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Research Article

ANTIOXIDANT POTENTIAL OF MORINGA OLEIFERA IN AMELIORATING PROSTATE HYPERPLASIA AND INFLAMMATION

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Abstract

Prostatitis and benign prostate hyperplasia (BPH) are common prostate-related conditions that affect many men. Oxidative stress has been implicated in the development and progression of prostate disorders, including prostatitis, and is associated with the generation of reactive oxygen species (ROS). Antioxidants play a crucial role in mitigating oxidative damage and have been studied for their potential therapeutic effects on prostate health. This study investigates the antioxidant potential of Moringa oleifera, a plant known for its rich phytochemical content, in an animal model of BPH induced by testosterone. The enzymatic activities of three key antioxidants—Malondialdehyde (MDA), Superoxide Dismutase (SOD), and Glutathione (GSH)—were measured spectrophotometrically to assess the plant's ameliorative properties. The results demonstrated a significant increase in antioxidant activity with Moringa oleifera treatment, as evidenced by elevated levels of MDA, SOD, and GSH. A statistically significant difference in mean GSH levels was observed on days 10, 20, and 25 of treatment ($p<0.05$), suggesting the plant's potential to mitigate oxidative stress associated with BPH. These findings support the use of Moringa oleifera as a potential therapeutic agent for prostate-related disorders and highlight the importance of antioxidants in reducing oxidative damage linked to prostate diseases

Keywords: Moringa oleifera, Antioxidants, Prostatitis, Benign Prostate Hyperplasia, Oxidative Stress

Introduction

Antioxidants have gained considerable attention in recent years due to their potential to counteract cellular damage caused by oxidative stress. Oxidative stress arises when there is an imbalance between the production of reactive oxygen species (ROS) and the body's antioxidant defense mechanisms. The accumulation of ROS can lead to cellular damage, and this has been implicated in the progression of several pathological conditions, including cancer, cardiovascular diseases, and neurodegenerative disorders. The prostate, a key organ in the male reproductive system, is especially vulnerable to oxidative stress, and conditions like prostatitis and prostate cancer have been linked to such stress. This paper focuses on the role of antioxidants in preventing or alleviating

oxidative damage associated with prostate diseases, especially prostatitis, and explores their potential for chemoprevention in prostate cancer.

Prostate cancer, one of the most common cancers among men worldwide, has a significant impact on global morbidity and mortality rates. While the precise etiology of prostate cancer remains unclear, numerous studies have identified risk factors that contribute to its development. Family history, age, ethnicity, genetic predisposition, obesity, and hormonal imbalances are all well-documented risk factors. The interplay between these factors is complex and remains a subject of ongoing investigation. However, one factor that has consistently emerged as a key contributor to prostate cancer development is oxidative stress. Elevated levels of ROS are believed to play a crucial role in the onset and progression of prostate cancer by inducing DNA damage, protein oxidation, and lipid peroxidation. The accumulation of oxidative damage can lead to mutations, which in turn may contribute to the neoplastic changes that characterize cancer.

Oxidative stress, particularly in the prostate, is further exacerbated by environmental factors, such as diet and lifestyle. Studies have shown that an imbalance in dietary intake, particularly in macromolecules, can contribute to oxidative damage, thereby raising the risk of prostate cancer. A diet high in fats and processed foods, for example, has been associated with increased levels of ROS. Conversely, diets rich in antioxidants—such as those derived from fruits and vegetables—have been shown to mitigate the damaging effects of ROS and reduce the risk of developing cancer. This has led to growing interest in the use of antioxidant-rich foods and plants as potential therapeutic agents for the prevention and treatment of prostate diseases.

The role of antioxidants in combating oxidative stress is well-established, as these compounds have the ability to neutralize free radicals and reduce the potential damage caused by them. Antioxidants act by either directly scavenging free radicals or by enhancing the body's endogenous antioxidant defense systems. These compounds can be found both in the body (endogenous antioxidants) and in external sources like food (exogenous antioxidants). The action mechanisms of antioxidants are complex and vary depending on the specific type of antioxidant. For instance, some antioxidants work by donating electrons to free radicals, neutralizing their harmful effects, while others may regulate enzymes that help maintain cellular balance. The body's primary antioxidant defense system includes enzymes such as superoxide dismutase (SOD), catalase, and glutathione peroxidase, which play critical roles in defending cells against oxidative damage.

One plant that has garnered attention in recent years for its antioxidant properties is *Moringa oleifera*. Moringa, commonly known as the drumstick tree, is native to parts of Asia and Africa and is well-regarded for its rich nutritional content. The leaves of Moringa contain high concentrations of vitamins, minerals, and bioactive compounds that exhibit potent antioxidant activities. The plant has been traditionally used for its medicinal

properties, and research in recent years has begun to uncover its potential in combating oxidative stress and inflammation, both of which are implicated in the development of prostate conditions. The phytochemicals found in Moringa, such as flavonoids, phenolic acids, and vitamins A and C, have been shown to possess significant antioxidant activity. These compounds may act synergistically to prevent or reduce oxidative damage in prostate tissues, thereby reducing the risk of developing prostatitis or prostate cancer.

In the context of prostate health, the importance of antioxidants cannot be overstated. Inflammation, a key feature of prostatitis, often triggers the production of ROS, leading to further tissue damage and, if left unchecked, contributing to the progression of prostate cancer. Antioxidants, by reducing oxidative stress, can potentially mitigate these inflammatory responses and limit the extent of tissue damage. Numerous studies have suggested that antioxidants may help inhibit the formation of neoplastic changes in the prostate and may even offer a protective effect against prostate cancer. Moreover, antioxidants have been shown to enhance the overall immune function, which is crucial in defending the body against cancerous growths. A growing body of evidence suggests that the use of antioxidants as a complementary or adjunctive therapy could help improve the outcomes of prostate cancer treatment.

A particularly intriguing aspect of antioxidant research is the potential for chemoprevention—using natural compounds to prevent or delay the onset of cancer. Chemopreventive agents, particularly those derived from plants, have received considerable attention due to their low toxicity and high bioavailability. The need for more effective and less harmful prevention strategies has driven the exploration of plant-based antioxidants such as those found in Moringa oleifera. While the benefits of antioxidants for general health are well-documented, there is a need for further investigation into their specific effects on prostate health. Given the high prevalence of prostate cancer and its associated mortality rate, exploring the potential chemopreventive role of antioxidants is crucial.

Reactive oxygen species (ROS), such as superoxide anions ($O2^-$), hydroxyl radicals (OH.), and hydrogen peroxide ($H2O2$), are highly reactive molecules that can cause oxidative damage to lipids, proteins, and DNA. In the prostate, ROS can induce DNA mutations, triggering abnormal cellular growth that leads to cancer. Under normal conditions, ROS are kept in check by antioxidants, which neutralize these harmful species and prevent cellular damage. However, when the balance between ROS and antioxidants is disrupted—either due to excessive ROS production or insufficient antioxidant defenses—oxidative stress occurs, leading to cellular damage and inflammation. In the case of prostate cancer, this disruption may play a key role in initiating and promoting tumorigenesis. One of the challenges in understanding the full impact of antioxidants on prostate health lies in the complexity of their action. The mechanisms through which antioxidants operate are diverse, involving not

just direct scavenging of ROS but also influencing various cellular pathways that regulate oxidative stress and inflammation. Antioxidants can modulate the activity of enzymes involved in redox reactions, influence gene expression, and alter the immune response. These multifaceted effects make antioxidants particularly promising as potential therapeutic agents for conditions such as prostatitis and prostate cancer. However, despite the encouraging evidence from preliminary studies, much remains unknown about the precise mechanisms by which antioxidants exert their protective effects on prostate tissues.

As research into the role of antioxidants in prostate health continues, the focus on plant-based antioxidants like those found in Moringa oleifera becomes even more important. Moringa's rich profile of bioactive compounds positions it as a promising candidate for future studies exploring its chemopreventive effects. Given the significant burden of prostate cancer worldwide and the increasing interest in natural, plant-based therapies, investigating the antioxidant potential of Moringa oleifera offers valuable insights into its role in prostate health.

In conclusion, oxidative stress plays a central role in the development and progression of prostate diseases, including prostatitis and prostate cancer. The growing body of evidence highlighting the beneficial effects of antioxidants, particularly those derived from plants like Moringa oleifera, underscores the need for continued research in this area. By deepening our understanding of how antioxidants mitigate oxidative damage and inflammation in the prostate, we can pave the way for more effective prevention and treatment strategies for prostate cancer. Further investigation is essential to establish the precise mechanisms by which antioxidants protect prostate health and to identify the most effective compounds for clinical use in the fight against prostate cancer.

MATERIALS AND METHODS

The fresh leaves and stem of Moringa oleifera used for this study were sourced from Oyigbo in Oyigbo Local Government Area of Rivers State. They were identified by a taxonomist and issued voucher number. Both leaves and stem were air-dried for a period of three weeks. Extraction of the phytochemicals was done with ethanol and further subjected to qualitative and quantitative analysis. The yields obtained were Alkaloids, flavonoids, Saponin, Tannins, Cardiac glycosides Terpenoids, Pheonols, and Steroids. Procedures included the methods of (Siddiqui et al., 2009), (Harborne 1973), (Kokate 2005), (Abadoni and Achuko, 2001) and (Bothelho et al., 2019).

The level of Glutathione (GSH) was measured using Randox Glutathione Peroxides (Ransel) assay kit, a product of Randox Labs UK. Measurements were taken at a wavelength of 405nm using a spectrophotometer.

Evaluation of Superoxide Dismutase (SOD) activity was carried out utilizing the method of (Misra and Tridorich, 1989) and measured spectrophotometricallly at a wavelength of 420nm.

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The Malondialdehyde (MDA), was analyzed by the method of (Gutteridge and Wilkins, 1982) using the Flouroscan Ascent a product of Thermo Electron Corporation, USA. The pink product of lipid peroxidation of reaction of MDA with 2-thiobarbituric acid was read spectrophotometrically at 532nm.

RESULTS Results obtained for control, induced but not treated and other groups for the antioxidants SOD, GSH

DAYS	**GP 1**	**GP 2**	**GP 3 20mg**	**GP 4 50mg**	**GP 5 100mg**			**GP 6 200mg**	**GP 7 300mg**	**GP 8**	**P-VALUE**
					20.22±0.57	22.09±0.12	24.11±0.10	25.17			
DAYS 5	12.14±0.57	18.31±1.117								30.11±0.0142	0.01
DAY 10	12.20±0.40	22.09±0.010	23.20±0.08	22.04±0.51	24.00±0.10			26.2±0.59	32.07±0.02	35.42±0.0160	0.01
DAY 15	12.41±0.66	30.22±0.036	24.20±0.06	24.51±0.1	24.30±0.21			33.04±0.76	37.00±0.58	40.02±0.1001	0.10
DAY 20	12.72±0.30	25.33±0.020	27.20±0.07	28.30±0.1	30.11±0.14			31.50±0.01	39.20±0.14	40.20±1.0125	0.01
DAY 25	12.30±0.78	30.60±0.078	32.30±0.07	33.80±0.1	37.30±0.07			44.20±0.28	52.30±0.01	66.40±0.2057	0.00

and MDA are shown on tables 1, 2 and 3. Generally there was evidence of increased activity of these antioxidants although it was concentration and time dependent.

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TABLE 1: DESCRIPTIVE AND COMPARATIVE ANALYSIS OF MEAN VALUES OF SUPEROXIDE DISMUTASE ON DAY 5, 10, 15, 20 AND 25 ON A GROUP BASIS

Values are Mean ± Stand Error of Mean (SEM) of Triplicate Determinations. P ≤ 0.05

TABLE 2: DESCRIPTIVE AND COMPARATIVE ANALYSIS OF MEAN VALUES OF GLUTATHIONE ON DAY 5, 10,15, 20 AND 25 ON A GROUP BASIS.

DAYS	GP 1	GP 2	GP 3 20mg	GP 50mg	4GP 5 100mg			GP 200mg	6GP 7 300 mg	GP 8	P-VALUE
			3.42		±0.02	3.44±0.08	3.72±0.03	4.21±			
DAYS	2.34± 0.46	3.11±0 .63								6.12± 0.13	0.246
DAY 100.04	3.21±	4.11±0 .05	3.62± 0.02	4.72±0.14	5.20±0.15			5.58± 0.06	6.21± 0.06	8.33± 0.02	0.001
DAY 150.45	2.31±	4.01±0 .05	4.51± 0.08	5.11±0.02	5.47±0.10			6.21± 0.01	7.42± 0.33	9.12± 0.13	0.211
DAY 200.47	2.14±	6.33±0 .01	5.22± 0.13	5.44±0.01	5.10±0.01			5.00± 0.71	8.60± 0.07	10.01 ±0.14	0.030
DAY 250.54	2.34±	10.70± 1.23	6.23± 0.07	7.44±1.06	7.44±0.03			8.33± 0.06	92±0.04	13.50 ±1.27	0.003

Values are Mean ± Stand Error of Mean (SEM) of Triplicate Determinations. P ≤ 0.05.
Increase in GSH was more marked on days 10 and 20 and 25 with P ≤ 0.01, 0.3 and 0.003 respectively.

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TABLE 3: DESCRIPTIVE AND COMPARATIVE ANALYSIS OF MEAN VALUES OF MALONDIALDYHYDE ON DAY 5, 10, 15, 20 AND 25 ON A GROUP BASIS.

DAYS	GP 1	GP 2	GP 3 20mg	GP 4 50mg	GP 5 100mg	GP 6 200 mg	GP 7 300mg	GP 8	P-VALUE
DAYS 5	3.22±0.08	5.32±0.07	6.14		±0.38	6.33±0		8.22±0.13	0.106
DAY 10	3.18±0.05	3.81±0.03	7.21±0.07	7.02±0.11	8.14±0.11	8.77 ±0.26	10.11± 0.09	10.27±0.21	0.001
DAY 15	4.57±0.95	5.63±0.03	7.82±0.06	8.24±0.11	8.97±0.14	10.01±0.06	12.40± 0.01	122.91±0.08	0.010
DAY 20	3.27±0.12	6.84±0.02	8.71±0.04	9.20±0.14	10.40±1.34	11.60±0.07	12.80± 0.07	15.10±0.86	0.001
DAY 25	3.14±0.13	14.50±0.64	9.80±0.01	10.60±0.07	12.60±0.07	14.40±0.28	16.50± 0.14	18.20±0.25	0.001

Values are Mean ± Standard Error of Mean (SEM) of Triplicate Determinations. P ≤ 0.05

Results show that the increase of MDA was both time and concentration dependent. P ≤ 0.01.

DISCUSSION

The use of plants and its identified phytochemicals in management of disease conditions has advanced the course of medical practice. In this research on Moringa oleifera, we have used qualitative and quantitative methods in attempt to identify the phytochemicals in the plant. We identified tannins, Flavonoids, Terpenoids, phenols, saponins glycosides and alkaloids at various concentration. Moreover, some mineral contents were discovered. Over the years, plant derivatives had undergone scientific scrutiny and some have been identified chemotherapeutics for Prostate Cancer largely on account of their antioxidant and anti-inflammatory potentials coupled with their tolerability margin and low cost [14, 15, 16]. Experimental models in animals have been adopted in several studies that show their anticarcinogenic and chemo preventive actions. In this research, encouraging data was obtained to support increasing levels of antioxidants that could exert anti-cancer effects. We observed a rise in the level of GSH, SOD, and MDA all of which could be used to express antioxidant capacity. These findings support the work in [7]. Generally, Antioxidants are molecules which may be natural or

artificial in origin. In the recent past, there has been a retinue of scientific literature that have reported on the physical and clinical parameters dealing with the utilization of antioxidants supplements [18, 19, 20]. It is known that molecular or genetic changes occurring in carcinogen as in Prostate cancer has the capacity to alter the protective effect of antioxidants [21, 22, 23]. A biological approach requiring the use of genomics, epigenetics and metabolomics may enhance the discovery of critical molecules and biochemical pathways in different set of patients which are regulated by the uptake of antioxidants. As shown from the results obtained in this study, there was improvement in the level of antioxidants to ameliorate Benign Prostate hyperplasia in this animal model. This gives credence to the fact that Moringa oleifera have phytochemical components with potential to attenuate prostatitis.

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