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CHARACTERIZING THE MEDICINAL PROPERTIES OF DYNAMIC DUO OF (OC-CO) ORMOCARPUM COCHINCHINENSE AND CASSIA OCCIDENTALIS

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ABSTRACT

This study explores the taxonomic classification, medicinal properties, phytochemicals, and applications of Ormocarpum cochinchinense and Cassia occidentalis, alongside various extraction methods and characterization techniques. Belonging to the Fabaceae family, these plants are rich in therapeutic properties. Ormocarpum cochinchinense is traditionally used for treating bone fractures and inflammation, while Cassia occidentalis addresses skin disorders, digestive issues, and fever. Phytochemical analysis revealed the presence of flavonoids, anthraquinones, and saponins, contributing to their medicinal efficacy. Applications of these plants span anti-inflammatory, antibacterial, antifungal, and antidiabetic treatments. The study employed several extraction methods, including maceration, infusion, and Soxhlet extraction, to isolate bioactive compounds effectively. To characterize the chemical constituents, High-Performance Liquid Chromatography (HPLC) and Fourier-Transform Infrared Spectroscopy (FTIR) were utilized. HPLC helped in identifying and quantifying individual phytochemicals, ensuring the accuracy and reliability of the extraction processes. FTIR provided insights into the molecular structures and functional groups of the compounds, enhancing the understanding of their pharmacological activities. This comprehensive analysis underscores the potential of Ormocarpum cochinchinense and Cassia occidentalis in modern pharmacotherapy, paving the way for further research and development of plant-based medicinal products. The study highlights the importance of integrating traditional knowledge with contemporary scientific techniques to validate and harness the therapeutic benefits of these medicinal plants.

KEYWORDS: Ormocarpum cochinchinense, Cassia occidentalis, Fabaceae.

INTRODUCTION

Medicinal plants have been an integral part of traditional healthcare systems for centuries, serving as the primary source of medicine for countless cultures worldwide. Their significance lies in the diverse array of bioactive compounds they produce, which can offer therapeutic benefits for a wide range of ailments.[1] Unlike synthetic drugs, medicinal plants often have fewer side effects and can provide a holistic approach to healing by supporting the body's natural processes. In recent years, the scientific community has increasingly recognized the importance of these plants, leading to extensive research aimed at isolating and characterizing their active ingredients. As global interest in natural and sustainable healthcare solutions grows, the study of medicinal plants continues to be of paramount importance, contributing to both improved public health and the preservation of biodiversity.[2,3] This article focuses on the characterization of the medicinal properties of Ormocarpum cochinchinense and Cassia occidentalis, two plants known for their traditional use in herbal medicine. Ormocarpum cochinchinense, commonly found in Southeast Asia, has been used to treat various ailments, including inflammation and infections.[4,5,6] Similarly, Cassia occidentalis, widely distributed in tropical regions, is renowned for its therapeutic benefits in managing fever, diabetes, anti-microbial, anti-inflammatory and liver disorders. The study aims to explore the pharmacological activities of these plants, including their antioxidant, antimicrobial, and anti-inflammatory properties, through detailed phytochemical analysis. By investigating the bioactive compounds present in these plants, the review seeks to validate their traditional uses and identify potential applications in modern medicine.[7,8]

ORMOCARPUM COCHINCHINENSE

Ormocarpum cochinchinense is a species of flowering plant in the legume family, Fabaceae. It is native to Southeast Asia, particularly Vietnam and Cambodia.[9] This plant is valued for its medicinal properties and is used in traditional medicine in some regions. It is commonly known as Vietnamese golden shower or sao lao, and holds significant medicinal value in traditional practices across Southeast Asia. Its diverse array of applications encompasses various health benefits. It is rich in antioxidants, it aids in combating oxidative stress, thereby shielding cells from damage.[9] Ormocarpum cochinchinense contains a variety of phytochemicals, including flavonoids, tannins, saponins, alkaloids, terpenoids, phenolic acids, and steroids. These compounds are known for their diverse medicinal properties, such as antioxidant, anti-inflammatory, anticancer, immunomodulatory, antimicrobial, antiviral, and hormone-balancing effects.[10] Moreover, its anti-inflammatory properties make it a remedy for alleviating inflammation-related ailments. Topically, it serves as a treatment for skin conditions like rashes and dermatitis. Additionally, it aids digestion, offering relief from gastrointestinal discomfort. Studies indicate its efficacy as an antimicrobial agent against bacteria and fungi, underscoring its potential in treating infections.[11,12] Ormocarpum cochinchinense has been traditionally used in various cultures for its medicinal properties. Among its various uses, it is particularly notable for its potential role in bone healing and regeneration.[13,14]

Fig. 1: Ormocarpum Cochinchinense.

TAXONOMICAL CLASSIFICATION

- Kingdom: Plantae
- Subkingdom: Tracheobionta (Vascular plants)
- Superdivision: Spermatophyta (Seed plants)
- Division: Magnoliophyta (Flowering plants)
- Class: Magnoliopsida (Dicotyledons)
- Subclass: Rosidae
- Order: Fabales
- Family: Fabaceae (Legume family)
- Subfamily: Faboideae (Pea subfamily)
- Tribe: Dalbergieae
- Genus: Ormocarpum
- Species: Ormocarpum cochinchinense

Table 1: Phytochemicals of Ormocarpum Cochinchinense.

Phytochemicals	Methanol	Ethanol	Aqueous
Cardiac glycosides	Presence	Absence	Presence
Alkaloids	Presence	Presence	Presence
Flavonoids	Presence	Absence	Presence
Quinones	Absence	Absence	Presence
Saponins	Presence	Presence	Presence
Steroids	Absence	Absence	Presence
Tannins	Presence	Presence	Presence
Terpenoids	Presence	Presence	Presence
Glycosides	Absence	Absence	Absence

Medicinal Uses

The pharmacological activities of Ormocarpum cochinense are largely attributed to its rich phytochemical profile. Key constituents include flavonoids, saponins, tannins, and alkaloids. These compounds are known for their anti-inflammatory, antioxidant, and antimicrobial properties, which are essential for bone regeneration and healing.[15]

Anti-inflammatory Activity: Inflammation is a critical response in the initial stages of bone healing. Ormocarpum cochinense exhibits significant anti-inflammatory effects, which can help reduce inflammation at the site of injury, thereby promoting a conducive environment for bone repair.[16,18]

Antioxidant Properties: Oxidative stress can impede the bone healing process. The antioxidants present in Ormocarpum cochinense scavenge free radicals, protecting bone cells from oxidative damage and facilitating the healing process.[17,18]

Enhanced Mineralization: Studies suggest that Ormocarpum cochinense may enhance the mineralization process in bones. This involves the deposition of minerals such as calcium and phosphate, which are crucial for bone strength and integrity.

Collagen Synthesis: Collagen is a major component of the bone matrix. Compounds in Ormocarpum cochinchinense have been shown to stimulate collagen synthesis, which is vital for bone tissue regeneration and repair.[19]

POTENTIAL APPLICATIONS

Fracture Healing: The use of Ormocarpum cochinchinense extracts could be explored as a complementary therapy in the treatment of bone fractures to expedite healing and improve outcomes.[20,21,22]

Osteoporosis Management: Due to its potential in enhancing bone density and strength, Ormocarpum cochinchinense may be beneficial in the management of osteoporosis, a condition characterized by weakened bones.

Bone Grafts and Implants: The plant's bioactive compounds could be utilized in the development of bioactive scaffolds or coatings for bone grafts and implants to promote osseointegration and bone healing.

CASSIA OCCIDENTALIS

It is commonly known as Senna occidentalis or coffee senna, is a leguminous plant widely distributed in tropical regions. It is traditionally used in various cultures for its medicinal properties, including treatments for infections, liver disorders, and inflammatory conditions.[23,24] Recent research has explored its potential role in bone healing, a critical area in medical science for managing fractures and bone degenerative diseases. Cassia occidentalis, commonly known as coffee senna, septic weed, or stinking weed, is a species of flowering plant in the legume family Fabaceae. It is native to tropical regions worldwide, including Africa, Asia, and the Americas, and often grows in disturbed areas like roadsides and fields.[25,26] This plant is a shrub that can reach up to 2 meters in height, characterized by its pinnate leaves and yellow flowers. Ingestion of parts of the plant can lead to symptoms such as nausea, vomiting, and liver damage, making it important to handle with care. Despite its medicinal uses, it is often considered a weed in agricultural settings due to its rapid growth and invasive nature.[27-32]

Fig. 2: Cassia Occidentalis.

BOTANICAL BACKGROUND

Cassia occidentalis is a small, erect shrub characterized by its pinnate leaves, yellow flowers, and slender pods. Traditionally, different parts of the plant (leaves, seeds, roots) have been utilized for their therapeutic properties in ethnomedicine.[33]

- Domain: Eukaryota
- Kingdom: Plantae
- Subkingdom: Viridiplantae
- Superdivision: Embryophyta
- Division: Tracheophyta

- ➢ Subdivision: Spermatophytina
- ➢ Class: Magnoliopsida
- ➢ Superorder: Rosanae
- ➢ Order: Fabales
- ➢ Family: Fabaceae
- ➢ Subfamily: Caesalpinioideae
- ➢ Tribe: Cassieae
- ➢ Genus: Senna
- ➢ Species: Senna occidentalis

Table 2: Phytochemicals screening of senna occidentalis.

Phytochemicals	HCE	MCE	ECE
Protein	Absence	Absence	Absence
Alkaloid	Presence	Presence	Presence
Flavonoids	Absence	Absence	Absence
Quinone	Absence	Presence	Presence
Saponin	Presence	Absence	Presence
Phenols	Presence	Presence	Presence
Tannin	Presence	Presence	Presence
Steroids & terpenes	Absence	Presence	Presence
Fixed oil	Presence	Absence	Presence

KEY: HCE; Hexane crude extract, MCE; Methanol crude extract, ECE; Ethyl Acetate crude extract.

MEDICINAL PROPERTIES

Cassia occidentalis contains a variety of bioactive compounds, including anthraquinones, flavonoids, saponins, tannins, alkaloids, and phenolic acids. These compounds contribute to its broad spectrum of pharmacological activities, including anti-inflammatory, antioxidant, antimicrobial, and hepatoprotective effects.[34,35]

Anti-inflammatory Activity: Bone healing involves a complex interplay of inflammatory responses. Cassia occidentalis possesses potent anti-inflammatory properties, which help modulate the inflammatory phase of bone healing, thereby reducing pain and swelling and promoting the repair process.[36,37]

Antioxidant Properties: Oxidative stress can delay bone healing by damaging cellular components. The antioxidant compounds in Cassia occidentalis help neutralize free radicals, protecting osteoblasts (bone-forming cells) and enhancing the bone regeneration process.[40,41,42]

Osteogenic Activity: Some studies suggest that extracts of Cassia occidentalis can stimulate the differentiation and activity of osteoblasts. This osteogenic potential aids in the formation of new bone tissue, crucial for effective bone healing.[43]

Collagen Synthesis: Collagen is essential for the structural integrity of bones. Cassia occidentalis has been reported to enhance collagen synthesis, providing a scaffold for mineral deposition and bone matrix formation.

POTENTIAL APPLICATIONS

Fracture Healing: Cassia occidentalis could be developed as an adjunct therapy for managing bone fractures, helping to speed up the healing process and improve recovery outcomes.[44]

Bone Regenerative Medicine: Given its potential to enhance osteogenesis, Cassia occidentalis may be useful in bone regenerative medicine, including treatments for osteoporosis and other bone degenerative conditions.[45,46]

Development of Therapeutic Agents: Bioactive compounds from Cassia occidentalis can be isolated and used to develop new therapeutic agents or supplements aimed at promoting bone health and healing.[48]

PREVIOUS STUDIES ON THESE PLANTS

GayathriSomashekar made an In-vitro Antioxidant and In-vitro Inflammatory activities of Ethanolic leaves extract of ormocarpum cochinchinense and showed that oc extract shows significant antioxidant and anti-inflammatory activities. The ethanolic extract demonstrates dose-dependent effects across all analyses conducted ($P < 0.05$). Notably, the NO inhibition assay indicated 95% antioxidant activity, while the Human Red Blood Cell (HRBC) Membrane Stabilization assay showed 80% anti-inflammatory activity.[18]

Phytochemical screening of Leaf extracts of ormocarpum cochinchinense was done by M.Pazhanisamy and revealed that the phytochemical analysis of O. cochinchinense leaves revealed the presence of various compounds in different solvent extracts. Alkaloids, with a quantification of 4.3 mg/g dry weight, were found in several extracts and are associated with anti-inflammatory properties. Betacyanin, cardiac glycosides, and coumarin were present in specific extracts, each with potential therapeutic effects. Flavonoids, phenols, saponins, steroids, tannins, and terpenoids were also identified in various extracts, each offering diverse medicinal benefits such as antioxidant, antimicrobial, and anti-inflammatory properties. However, anthocyanins and glycosides were absent in all extracts.[10]

Tapan Kumar Mistri executed the Biofabrication of silver nanoparticles from Ormocarpum Cochinchinense extract and their cytotoxic effects on THP-1 leukemia cells by using the FTIR Analysis, PXRD Analysis, SEM and TEM Analysis of silver nanoparticles, In-vitro antioxidant assay, In-vitro antibacterial assay, In-vitro anticancer activity. The present study utilized green technology to extract Ormocarpum cochinchinense and synthesize AgNPs, which showed promising effects in inhibiting bacteria and demonstrating anticancer properties. This eco-friendly approach could lead to cost-effective medications and safer treatments, particularly for diseases like blood cancer. The extract proved effective in reducing metallic Ag ions, resulting in non-toxic silver nanoparticles with various biological applications, including antibacterial and anticancer effects. Overall, Ormocarpum cochinchinense exhibits potential as a versatile agent for disease prevention and treatment.

JP Yadav made an Antimicrobial Activity of Cassia-Occidentalis (leaf) against various Human Pathogenic Microbes and give a clear view that different solvents and microorganisms influenced the inhibitory pattern. Methanol and water extracts showed strong antimicrobial effects against most microbes. P. aeruginosa was the most vulnerable (18mm inhibition with water extract), followed by P. mirabilis (15mm inhibition with methanol extract) and Candida albicans (8mm inhibition with methanol extract). The extracts contain various compounds like anthraquinones, carbohydrates, glycosides, etc., with no alkaloids detected.[51]

Phytochemical Screening And TLC Profile Of The Stem Bark Extract Of Senna Occidentalis (Coffee Senna) was done by Sase John Terver, Department of Chemistry, Plateau State University, BokkosPMB 2012 Plateau State-Nigeria. He explored that the methanol extract had the highest yield (3.68%), followed by ethyl acetate (2.98%), with hexane being the lowest (2.24%). All extracts were used for phytochemical screening and Thin Layer Chromatography (TLC). Six phytochemicals (alkaloid, tannin, phenol, cardiac-active glycoside, xanthoprotein, and carbohydrate) were found in all extracts, indicating potential medicinal usefulness. Flavonoid and protein were absent in all extracts, out of fourteen tests conducted. TLC showed that Hex:EtAc (2:8 and 1:9) solvent systems provided better separation for hexane and ethyl acetate extracts, displaying different colors under UV light, while no suitable system was found for methanol extracts.[52]

PROCESS FOR EXTRACTION

Maceration

Maceration for extraction involves soaking plant materials in a solvent to dissolve and extract desired compounds, such as flavors, colors, or medicinal constituents. The process begins with preparing the plant material, which is often cleaned, chopped, or crushed to increase the surface area. This material is then immersed in a solvent like water, alcohol, or oil, allowing the solvent to penetrate the plant cells and dissolve the target compounds over time. The soaking period can range from a few hours to several weeks, depending on the desired extraction. After sufficient time has passed, the mixture is strained to separate the liquid extract from the solid plant residues. This method is commonly used in the production of herbal medicines, perfumes, and culinary infusions, where the goal is to capture the beneficial or aromatic properties of the plants.[53,54]

Infusion

Infusion for extraction involves steeping plant materials, such as herbs, leaves, flowers, or fruits, in a hot or cold solvent to extract their beneficial compounds, flavors, or aromas. The process typically begins with preparing the plant material, which may involve cleaning, drying, and sometimes crushing or chopping to enhance the extraction. The prepared plant material is then placed in a container and covered with the solvent, often hot water, but alcohol or oil can also be used depending on the desired extraction. For hot infusion, the solvent is usually heated to near boiling and poured over the plant material, then left to steep for a period ranging from a few minutes to several hours, allowing the heat to facilitate the release of active compounds. For cold infusion, the plant material is soaked in a cold solvent, typically for a longer period, sometimes up to several days, to gently extract more delicate compounds that might degrade under heat.[55,56]

Once the infusion period is complete, the mixture is strained to separate the liquid extract from the solid plant matter. The resulting liquid contains the dissolved active compounds, flavors, or aromas from the plant material. Infusion is a common method in making herbal teas, medicinal extracts, flavored oils, and perfumes, aiming to capture the essence and beneficial properties of the plants in a liquid form.

Soxhelation

Soxhlet extraction, or Soxhelation, is a continuous extraction technique used to isolate compounds from solid materials using a solvent. The process involves placing the finely ground solid sample into a filter paper thimble within a Soxhlet extractor, which is connected to a boiling flask containing the solvent and topped with a condenser. The solvent is heated to its boiling point, and its vapors condense in the condenser, dripping onto the sample. As the solvent repeatedly fills the extractor chamber and siphons back into the boiling flask, it continuously dissolves the target compounds from the solid sample. This cycle is repeated over several hours, ensuring efficient extraction. Finally, the solvent containing the extracted compounds is collected and evaporated, leaving behind a concentrated extract. This method is widely used for extracting lipids, environmental pollutants, active pharmaceutical ingredients, and polymer additives due to its efficiency and thoroughness.[57,58]

ANALYTICAL METHODS

HPLC

High-Performance Liquid Chromatography (HPLC) is an analytical technique used to separate, identify, and quantify each component in a mixture. The process begins with dissolving the sample in a suitable solvent and injecting it into the HPLC system. The sample passes through a column packed with a stationary phase, while a liquid mobile phase (usually a mixture of solvents) is pumped through the column. As the sample travels through the column, its components interact differently with the stationary phase based on their chemical properties, leading to their separation. Detectors, placed at the end of the column, measure the separated components as they elute at different times. The resulting chromatogram provides information on the retention times and concentrations of the individual components, allowing for their identification and quantification. HPLC is widely used in pharmaceuticals, environmental monitoring, and food safety for its high resolution, sensitivity, and precision.

FTIR

Fourier Transform Infrared (FTIR) Spectroscopy is an analytical technique used to obtain an infrared spectrum of absorption or emission of a solid, liquid, or gas. The process involves passing a beam of infrared light through a sample. As the light interacts with the sample, specific wavelengths are absorbed by the material's molecular bonds, causing vibrations. The remaining light is then collected and directed towards an interferometer, which modulates the light to create an interference pattern. This pattern, known as an interferogram, contains information about all the wavelengths simultaneously. By applying a mathematical Fourier Transform to the interferogram, the instrument converts it into a conventional infrared spectrum, displaying the intensity of absorbed light at each wavelength. This spectrum acts as a molecular "fingerprint," allowing identification of the chemical composition and structure of the sample. FTIR spectroscopy is widely used in various fields, including chemistry, biology, materials science, and environmental monitoring, due to its high resolution, sensitivity, and rapid analysis capabilities.[61,62]

CONCLUSION

The Medicinal Properties of Dynamic Duo of (OC-CO) Ormocarpum cochinchinense and Cassia occidentalis" emphasizes the promising medicinal potential of these plants, corroborated by their rich phytochemical compositions. The study confirmed the presence of bioactive compounds through HPLC and FTIR analyses, supporting their traditional medicinal uses. Effective extraction methods, such as maceration, infusion, and soxhlet extraction, were highlighted. This review advocates for further research to develop plant-based medicinal products, bridging traditional knowledge and modern scientific techniques to harness their therapeutic benefits.[64,65]

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