication of BPH will be of tremendous benefit to the less privileged nations. The aforementioned statement justified and warranted the study.

2. MATERIALS AND METHODS

2.1 Plant Materials

2.1.1 Collection and identification of plant materials

The leaves and seed pods of *Telfairia occidentalis* were procured from a regular vegetable market situated in Ojoo, Ibadan, South West Nigeria. Authentication was at the Forest Research Institute of Nigeria (FRIN) Ibadan with voucher specimen FHI: 110042 deposited at the herbarium of the Institute.

2.1.2 Preparation of extracts

The obtained leaves and seeds were dried at room temperature with filtered air. Both were separately blended to produce very fine powdery substances which were used for respective extraction. Two hundred and fifty grammes (250 g) each of these powdery leaves and seeds were used for the aqueous and ethanolic extractions.

The following yields were obtained;

i Aqueous leaf extract- 14.0% (0.05 g/ml)
ii Aqueous seed extract- 11.3% (0.06 g/ml)
iii Ethanolic leaf extract- 10.0% (1.36 g/ml)
iv Ethanolic seed extract- 30.0% (2.47 g/ml)

2.2 Animals

Fifty adult male wistar rats weighing 150 to 220 g were procured from the College of Medicine animal house, University of Ibadan. They were acclimatized for two weeks in a well ventilated and illuminated environment. The ambient temperature was conducive for the study. The animals were fed liberally with standard rat diet and water.

2.3 Design of the Experiment

The criteria for group allotment were the interventional agent and the timing of its administration, consequently, the 50 rats were randomly allotted into ten equal groups. These groups were as stated below;

1. Normal Control (CN) – not induced
2. Induced Control (CI) - induced but not treated
3. Aqueous Leaf Post-Induction (ALP)
4. Ethanolic Leaf Post-Induction (ELP)
5. Aqueous Seed Post-Induction (ASP)
6. Ethanolic Seed Post-Induction (ESP)
7. Aqueous Leaf Concurrent (ALC)
8. Ethanolic Leaf Concurrent (ELC)
9. Aqueous Seed Concurrent (ASC)
10. Ethanolic Seed Concurrent (ESC)

2.4 Induction of Benign Prostatic Hyperplasia

Testosterone (Green Field Pharm. JIANG SU Ltd, China) and oestradiol (Medipharm Pvt. Lahore, Pakistan) were administered for the induction of benign prostatic hyperplasia.

Goya oil was used as diluent for the hormones. The hormones were administered parenterally at the inguinal region with oestradiol at 80 µg and testosterone at 300 µg per 100 g body weight every other day for three weeks [17-19].

2.5 Conduct of the Experiments

Through a pilot study, the induction of benign prostatic hyperplasia (BPH), using the method stated in 2.4, was histologically confirmed.

All the post induction groups, (ALP, ASP, ELP and ESP) had oral administration of respective extract at 3 g/kg body weight daily for three weeks [20].

For the groups ALC, ASC, ELC and ESC (concurrent groups), the respective oral extract was administered concurrently with the hormones.

The two control groups (CN and CI) had water and rat feed for same duration.

Following three weeks of intervention, blood samples for full blood count were collected from the tails of all the animals. Thereafter, they were sacrificed under sedation with parenteral ketamine hydrochloride and diazepam. The harvested prostate gland of each animal was divided into two with one half processed for histological examination using hematoxylin and

Eosin (H&E) stain; while the other for biochemical assay {Catalase (CAT), Glutathione peroxidase (GPx), Superoxide dismutase(SOD) and Malondialdehyde (MDA)}.

2.6 Data Analysis and Processing

The numerical aspects of the results were analyzed with Statistical Package for the Social Sciences (SPSS) version 20 and expressed as percentages, means plus standard deviation of means (SD). The student t- test was used for inter group comparison and level of significance was set at $p<0.05$.

3. RESULTS

3.1 Gross Observation

No mortality was recorded amongst the groups. The group CN animals were healthy, normoactive and recorded weekly weight gain. The CI animals were observed to be hyperactive with loss of fur around the dorsal trunk and fluctuating body weight. In the concomitant groups only ELC recorded significant weight loss otherwise normal. The post induction groups were noticed to be aggressive and also had progressive weight gain.
All the harvested prostate glands were macroscopically normal.

3.2 Body Weight

All the groups with the exemption of ESP and ELC had weight gain; while ESP was static but ELC had weight loss (Table 1).

3.3 Prostate Weight

As expected, group CN had the least prostate weight. The mean prostate weight of CI was higher than the post induction groups but lower than the concurrent groups (Table 2).

3.4 Oxidative Stress Parameters

All the experimental groups had lower levels of pro oxidant (MDA) but higher values of antioxidants (GPx, CAT and SOD) than CI group (Table 3).

3.5 Histological Assessments

Epithelial hyperplasia was observed in all the induced groups however, at a lesser degree in the post induction groups (Plates 1-3).

4. DISCUSSION

The proliferation of the prostate gland in rats is stimulated by 5α- dihydrotestosterone (DHT), the biologically active form of testosterone [21,22]. The increased physical activity and aggression displayed by the group CI animals could be attributable to the anabolic effects of testosterone, however, these attributes were not observed in the experimental groups. It may thus be postulated that extracts (aqueous and alcoholic) of *T. occidentalis* irrespective of the timing of administration in rats were capable of ameliorating the anabolic effects of testosterone. By extension, it may be deduced that *T. occidentalis is* capable of ameliorating the severity of benign prostatic hyperplasia (BPH) in Wistar rats.

Table 1. Mean group weight (g)

Group	W_0	W_1	Mean ΔW	%weight change	(N=50)
CN	164±7.42	186±37.15	22±2.74	13.41	
CI	202±33.45	208±29.92	6±11.40	2.97	
ALP	171±12.94	191±5.47	20±9.35	11.70	
ELP	190±19.36	201±22.47	11±17.82	5.79	
ASP	187±20.19	197±16.05	10±7.07	5.35	
ESP	193±14.40	193±13.51	0.0±5.00 [a*]	0.00	
ALC	198±22.52	203±13.96	7±7.58	3.54	
ELC	212±13.51	202±9.08	-10±7.07 [b*]	-4.72	
ASC	152±21.97	157±8.37	5±14.14	3.29	
ESC	150±9.35	154±6.52	4±6.52	2.67	

*The mean weight change in CN was significantly higher than (a) ESP and (b) ELC.W_0, (initial weight); W_1, (final weight); ΔW, (weight change). The negative mean weight change for group ELC connote reduction in mean body weight. N= 50 indicates the population size. * $P< 0.05$*

Table 2. Mean prostate weight (g/100g body weight)

Group	Weight of prostate
CN	0.08±0.03
CI	0.16±0.03
ALP	0.09±0.02^{a*}
ELP	0.14±0.04
ASP	0.12±0.01
ESP	0.13±0.04
ALC	0.19±0.01^{b***}
ELC	0.17±0.02^{c**}
ASC	0.25±0.05$^{d\ f***}$
ESC	0.21±0.03^{e***}

The mean weight of the prostate gland of CN group was significantly lower than that of (b) ALC, (c) ELC, (d) ASC and (e) ESC groups. The Induced control (CI) group had significantly higher mean prostate weight than (a) ALP but lower than (f) ASC groups
$^{*}P< 0.05$, $^{**}P< 0.01$ and $^{***}P< 0.001$

Table 3. Mean values of antioxidants

Group	GPx (µmol/mg)	CAT (µmol/mg)	SOD (µ/mg)	MDA (µmol/mg)	N=50
CN	6.71±0.09	4.70±0.20	0.53±0.10	6.80±0.15	
CI	5.66±0.19	1.20±0.16	0.03±0.01	10.32±1.92	
ALP	5.80±0.25^{a***}	1.60±0.12^{c***}	0.21±0.03^{ef***}	9.51±1.20^{g**}	
ELP	6.01±0.37^{a***}	1.56±0.17 ^{c***}	0.21±0.02 ^{ef***}	9.51±0.42^{g**}	
ASP	5.95±0.17^{a***}	1.68±0.13 ^{c***}	0.22±0.03 ^{ef***}	10.21±1.03^{g**}	
ESP	5.96±0.20^{a***}	1.68±0.13 ^{c***}	0.18±0.04 $^{ef***-}$	9.64±1.11 ^{g**}	
ALC	6.07±0.11^{a***}	2.40±0.45 ^{cd***}	0.33±0.01 ^{ef***}	8.72±0.35	
ELC	6.12±0.14^{a***,b*}	4.28±0.37^{d***}	0.33±0.04 ^{ef***}	7.85±0.66^{h*}	
ASC	6.07±0.10^{a***}	2.42±0.42 ^{cd***}	0.28±0.02 ^{ef***}	9.06±1.37^{g**}	
ESC	6.10±0.25^{a***b*}	2.40±0.40 ^{cd***}	0.21±0.0 ^{ef***}	8.26±0.20	

The mean gluthation peroxidase (GPx) value of the CN group was significantly higher than those of the experimental groups(a). While that of group CI was lower than ELC and ESC (b). The catalase activites in all the experimental groups except ELC were significantly higher than the CN group(c). The catalase value of CI group was significantly lower than ALC,ELC, ASC and ESC (d) . The normal control had higher superoxide dismutase (SOD) activites while group CI had lower activites than the experimental (e & f). The MDA activies of ALP,ELP,ASP,ESP and ASC were significantly higher than that of CN (g) . Only group ELC had significantly higher MDA activity than CI (h). N= 50 indicates the population size
$^{*}P< 0.05$, $^{**}P< 0.01$ and $^{***}P< 0.001$

Table 4. Haematological profile (mean)

Group	Leukocyte (WBC) count (/µL)
CN	3240±359.5
CI	6300±2443
ALP	5980±1226
ELP	5650±577
ASP	5420±1074
ESP	6710±1488^{a*}
ALC	6830±1857^{a*}
ELC	5930±1539
ASC	7390±2125^{a**}
ESC	7730±2207^{a**}

The group CN leukocyte count was significantly lower than those of (a) groups ESP, ALC, ASC and ESC.
$^{*}P< 0.05$ and $^{**}P< 0.01$

Alopecia (hair loss) is a documented feature of increased testosterone level [23,24]. There was fur loss (alopecia) in the CI group but not in the experimental groups, this could be suggestive of the ability of *T. occidentalis to* reduce elevated testosterone level thereby ameliorating the severity of BPH.

Testosterone at high doses suppresses weight gain in castrated rats [25,26] this is by reduction in body fat [27-29]. This may explain the pattern of weight change seen in the groups. With regards to weight change, only groups ESP and ELC had significantly lower values in comparison with the non-induced control (CN). This might infer that ethanolic extract of seed or leaf of *T. occidentalis* was able to lower the elevated level of testosterone and consequently mellowed the adipolysis effect of high testosterone level.

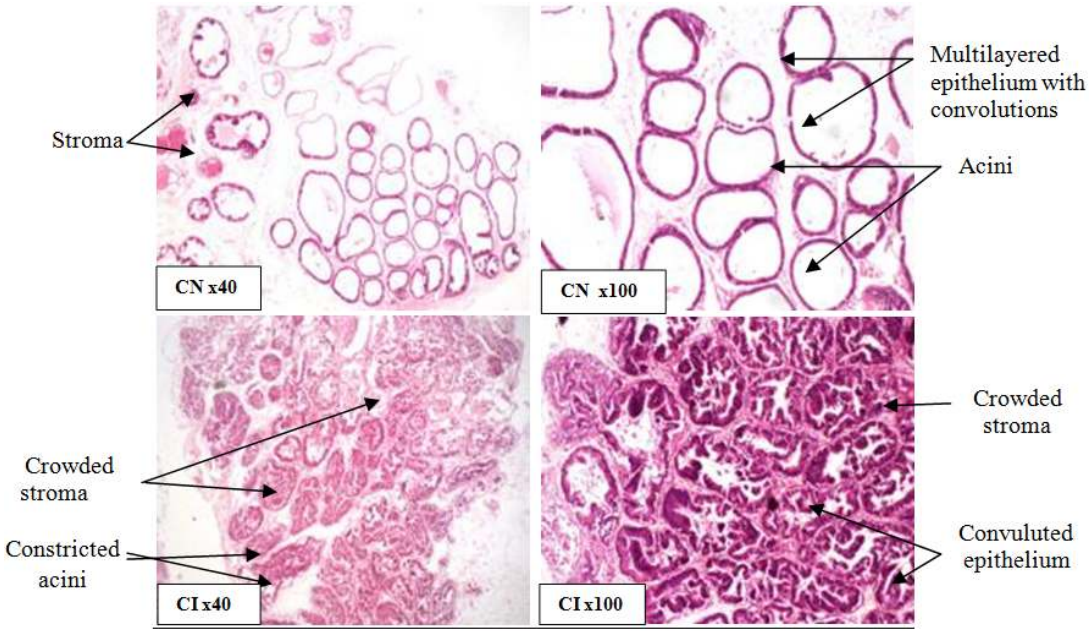

Plate 1. Prostate gland of the control groups (H &E)

The features seen in the group CN were those of non enlargd prostate in rat while those seen in the CI group were those of enlarged prostate gland (BPH)

The prostate weights of all the post induction groups were lower than that of CI with the value for ALP being significant. Those animals that had concurrent administration of *T. occidentalis* extracts had significantly higher values. This clearly shows that both the seed and leaf of the plant contain phytochemicals that could shrink the prostate gland; with the aqueous extract being efficacious. However, whether the shrinkage affects only the enlarged prostate or also the normal prostate could not be ascertained by this study (as there was no non induced group that had the extract) further studies are required to elucidate the phytochemicals of *T. occidentalis* that may be responsible for the shrinkage. Thereafter, this study may be translated to the non surgical management of BPH in men.

The white blood cell (WBC) or leukocyte counts of all the groups (CI inclusive) were markedly higher than that of the CN group with some (ESP, ALC, ASC and ESC) being significant. If the value for the CN group is taken as normal for rats, it may be reasonably concluded that the groups had leukocytosis (elevated WBC count).

A major component of inflammatory response is leukocytosis. The observed leukocytosis, connoted inflammation of the prostate gland (prostatitis). The prostatitis was of lesser severity in the four groups (ALP, ELP, ASP and ELC) that had insignificant leukocytosis than the significant groups (ESP, ALC, ASC and ESC). It may be deduced that both the leaves and seeds (the leaves being slightly better) of *T. occidentalis* either in aqueous or ethanol preparation administered in established BPH are associated lesser prostatitis than with concurrent administration. A strong positive correlation had long been established between the severity of the inflammation and the magnitude of the enlargement in BPH [30,31]. Since not all adult men will develop BPH in their life time; it will be more rational and practicable to prescribe aqueous preparation of *T. occidentalis* leaves or seeds to men with clinical diagnosis of BPH. The leukocyte count may drop progressively approaching the normal value if the duration of the study had been extended. This may be the rationale for further future study.

There are several products of leukocytes some beneficial and some harmful to the human body systems. Products that have been implicated in the aetiopathogeneses of major diseases such as hypertension, diabetes mellitus and BPH; include reactive oxygen species (ROS) and inducible nitric oxide [32]. Any event or process that results in excess ROS either due to their

over production or reduced depletion by antioxidants will result in oxidative stress (OS). Inflammatory response of the prostate gland results in the generation of free radicals such as inducible nitric oxide, reactive nitric species and ROS .These molecules will induce oxidative stress in the tissue and DNA resulting in hyperplasia of the prostate gland [33,34]. An altered apoptosis leads to hyperplastic or malignant transformation of the prostate [35].

Malonaldehyde (MDA) is an end product of peroxidation of polyunsaturated fatty acids and their esters. Thus the estimation of the serum level of MDA is an in vivo index of lipid peroxidation and thus represents a biomarker of OS [36]. The CN group had the lowest MDA value while group CI had the highest with the experimental groups in between. The plausible inference from this observation is that induction and establishment of BPH in rats were associated with oxidative stress. Available literature emphasized significantly elevated MDA values in BPH patients than their control cohort [37-40]. All the experimental groups had MDA values lower than that of CI; thus the extracts of *T. occidentalis* leaf and seed were capable of ameliorating the OS associated with BPH in rats.

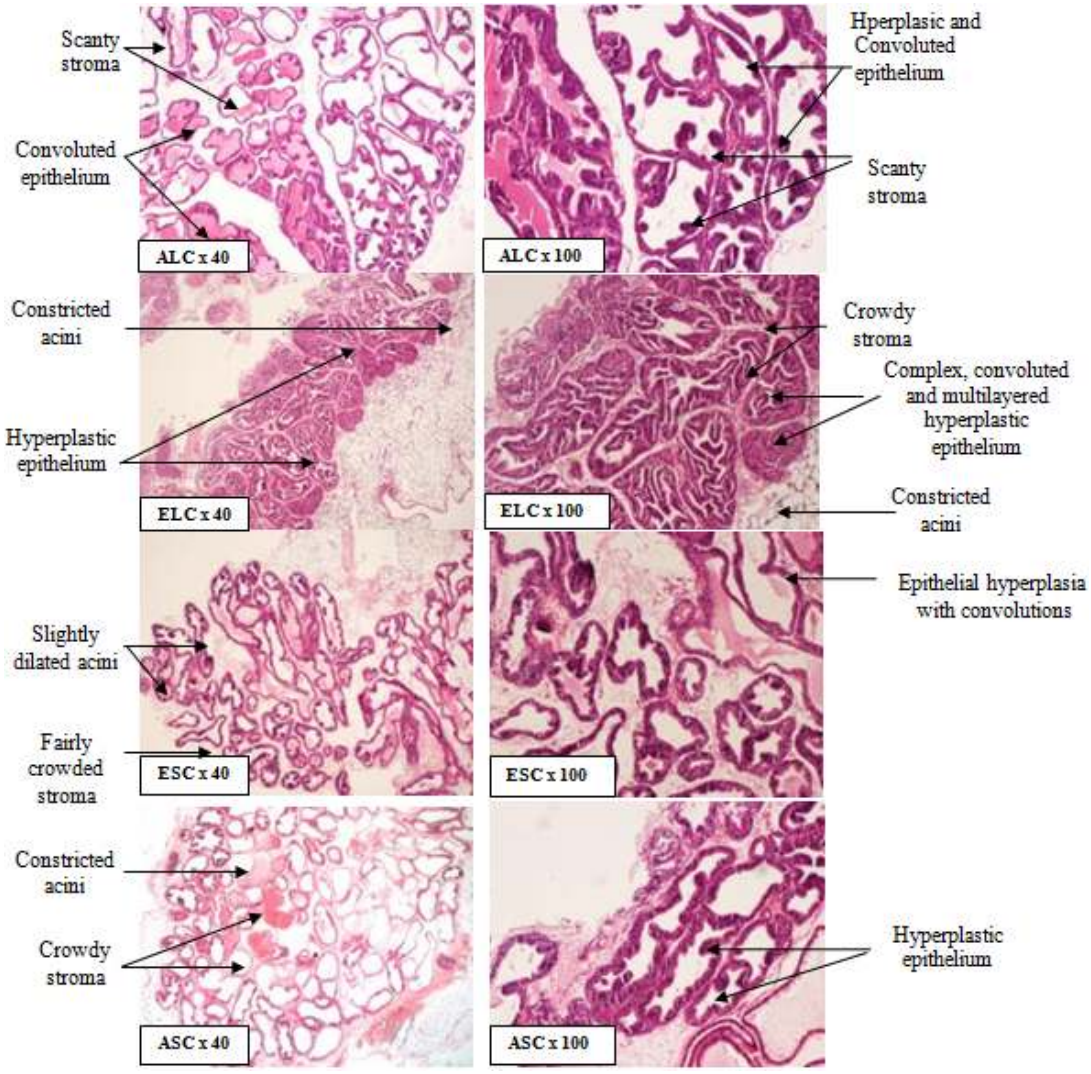

Plate 2. Prostate gland of the concurrent groups (H &E)

The epithelium appeared convoluted and hyperplastic in all the concurrent groups. The stroma was scanty in ASC while others had crowded stroma

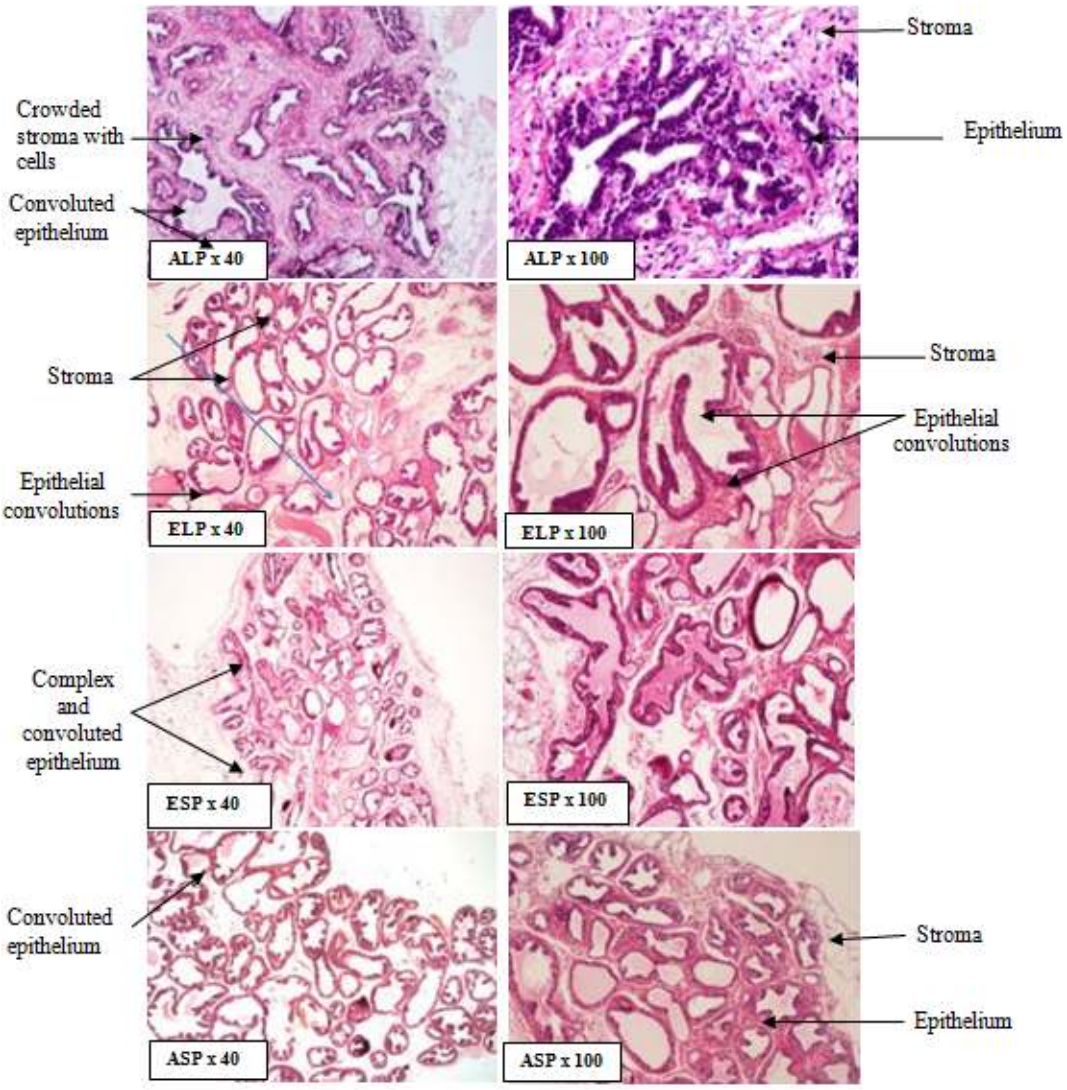

Plate 3. Prostate gland of the post induction groups (H &E)

The ALP epithelium showed prominent convolutions with hyperplasia. The stroma was cellular and with glandular expansion. These features were of lower magnitude in the ELP. Features seen in ESP were similar to those of ALP. Some degree of stromal hyperplasia with cribriform pattern were observed in ASP

However, the concurrent administration appeared to be better protocol. An extrapolation of this postulate into the management of BPH patients may be recommendation of the extracts as nutritional supplement to men in BPH age bracket with rising prostate specific antigen levels.

Glutathione peroxidase (GPx), being one of the glutathione transferases protects the human body from oxidative insults by conjugating glutathione [41]. This implies that elevated or high level of GPx is protective against oxidative damage. The CN group had higher GPx value than group CI. This is in keeping with BPH being associated with oxidative stress. All the experimental groups had mean GPx values being significantly higher than the induced but untreated group (CI). These GPx results demonstrated the ability of *T. occidentalis* to ameliorate the oxidative stress (as measured by GPx value) involved in the aetiopathogenesis of induced BPH in rats.

Other naturally occurring antioxidants besides GPx that prevent ROS induced oxidative damage are superoxide dismutase (SOD) and catalase (CAT). Their activities have been conclusively

established to be low in patients with BPH. Thus any plant whose extract is able to raise their levels is likely to be able to ameliorate the symptomatology of BPH (if not able to prevent its development). In the experiment being discussed, the SOD activity of the CI group was markedly lower than that of CN, thus it should be safe to conclude that reduction in an antioxidant level was a mechanism of oxidative damage in induced BPH in rat. However, all the experimental groups had significantly higher SOD activities than the CI. The import of this statement is that the extracts (leaf and seed) of *T. occidentalis* ameliorated the oxidative damage occasioned by BPH induction. The catalase profile in this experiment was similar to that of SOD.

In summary, the profiles of the three antioxidants (GPx, SOD and CAT) and pro-oxidant (MDA) in the experimental groups clearly demonstrated that extracts of leaf or seed of *T. occidentalis* were able to downplay the role of ROS induced oxidative damage in the aetiopathogenesis of BPH in rats.

The histology of the prostate gland of the CI group showed marked epithelial and stromal hyperplasia typical of BPH. Similar degree of hyperplasia could be seen in the ELC while the remaining three concurrent groups (ASC, ESC and ALC) showed lesser degree of epithelial and stromal hyperplasia. This might connote the ability of these three extracts of *T. occidentalis* concurrently administered to reduce the magnitude of epithelial hyperplasia that typifies BPH. The histology of the prostate obtained from all the post induction groups showed lesser degree of epithelial hyperplasia when compared with the CI group. Thus the seed or leaf extract administered following the establishment of BPH in rats were capable of reversing the glandular hyperplasia. If this observation was to be extrapolated into the management of BPH in humans, it may imply that the extracts are capable of shrinking the enlarged prostate (a fate that is usually accomplished by 5α- reductase inhibitor or by orchidectomy). If this assertion is explored further and found to be true, it will offer a great relief to BPH patients as it significantly reduce disease burden.

5. CONCLUSION

This study demonstrated the ability of *T. occidentalis* seed and leaf to ameliorate the anabolic effects of testosterone as evidenced by non aggressiveness and absence of alopecia in the experimental groups. Also the extracts of the plant were able to reduce the enlarged size of the prostate intiated by BPH by reduction in prostate weight and severity of the associated prostatitis. The contribution of oxidative stress in the aetiopathogenesis of BPH was reduced by the extracts. This was achieved by lowering the level of malonaldehyde (a pro oxidant) and increasing the activities of glutathione peroxidase, sodium dismutase and catalase (antioxidants). The lesser degree of epithelial hyperplasia seen in the experimental groups favours the use of the plant in the management of BPH. The response to treatment by BPH patients is evaluated by lower urinary tract symptom score. The severity of these symtoms has direct correlation with the prostate size (volume). Since the extracts of *T. occidentalis* were able to shrink the prostate, consumption of the plant by BPH patients may result in reduced mobidity and mortality associated with the pathology. This will be more acceptable to the patients since the plant is readily accessible and affordable.

CONSENT

It is not applicable.

ETHICAL APPROVAL

The authors here declare that the study was carried out with approval of the University of Ibadan Ethical Committee on Experimental Animal. Also the “Principles of laboratory animal care” as contained in the NIH publication No. 85-23, revised 1985 were duly observed by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Nunn J. Ancient Egyptian medicine. USA: University of Oklahoma Press; 2002.
2. Ackerknecht EH. A short history of medicine. Baltimore: Johns Hopkins University press; 1982.
3. Robson B, Baek OK. The Engines of hippocrates*:* From the dawn of medicine to medical and pharmaceutical informatics. New Jersey: John Wiley & Sons. 2009;50.
4. Kumar V, Yadav CS, Datta SK, Singh S, Ahmed RS, Goel S. Association of GSTM1

and GSTT1 polymorphism with lipid peroxidation in benign prostate hyperplasia and prostate cancer: A pilot study. Disease Markers. 2011;30:163-169.
5. ChongW. Herbal medicine research and global health: An ethical analysis. Bulletin of the World Health Organization. 2003;86: 577-656.
6. Ginter E. Vegetarian diets, chronic diseases and longevity. Bratislavske Lekarske Listy. 2008;109(10):463-466.
7. Ajala O, English P, Pinkney J. Systematic review and meta-analysis of different dietary approaches to the management of type-2 diabetes. American Journal of Clinical Nutrition. 2013;97(3):505-516.
8. Rothgerber H. A comparism of attitudes towards meat and animals among strict and semi-vegetarians. Appetite. 2014;72: 98-105.
9. Yazigi SM, de Salles PV, Giannini AG, Roschel H, Concepción OM, Gualano B. Brain creatine depletion in vegetarian. A cross-sectional ^{1}H-Magnetic resonance spectroscopy (^{1}H-MRS) study. British Journal of Nutrition. 2014;111(7):1272-1274.
10. Akoroda MO. Ethnobotany of *Telfairia occidentalis* (cucurbitaceae) among Igbos of Nigeria. Society for Economic Botany. 1990;44:29-39.
11. Nwanna EE, Ibukun EO, Oboh G. Inhibitory effects of methanolic extracts of two eggplant species from south-western Nigeria on starch hydrolysing enzymes linked to type-2 diabetes. African Journal of Pharmacy and Pharmacology. 2013; 7(23):1575-1584.
12. Oboh G, Akindahunsi AA. Change in the ascorbic acid, total phenol and antioxidant activity of some sun-dried green leafy vegetables in Nigeria. Journal of Nutrition Health and Aging. 2014;18:29-36.
13. Oboh G. Hepatoprotective property of ethanolic and aqueous extracts of *Telfairia occidentalis* (Fluted Pumpkin) leaves against garlic-induced oxidative stress. Journal of Medicinal Food. 2005a;8:560-563.
14. Oboh G, Rocha JB. Istribution and antioxidant activity of polyphenols in ripe and unripe tree pepper (*Capsicum pubescens*). Journal of food Biochemistry. 2006;31:456-473
15. Deters LA, Benign prostatic hypertrophy. Available:http://www.medscape.com/article/437359
16. Patel ND, Parsons JK. Epidemiology and etiology of benign prostatic hyperplasia and bladder outlet obstruction. Indian Journal of Urology. 2014;30(2):170-176.
17. Bernoulli J, Yatkin E, Talvitie EM, Santti R, Streng T. Urodynamic changes in a noble rat model for nonbacterial prostatic inflammation. Prostate. 2007;67(8):888-899.
18. Bernoulli J, Yatkin E, Konko IY, Talvitie EM, Santti R, Streng T. Prostatic Inflammation and obstructive voiding in the adult Noble rat: Impact of the testosterone to oestradiol ratio in serum. Prostate. 2008; 68(12):1296-1306.
19. Adesanya AO, Olaseinde OO, Oguntayo OD, Otulana JO, Adefule AK. Effects of methanolic extract of citrullus lanatus seed on experimentally induced prostatic hyperplasia. European Journal of Medicinal Plants. 2011;1(4):171-179.
20. Gossell-Williams MA, Davis NO. Inhibition of testosterone-induced hyperplasia of the prostate of sprague-dawley rats by pumpkin seed oil. Journal of Medicinal Food. 2006;9:284-286.
21. Baulieu EE, Lasnitzki I, Robel P. Testosterone prostate gland and hormone action. Biochem Biophys Res Commun. 1968;32:575-577.
22. Wilson JD, Gloyna RE. The intranuclear metabolism of testosterone in the accessory organs of reproduction. Recent Prog Horm Res. 1970;26:309-336.
23. Mooradian AD, Morley JE, Korenman SG. Biological actions of androgens. Endocrine Reviews. 1987;8(1):1-28.
24. Bratoeff E, Cabeza M, Ramirez E, Heuze Y, Flores E. Recent advances in the chemistry and pharmacological activity of new steroidal antiandrogens and 5 alpha-reductase inhibitors. Current Medicinal Chemistry. 2005;12(8):927-943.
25. Wade GN, Gray JM. Theoretical review. Gonadal effects on food intake and adiposity: Metabolic hypothesis. Physiol Behav.1979;22:583.
26. Nunez AA. Dose dependent effects of testosterone on feeding and body weight in male rats. Behav Neural Biol. 1982;34(4): 445-449.
27. Kochakian CD, Webster JA. Effect of testosterone propionate on the appetite, body weight and composition of the normal rat. Endocrinology. 1958;63(6):737-742.
28. Leshner AI, Collier G. The effects of gonadectomy on the sex differences in

dietary self- selection patterns and carcass compositions of rats. Physiol Behav. 1973;11:671-676

29. Håkonsen LB, Thulstrup AM, Aggerholm AS, Olsen J, Bonde JP, Anderson CY, et al. Does weight loss improve semen quality and reproductive hormones? Results from a cohort of severely obese men. Reproductive Health. 2011;8(24):1-8.
30. Nickel JC, Downey J, Young I, Boag S. Asymptomatic inflammation and/or infection in benign prostatic hyperplasia. BJU Int. 1999;84:976–81.
31. Anim JT, Udo C, John B. Characterisation of inflammatory cells in benign prostatic hyperplasia. Acta Histochem. 1998;100: 439–49.
32. Minciullo PL, Inferrera A, Navarra M, Calapai G, Magno C, Gangemi S. Oxidative stress in benign prostatc hyperplasia. Urol Int. 2015;94:249-254.
33. Chughtai B, Lee R, Te A, Kaplan S. Role of inflammation in benign prostatic hyperplasia. Rev Urol. 2011;13:147–150.
34. Kullisaar T, Türk S, Punab M, Mändar R.Oxidative stress – Cause or consequence of male genital tract disorders? Prostate. 2012;72:977–983.
35. Hamid AR, Umbas R, Mochtar CA. Recent role of inflammation in prostate diseases: chemoprevention development opportunity. Acta Med Indones. 2011;43: 59–65.
36. Meagher EA, FitzGerald GA. Indices of lipid peroxidation *in vivo*: Strengths and limitations. Free Radic Biol Med. 2000;28: 1745–1750.
37. Merendino RA, Salvo F, Saija A, Di Pasquale G, Tomaino A, Minciullo PL, et al. Malondialdehyde in benign prostate hypertrophy: a useful marker? Mediators Inf lamm. 2003;12:127–128.
38. Srivastava DS, Mittal RD. Free radical injury and antioxidant status in patients with benign prostate hyperplasia and prostate cancer. Indian J Clin Biochem. 2005;20:162–165.
39. Aryal M, Pandeya A, Das BK, Lamsal M, Majhi S, Pandit R, et al. Oxidative stress in patients with benign prostate hyperplasia. J Nepal Med Assoc. 2007;46:103–106.
40. Arsova-Sarafinovska Z, Eken A, Matevska N, Erdem O, Sayal A, Savaser A, et al. Increased oxidative/nitrosative stress and decreased antioxidant enzyme activities in prostate cancer. Clin Biochem. 2009;42: 1228–1235.
41. Ntais C, Polycarpou A, Ioannidis JP. Association of GSTM1, GSTT1 and GSTP1 Gene polymorphisms with the risk of prostate cancer: A meta-analysis. Cancer Epidemiol Biomarkers Prev. 2005;14:176–181.

Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/12411