

EXPLORING *RUTA GRAVEOLENS*: A HOLISTIC REVIEW*Dr. G. N. Pramodini,¹Mufeeda and ²Fathimathul Nazrin K. A.

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ABSTRACT

Ruta graveolens L., also referred to as "rue," is an annual herb that produces stunning yellow blossoms. It has medicinal properties and is used to treat various ailments. It exhibits antioxidant and antibacterial properties and is a rich source of phytochemicals. It is known as the Cardiac plant due to its many therapeutic uses. Both in India and beyond, ruta is utilized for therapeutic purposes. Ruta is also utilized in traditional systems of medicine in India, such as Ayurveda, Homeopathy, and Unani. It is a valuable source of phytochemicals and various plant-based compounds. It shows antimicrobial activity against microbes. *Ruta graveolens* L. also shows antioxidant activity. Medicinal plants are currently facing extinction as a result of overexploitation. Consequently, plant tissue culture is crucial to preserving the plants. Numerous plant tissue culture procedures have also been created for Ruta in order to preserve both biodiversity and plants.

KEYWORDS: *Ruta graveolens* L. plant tissue culture, biodiversity, antibacterial, and antioxidant.

INTRODUCTION

In recent years, there has been a significant surge in the usage of medicinal plants in natural medicines. As a result, pharmacologists and the scientific community now prioritize identifying their chemical components and possible medical uses.^[8] One significant aspect of the nation's natural wealth is its medicinal plant diversity. Their contribution to the rural population's access to health care benefits is significant. Additionally, they serve as therapeutic agents and vital raw materials for the production of traditional medicines.^[7]

Rue, or *Ruta graveolens* L., is a herbaceous perennial that is indigenous to the Mediterranean region. According to Ratheesh and Helen (2007), *R. graveolens* is the more significant of the two species that are utilized in traditional medicine.^[1] The Rutaceae is a family of angiosperms that has 1730 species across 158 genera in the order Sapindales. Easily identified by the citrus or lime-like smell of crushed leaves, broken twigs, or fruits, the Rutaceae family include a wide variety of shrubs, climbers, and trees.^[7] It is a semi-shrubby perennial that grows to a height of 65 to 70 cm. It has a strong, disagreeable smell.^[7]

In Iran, *R. graveolens* is referred to as "Sodaab". *R. graveolens* is a tiny, semi-woody perennial or evergreen sub-shrub that is 0.6 to 0.9 m tall and about as wide. Toxins such as snake and scorpion venoms have been counteracted by *R. graveolens* extracts.^[1] Since ancient times, *Ruta graveolens* has been a staple of the European

pharmacopoeia. Numerous inflammatory diseases have traditionally been treated using *Ruta graveolens* L. In homeopathic medicine, rue oil is commonly used as a rubefacient and an antiviral agent to treat Eczema, psoriasis, and certain dermatoses.^[7]

Rutin is abundant in *R. graveolens* and serves as a capillary and venotonic protector. In addition to helping with other visual issues, rutin has been used to treat edema, thrombogenesis, inflammation, spasms, and hypertension. Pregnant and nursing women were advised not to take it because large dosages can produce uterine hyperemia and increased mobility (oxytocic effect), both of which can result in abortion.^[1] potential application in the management of several of ailments, such as depression, Alzheimer's disease, and cancer.^[4]

Alkaloids, coumarins, volatile compounds, terpenoids, flavonoids, and furoquinolines are among the several chemical components that have been extracted from various plant parts.^[1]

The primary constituents of essential oils derived from fruits, flowers, and leaves are 2-nonanone, 2-nonyl acetate, and 2-undecanone. Saponins, alkaloids, amino acids, phenols, and flavonoids are all found in leaves and young stems. Moreover, it contains rutacridone, acridone glucosides, gravacridondiol, and acridone epoxides.^[7] Many different kinds and amounts of secondary metabolites are produced by plants, and these metabolites are essential for environmental adaptation.

Plants are capable of producing secondary metabolites to protect themselves from natural enemies such as bacteria, viruses, fungi, and insects.^[4]

BOTANICAL DESCRIPTION

Morphological characters

Ruta graveolens L. is a glabrous, fragrant, perennial herb or sub-shrub. The stem is up to one meter tall, smooth, thin, and pale glaucous green. The leaves are alternating, glaucous, gland-dotted, complex, two-three pinnate. Leaflets can be oblong or linear-oval in shape. Terminal corymbose, irregularly dichotomous cymes make up the inflorescence. Regular bisexual flowers, pentamerous terminal flowers, and tetramerous flowers are all possible. The distinctive, widely dispersed, greenish yellow petals are hooded and broad at the top, sharply

joined to a thin claw below, and have a wavy, occasionally serrated border. The fruits are roundish, hard, dry, and have four to five blunted lobed tops.^[2]

Synonyms: *Ruta angustifolia*, *ruta divaricata*, *ruta hortensis* mill.^[9]

Vernacular names

Hindi: Sanool, Saatri

Urdu: Sudab

Arabic: Sudab, Suzab

Persian: Satap

Greek: Fejan, Safayan;

Sanskrit: Sadapah

English: Rue, Garden Rue, Herb of grace.^[5]



Fig. No. 1: Plant *Ruta Graveolens*.

Taxonomical Classification^[9]

Kingdom Plantae

Phylum Streptophyta

Class Equisetopsida

Subclass Magnoliidae

Order Sapindales

Family Rutaceae

Genus *Ruta*

Species *Ruta graveolens*

Geographical distribution

Native to the Mediterranean region, *R. graveolens* is a herbaceous perennial. It is now grown for both medicinal and decorative purposes in Asia, South America, and Europe. Rue has been an essential herb in European pharmacopoeia since antiquity.^[4]

Introduced into Alberta, Algeria, Austria, Balears, Belgium, California, Canary Is., Cape Provinces, Connecticut, Corse, Czechoslovakia, District of Columbia, East Aegean Is., Ecuador, France, Germany, Great Britain, Greece, Hungary, Illinois, Italy, Missouri, New Jersey, New York, North Carolina, Northern Provinces, Ontario, Pennsylvania, Québec, Rhode I., Romania, South European Russia, Spain, Switzerland, Texas, Ukraine, Vermont, Vietnam, Virginia, West Virginia, Wisconsin.^[9]

PHYTOCHEMICAL PROFILE

R. graveolens has been shown to contain over 200 different chemicals. Furthermore, *R. graveolens* has been shown to contain a wide variety of volatile oil components, which contribute to its potent and distinct smell. The non-volatile portion of *R. graveolens* mostly consists of acridone and quinoline alkaloids, as well as phenylpropanoids, particularly coumarins and alkaloids. Steroids and quinones are the least prevalent non-volatile components, while flavonoids are less prevalent in the plant and are mentioned in fewer publications.^[3] The phytochemical substances identified from this plant include rutin, quercetin, rutacridone, rutacridone epoxide, psoralen, methoxypsoralen, and gravacridondiol. It was determined that the primary monoterpene components of *R. graveolens* essential oil are α -pinene, limonene, and 1,8-cineole.

The well-known phytochemical components of *R. graveolens* include furoquinolines, terpenoids, coumarins, volatiles, acridone alkaloids, and flavonoids.

Additionally, the existence of glycosides, tannins, and saponins has been demonstrated. The two primary active flavonoids found in *R. graveolens* are rutin and quercetin. Rutin was initially isolated from *R. graveolens* leaves. There are significant amounts of aliphatic acids,

alcohols, and ketones in *R. graveolens* essential oil. Additionally, *R. graveolens* generates large amounts of linear furanocoumarins, primarily psoralen and methoxypsoralen.

In vitro studies using human cell lines have demonstrated the anticancer potential of furanoacridones and acridone alkaloids isolated from *R. graveolens*. Using in vitro techniques, *R. graveolens* has been quickly cloned. Hairy root culture has been discovered to be beneficial for increasing the synthesis of bioactive compounds from this plant species.^[4]

The results of the seed analysis showed that the nitrogenous compounds were 21.6%, the fixed oil was 36.8%, and the ash was 13.8%. Its fatty acid makeup is as follows: palmitic acid 21.8%, stearic acid 9.1%, oleic acid 22.0%, and linoleic acid 44.5%. The seed oil is of the drying type (iodine value: 189). New coumarins, sitosterol, and ceryle alcohol are present in the unsaponified materials. 90% of the pure oil of rue is made up of methyl nonyleketone.^[5]

PHARMACOLOGICAL ACTIVITY

Anti-oxidant Activity

70% methanolic extract of *Ruta graveolens* leaves inhibits the guinea pig liver aldehyde oxidase enzyme with an 89–96% reduction. In a dose-dependent manner, the hepatic aldehyde oxidase activity can be inhibited by the whole extract and the two main flavonoids of *Ruta graveolens*, quercetin and rutin.^[5]

Antimicrobial Activity

It has been found that *R. graveolens* essential oil exhibits antibacterial action. With minimum inhibitory concentrations (MIC) ranging from 3.5 to 7.94 µg/ml for the investigated bacterial strains—*E. Coli*, *Staphylococcus aureus*, *Klebsiella pneumonia*, and *Pseudomonas aeruginosa*—the essential oil demonstrated notable antibacterial activity.^[7]

Anti-cancer Activity

R. graveolens L. furanoacridones have anti-cancer properties. Using the MTT assay to examine the cytotoxic effects of a number of furanoacridones that were separated from Rue and two additional acridone alkaloids (evoxanthine and arborinine) against human cell lines (A431, MCF7, and HeLa), it was determined that *Ruta graveolens* exhibits strong anti-cancer properties.^[10]

Anticonvulsant Activity

A methanolic extract of *Ruta graveolens* has been shown to have anticonvulsant properties against seizures in mice brought on by picrotoxin, bicuculline, pentylenetetrazole, or N-Methyl-DL-aspartic acid.^[11]

Anti-inflammatory Activity

It has been demonstrated that the ethanolic, methanolic, and aqueous extracts of *Ruta graveolens* have anti-

inflammatory properties against carrageenan-induced paw edema in male Wistar rats.^[12]

Anti-arrhythmic Activity

A possible anti-arrhythmic effect is demonstrated by an alkaloidal extract of *Ruta graveolens* in isolated rat hearts. Effective and functional refractory periods and nodal conduction time are considerably extended by *Ruta graveolens* extracts in a rate-dependent manner. The extract's effects are shown on both the node's slow and fast pathways.^[13]

Anti-androgenic Activity

Ruta graveolens was shown to have anti-androgenic properties in male albino rats who exhibited aggressive and sexual behavior. This resulted in a decrease in sperm motility and density in the testicular ducts and cauda epididymis. Reduced testosterone and FSH levels, less aggressive behavior, and lower spermatogenic activity were all noted in somniferous tubules.^[14]

Antihyperglycemic Activity

Ruta graveolens has been shown to exhibit antidiabetic properties against diabetic (type 2) albino rats produced by streptozotocin and nicotinamide. The *Ruta graveolens* has strong antihyperglycemic properties because of its insulinogenic actions, which improve peripheral insulin action, lower hepatic glucose levels, increase peripheral glucose uptake, and lower intestinal glucose.^[15]

Antidiarrheal Activity

Ruta graveolens leaves and stem ethanolic extracts have antidiarrheal properties against castor oil-induced diarrhea. The antidiarrheal properties of the leaf and stem extracts were concentration-dependent. *Ruta graveolens* has antidiarrheal properties because it inhibits enteropooling brought on by castor oil, which delays the beginning of diarrhea and suppresses propulsive action.^[16]

CONCLUSION

Ruta graveolens L also known as rue, is a multipurpose herb belonging to the Rutaceae family. Secondary metabolites such coumarins, alkaloids, volatile oils, flavonoids, and phenolic acids are plentiful in it. Because of its extensive therapeutic qualities, it has been widely used all throughout the world. This species' extracts and essential oils have a wide range of pharmacological properties, such as analgesic, anti-inflammatory, antibacterial, antipyretic, antioxidant, and contraceptive actions. They also have hypotensive, antiviral, anticancer, antiparasitic, antihyperglycemic, and free radical scavenging qualities. The plant is of great interest to the pharmaceutical industry because of its wide range of medicinal uses, which emphasize its potential to support a number of pharmacological therapies.

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