

REVIEW OF ANTIOXIDANT AND ANTI-INFLAMMATORY ACTIVITY OF NATURAL PLANTS

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ABSTRACT

*The growing interest in plant-based therapeutic agents has led to an increased exploration of their **antioxidant** and **anti-inflammatory** properties. This review focuses on three significant medicinal plants: **Azadirachta indica** (Neem), **Moringa oleifera** (Moringa), and **Rosmarinus officinalis** (Rosemary), all of which possess notable pharmacological properties. These plants have been widely studied for their active constituents, such as flavonoids, polyphenols, and terpenoids, known for their antioxidant and anti-inflammatory effects. The **UV-Visible spectrophotometry** method plays a pivotal role in quantifying and validating the bioactivity of these plants. This review provides a comprehensive examination of the **botanical profiles, bioactive compounds, traditional and medicinal uses**, and their pharmacological significance. Furthermore, the article explores the applicability of these plants in modern therapeutic settings, showcasing their potential in the treatment of chronic inflammatory and oxidative stress-related diseases.*

1. INTRODUCTION

The utilization of plant-based remedies has been a cornerstone of traditional medicine for centuries, offering a wealth of natural compounds beneficial for health management. Among the most sought-after plant-based compounds are **antioxidants** and **anti-inflammatory agents**, which have gained widespread attention due to their ability to address chronic diseases. **Oxidative stress**,

characterized by an imbalance between free radicals and antioxidants, contributes to the progression of several health conditions, including **cardiovascular diseases, cancer**, and **neurodegenerative disorders** (Sies, 2015; Halliwell & Gutteridge, 2015). Similarly, **inflammation**, when prolonged, is implicated in conditions such as **arthritis, diabetes**, and **asthma** (Chung et al., 2012).

Azadirachta indica (Neem), **Moringaoleifera** (Moringa), and **Rosmarinusofficinalis** (Rosemary) are three plants extensively studied for their potential to mitigate oxidative stress and inflammation. Their bioactive compounds, including flavonoids, terpenoids, and polyphenols, contribute to their therapeutic activities. This review provides an in-depth analysis of the antioxidant and anti-inflammatory activities of these plants, focusing on the role of **UV-Visible spectrophotometry** in evaluating their bioactive compounds and therapeutic potential. The **UV-Visible spectrophotometer** is an invaluable tool for assessing the absorption characteristics of plant extracts, offering a reliable method to quantify active compounds and their biological effects (Pandey & Rizvi, 2009).

OXIDATION: Oxidation is a chemical reaction that involves the loss of one or more electrons by an atom, molecule, or ion. It is a process that can result in a change in the chemical composition of a substance.

ANTIOXIDANT: An antioxidant is a molecule that helps prevent or reduce cell damage caused by free radicals, which are unstable molecules that can damage cells and contribute to aging and diseases.

HOW ANTIOXIDANT WORKS:

1. Neutralizing free radicals: Antioxidants donate electrons to free radicals, stabilizing them and preventing them from causing further damage.

2. Mopping up oxidative stress: Antioxidants help reduce oxidative stress by removing free radicals and other reactive oxygen species.

TYPES OF ANTIOXIDANTS:

1. Vitamins: C, E, and beta-carotene (a precursor to vitamin A)

2. Minerals: Selenium, manganese, and zinc

3. Polyphenols: Found in tea, coffee, chocolate, and many fruits and vegetables

4. Carotenoids: Lycopene, lutein, and zeaxanthin

5. Flavonoids: Quercetin, kaempferol, and isorhapontigenin

FOOD SOURCES OF ANTIOXIDANTS:

1. Berries: Blueberries, strawberries, raspberries, and cranberries

2. Leafy greens: Spinach, kale, and collard greens

3. Nuts and seeds: Almonds, sunflower seeds, and pumpkin seeds

4. Fatty fish: Salmon, tuna, and mackerel

5. Sweet potatoes: Rich in beta-carotene

BENEFITS OF ANTIOXIDANTS:

1. Reducing inflammation: Antioxidants can help reduce inflammation, which is associated with various diseases.

2. Protecting against cell damage: Antioxidants can help protect cells from damage caused by free radicals.

MARKETED DRUGS USED FOR ANTIOXIDANT TREATMENT:

1. Probucol
2. Vitamins – Vit A, Vit C, Vit E.
3. Polyphenols
4. Glutathione
5. Allopurinol
6. Edaravone

INFLAMMATION: Inflammation is a natural response of the body's immune system to injury, infection, or damage. It involves the activation of immune cells, the release of chemical signals, and the increased blood flow to the affected area.

TYPES OF INFLAMMATION:

1. Acute inflammation: A short-term response to injury or infection, characterized by redness, swelling, pain, and heat.

2. Chronic inflammation: A long-term response to ongoing injury or infection, which can lead to tissue damage and disease.

CAUSES OF INFLAMMATION:

1. Infection: Bacterial, viral, or fungal infections can trigger inflammation.

2. Injury: Physical trauma, such as cuts, burns, or broken bones, can cause inflammation.

3. Autoimmune disorders: Conditions like rheumatoid arthritis, lupus, and multiple sclerosis, where the immune system attacks healthy tissues.

4. Allergies: Allergic reactions to substances like pollen, dust, or certain foods can lead to inflammation.

SYMPTOMS OF INFLAMMATION:

1. Redness: Increased blood flow to the affected area.

2. Swelling: Fluid buildup in the affected area.

3. Pain: Sensation of discomfort or tenderness.

4. Heat: Increased temperature in the affected area.

ANTI-INFLAMMATION:

Anti-inflammation refers to the process of reducing or preventing inflammation, which is a natural response of the body's immune system to injury, infection, or damage.

TYPES OF ANTI-INFLAMMATORY RESPONSES:

1. Acute anti-inflammatory response: A short-term response to injury or infection, aimed at reducing inflammation and promoting healing.

2. Chronic anti-inflammatory response: A long-term response to ongoing inflammation, aimed at reducing tissue damage and promoting repair.

NATURAL SOURCES OF ANTI-INFLAMMATION:

Foods: Fatty fish, Turmeric, Ginger, Berries and Green leafy vegetables.

Herbs and spices: Garlic, Rosemary, Ashwagandha.

Supplements: Omega-3-fatty acids (EPA&DHA), Curcumin, Ginger extract.

Loss of function: Reduced mobility or function in the affected area.

MARKETED DRUGS USED TO TREAT INFLAMMATION:

➤ NONSTEROIDAL ANTI-INFLAMMATORY DRUGS(NSAIDS):

1. Ibuprofen (Advil, Motrin): Used to treat pain, inflammation, and fever.

2. Naproxen (Aleve): Used to treat pain, inflammation, and fever.

3. Celecoxib (Celebrex): Used to treat pain, inflammation, and stiffness associated with osteoarthritis and rheumatoid arthritis.

4. Meloxicam (Mobic): Used to treat pain, inflammation, and stiffness associated with osteoarthritis and rheumatoid arthritis.

2. PLANT PROFILE

2.1 Azadirachta indica (Neem)

- **Systematic Position:**

- Kingdom: Plantae
- Phylum: Angiosperms
- Class: Eudicots
- Order: Sapindales
- Family: Meliaceae
- Genus: Azadirachta
- Species: A. indica

- **Botanical Description:**

- Neem is a fast-growing, evergreen tree indigenous to **India** and **Southeast Asia**, reaching heights up to 20 meters. It produces pinnate leaves with a bitter taste due to **azadirachtin**, a major bioactive compound. The tree flowers with small white clusters and bears fruits containing seeds rich in oil.
- **Growing Conditions:**
 - Neem flourishes in tropical and subtropical regions, preferring well-drained, dry soils. Its drought resistance makes it ideal for arid climates, and it grows best in temperatures between 25°C and 35°C.
- **Medicinal Uses:**
 - **Anti-inflammatory activity:** Neem extracts exhibit significant anti-inflammatory properties, owing to compounds like flavonoids and alkaloids. It has been used in traditional medicine to treat conditions such as **rheumatoid arthritis** and **eczema** (Zhao et al., 2019).
 - **Antioxidant activity:** Neem's potent antioxidant effects are attributed to its phenolic and flavonoid content, which help neutralize free radicals and reduce oxidative stress (Dhuley, 1999).
- **Traditional and Ethnomedicinal Uses:** Neem is referred to as "Sarva Roga Nivarini" in Ayurveda,

meaning "the healer of all ailments." Its traditional applications include:

- **Skin disorders:** Neem leaves and oil are applied to treat eczema, acne, scabies, and fungal infections.
- **Dental care:** Neem twigs (chewing sticks or *datun*) are used to maintain oral hygiene and prevent gum diseases.
- **Digestive health:** Decoctions of neem bark and leaves are used for ulcers, intestinal worms, and liver detoxification.
- **Fever and malaria:** Neem tea and extracts are traditionally used to manage malarial symptoms.
- **Contraception:** Neem oil has been used in folk medicine as a natural contraceptive agent.

In Unani medicine, neem is used as a blood purifier and for treating ulcers, leprosy, and wounds [Sengupta et al., 2011]

2.2 Moringa oleifera (Moringa)

- **Systematic Position:**
 - Kingdom: Plantae
 - Phylum: Angiosperms
 - Class: Eudicots
 - Order: Brassicales
 - Family: Moringaceae
 - Genus: Moringa
 - Species: M. oleifera
- **Botanical Description:**
 - Moringa is a rapidly growing, deciduous tree that can reach up to 10 meters in height. It has pinnate leaves and produces cream-colored flowers, followed by long,

pod-like fruits containing seeds with valuable oil.

- **Growing Conditions:**
 - Moringa is well-suited to arid and semi-arid climates, preferring sandy, well-drained soils. It thrives in temperatures between 25°C and 35°C and is known for its resilience to drought.
- **Medicinal Uses:**
 - **Anti-inflammatory activity:** Moringa is traditionally used to treat inflammatory diseases, such as **arthritis**. Its polyphenol content, particularly **quercetin**, has been shown to reduce inflammatory markers (Anwar et al., 2007).
 - **Antioxidant activity:** Moringa's leaves are rich in antioxidants, including **vitamin C**, **beta-carotene**, and **flavonoids**, which help protect the body from oxidative damage (Fahey, 2005).
- **Traditional and Ethnomedicinal Uses:** Moringa is referred to as the "Miracle Tree" due to its high nutritional and medicinal value. Traditional uses include:
- **Gastrointestinal disorders:** Boiled leaves and pods are consumed to treat constipation, gastritis, and ulcers.
- **Immune and metabolic health:** Used as a tonic for general weakness, anemia, and malnutrition.

- **Joint pain and inflammation:** Decoctions are used to reduce swelling and arthritis pain.
- **Lactation aid:** In many parts of India and Africa, moringa is used to enhance breast milk production.
- **Wound healing:** Moringa paste is applied to wounds and burns to promote healing.

In African traditional medicine, it is used to treat hypertension, diabetes, and bacterial infections [Rahman et al., 2018] .

2.3 Rosmarinus officinalis (Rosemary)

- **Systematic Position:**
 - Kingdom: Plantae
 - Phylum: Angiosperms
 - Class: Eudicots
 - Order: Lamiales
 - Family: Lamiaceae
 - Genus: Rosmarinus
 - Species: R. officinalis
- **Botanical Description:**
 - Rosemary is a perennial herb, typically growing up to 1.5 meters tall. It features narrow, needle-like leaves and aromatic flowers ranging in color from pale blue to violet. Its medicinal properties are attributed to volatile oils, such as **rosmarinic acid** and **carnosic acid**.
- **Growing Conditions:**
 - Preferring Mediterranean climates, rosemary grows best in well-drained soils and full sunlight. It is drought-tolerant and thrives in areas with mild, wet

winters and hot, dry summers.

- **Medicinal Uses:**
 - **Anti-inflammatory activity:** Rosemary has long been used for treating muscle pain and inflammation. Its bioactive compound **rosmarinic acid** has been shown to inhibit pro-inflammatory cytokines (Briante et al., 2003).
 - **Antioxidant activity:** Rosemary is rich in **carnosic acid**, which has demonstrated significant antioxidant properties, particularly in protecting against **neurodegenerative diseases** (Tassoni et al., 2011).
- **Traditional and Ethnomedicinal Uses:** In traditional Mediterranean and European medicine, rosemary is considered a symbol of remembrance and healing:
- **Cognitive health:** Used in teas or infusions to enhance memory and concentration.
- **Digestive support:** Rosemary is traditionally consumed to relieve bloating, indigestion, and gas.
- **Pain and inflammation:** Oil extracts are applied topically for joint and muscle pain.
- **Respiratory conditions:** Steam inhalation with rosemary is used for relieving cough and sinus congestion.

- **Antiseptic use:** Rosemary oil is applied for wound cleansing and to prevent infections.

Rosemary was also widely used in ancient Greek and Roman cultures in rituals and as a natural preservative due to its antimicrobial properties [Kelsey et al., 2010] .

3. CONCLUSION

From the references of articles of literature reviews concluded that the work has been done with individual plants like neem , moringa and rosemary with using UV-visible spectroscopy. So, we want to do the combination experiment work on neem-moringa , moringa-rosemary and rosemary-neem conclude that anti-oxidant and anti-inflammatory property by using UV-visible spectroscopy.

The plants **Azadirachta indica**, **Moringa oleifera**, and **Rosmarinus officinalis** offer substantial therapeutic potential in the management of oxidative stress and chronic inflammation. Their bioactive compounds, such as flavonoids, terpenoids, and polyphenols, are pivotal in reducing cellular damage and inflammatory responses. Furthermore, the **UV-Visible spectrophotometry** technique provides an efficient method for quantifying the bioactive constituents responsible for these effects, further validating their medicinal relevance. The growing body of evidence supports the integration of these plants in pharmaceutical and nutraceutical formulations aimed at treating a variety of chronic diseases. Future research into the molecular mechanisms of their antioxidant and anti-inflammatory actions will enhance their clinical applications, offering

promising alternatives for modern healthcare.

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