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**Phytochemical, Pharmacological and therapeutic
significance of *Quercus infectoria* Oliv.**

Sarika Tiwari^{1*}, Sumeet Dwivedi² and Raghvendra Dubey¹

1, College of Pharmacy, Dr. A.P.J. Abdul Kalam University, Indore, (M.P.) - India

2, Department of Pharmacognosy, Swami Vivekanand College of Pharmacy, Indore, (M.P.) - India

Abstract

The present review focuses on the phytochemical profile, pharmacological aspects and therapeutic and traditional uses of *Quercus infectoria* Oliv.: An Indian medicinal plants widely used in the treatment of microbial infections, inflammation and pain.

Keywords: *Quercus infectoria* Oliv., Pharmacology, Phytochemicals

Introduction

***Quercus infectoria* Oliv. Synonyms:** *Quercus carpinea* Kotschy ex A.DC., *Quercus grosseserrata* Kotschy ex Wenz., *Quercus puberula* O.Schwarz, *Quercus thirkeana* K.Koch;
Local name: Oak, Majuphal; **Family:** Fagaceae.

Quercus infectoria or locally known as Manjakani in Malaysia is a small tree native of Greece and Asia Minor, with four to six feet in height. The stems are crooked, shrubby looking with smooth and bright-green leaves borne on short petioles of 1 to 1.5 inches long. The leaves are bluntly mucronate, rounded, smooth, unequal at the base and shiny on the upper side. Meanwhile, *Quercus infectoria* galls are corrugated and can be used as a thickener in stews or mixed with cereals for making bread.¹⁻³

Phytochemical Profile⁴⁻⁵

The galls from *Quercus infectoria* contain the highest naturally occurring level of tannin, approx. 50–70%, syringic acid, β -sitosterol, amentoflavone, hexamethyl ether, isocryptomerin, methyl betulate, methyl oleanate and hexagalloyl glucose. They also contain 2-4% each of gallic and ellagic acid that are polymerized to make tannins. Tannins have been used for hundreds of years for medical purposes and are currently indispensable in dermatology and have been used for tanning of leather.

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Tannins comprise a large group of natural products widely distributed in the plant kingdom. They have a great structural diversity, but are usually divided into two basic groups: the hydrolyzable type and the condensed type. Hydrolyzable tannins include the commonly occurring gallic and ellagic acid contained in the nutgalls.

Hydrolyzable tannins are present in many different plant species but are found in particularly high concentrations in nutgalls growing on *Rhus semialata* (Chinese and Korean gallotannins) and *Quercus infectoria* (Turkish and Chinese gallotannins), the seedpods of *Caesalpinia spinosa* (Tara tannins), and the fruits of *Terminalia chebula*. The gallic and ellagic acid hydrolyzable tannins react with proteins to produce typical tanning effects; medicinally, this is important to treat inflamed or ulcerated tissues. They also contribute to most of the astringent property of manjakani and are therefore great for vaginal tightening.

Although both types of tannin have been used to treat diseases in traditional medicine, the hydrolyzable tannins have long been considered official medicinal agents in Europe and North America. They have been included in many pharmacopoeias, in the older

* Corresponding Author

E.mail: sarikasharmag@gmail.com

editions in particular, and are specifically referred to as tannic acid. These were recommended for treatment of inflammation and ulceration, including topical application for skin diseases and internal use for intestinal ulceration and diarrhea. Now, the condensed tannins also have important medicinal roles, such as stable and potent antioxidants. In China, tannin-containing substances, such as galls, pomegranate rinds, and terminalia fruits, are used in several medicinal preparations.

Therapeutic Uses⁶⁻¹⁰

The galls of *Quercus infectoria* have also been pharmacologically documented to possess astringent, antidiabetic, antitremorine, local anaesthetic, antiviral, antibacterial, antifungal, larvicidal and anti-inflammatory activities. The main constituents found in the galls of *Quercus infectoria* are tannin (50-70%) and small amount of free gallic acid and ellagic acid.

The wide range of pharmacological activities of this plant might support the efficacy of extract preparation of *Quercus infectoria* that are widely used in Malaysia for treating many kinds of health problems since many decades ago. The nutgalls have been pharmacologically documented on their antiamebic, anticariogenic and anti-inflammatory activities, to treat skin infections and gastrointestinal disorders.

Traditional Uses¹¹

- It has been used as dental powder and in the treatment of toothache and gingivitis.
- Traditionally dried fruit powder used in the treatment of women disorders
- Whole plant is useful in the treatment of microbial infection

Pharmacological Profile¹²⁻²⁴

Quercus infectoria Oliv. is medicinal plants having wide therapeutic efficacy. The pharmacological activity of the plant is mentioned below:

Anti-microbial activity

Ethanol extract displayed relatively better inhibitory activity towards all tested urobacterial species and significantly inhibited the growth of the gram negative bacteria. Thus helps in preventing UTI. Proposed etiopathogenesis was tannins prevent bacteria from adhering to cells because hydrolysable tannins contain structures similar to the bacterial binding receptors on the surface of urinary tract cells and thereby preventing adherence of the bacteria to the cell surface receptors.



Fig. 1: *Quercus infectoria* Oliv. Plant



Fig. 2: *Quercus infectoria* Oliv. Fresh Fruits



Fig. 3: *Quercus infectoria* Oliv. Dried Fruits

Mechanism of *Quercus infectoria* (nutgalls) extract and its component were investigated for anti-methicillin –resistant *Staphylococcus aureus* (MRSA). The appearance of pseudomulticellular bacteria in the nutgall ethanol extract cell and the synergistic effect of the plant extract with beta-lactamase-susceptible penicillins indicated that the extract may interfere with staphylococcal enzymes including wall autolysins and beta-lactamase.

Active compounds present in crude ethanol extract shows antibacterial activity with dose dependent manner. Their mode of antimicrobial action may be related to their ability to inactivate microbial adhesions, enzymes, cell envelope transport proteins, complex with polysaccharides etc.

The antimicrobial activity of *Q. infectoria* was examined using different solvents of varying polarity and efficacy was compared. The results obtained from this study reveal that *Quercus infectoria* galls have antimicrobial activity against Gram-positive *Bacillus subtilis*, and *Staphylococcus aureus* and Gram-negative bacteria *Escherichia coli*. All extracts from the galls inhibited the Gram-positive bacteria better than Gram-negative bacteria.

Anti-inflammatory activity

Effect of alcoholic extract of *Q. infectoria* galls was evaluated on various experimental models of inflammation. Oral administration of gall extract significantly inhibited carrageenan, histamine, serotonin and prostaglandin E2 induced paw edemas, while topical application of gall extract inhibited phorbol-12-myristate-13-acetate induced ear inflammation. Proposed pathophysiology: the anti-inflammatory activity of the galls may be related to inhibition in functions of macrophages and neutrophils wherein the extract inhibits the release of inflammatory mediators, viz. PGE2, NO, O2- and lytic enzymes from these cells.

Hepatoprotective action

The alcoholic extract of fruits can offer 36% liver protection against carbon tetrachloride induced toxicity at a dose of 800 mg/kg. In a study, galls of *Quercus infectoria* were evaluated for their hepatoprotective effect against carbon tetra chloride (CCl4) induced hepatotoxicity in rats. Subcutaneous injection of CCl4, administered twice a week, produced a mark elevation in the serum levels of aspartate transaminase (AST), alanine transaminase (ALT) and tumor necrosis factor (TNF-alpha). Daily oral administration of aqueous ethanolic extract of *Quercus infectoria* galls at 200, 400 and 600 mg/kg doses produced a dose dependent reduction in the serum levels of liver enzymes and inflammatory

mediators and attenuated the necroinflammatory changes in the liver.

Nephroprotective anti tumour activity *Quercus infectoria* acts as a potent chemopreventive agent and suppresses Fe-NTA induced renal carcinogenesis and oxidative and inflammatory response in wistar rats. Oral administration of *Quercus infectoria* at doses of 75 and 150 mg/kg b wt effectively suppressed renal oxidative stress, inflammation and tumour incidence. Chemopreventive effects were associated with up-regulation of xenobiotic metabolizing enzyme activities and down regulation of serum toxicity markers.

Wound healing property

In an experimental trial, ethanol extract of the shaded dried leaves of *Quercus infectoria* were studied for its effect on wound healing in rats, using incision, excision and dead space wound models, at two different dose levels of 400 and 800 mg/kg. The plant showed a definitive, positive effect on wound healing, with a significant increase in the levels of the antioxidant enzymes, superoxidase dismutase and catalase, in the granuloma tissue. This wound healing potential may be due to its action on antioxidant enzymes.

Antidiabetic activity

R. Saini et al tested the methanolic extract of roots of *Quercus infectoria* Olivier at a dose of 250 mg/kg and 500 mg/kg body weight respectively for anti-diabetic activity compared with glibenclamide, an oral hypoglycemic agent (3mg/kg) in alloxan induced hyperglycaemic rats. The blood glucose levels were measured at 0, 2h, 4h and 6h after the treatment. This reduced the blood glucose from 282.52 to 206.57mg/dl after oral administration of extract (P<0.01).

Larvicidal activity

An effort to assay *Anopheles stephensi* larvae with gall extracts of *Quercus infectoria* was made under laboratory conditions. Ethyl-acetate extract was found to be most effective for larvicidal activity against the fourth instar larvae, followed by gallotonin, n-butanol, acetone, and methanol respectively.

Anticandida activity

Methanol and aqueous extracts of *Q. infectoria* galls were tested for anti-candida activity against *Candida albicans*, *Candida krusei*, *Candida glabrata*, *Candida parapsilosis* and *Candida tropicalis*. Results showed that both methanol and aqueous extracts displayed substantial anticandida activity and pyrogallol was the major component of both crude extracts. Pyrogallol has been reported to have various

biological activities such as candidicidal and fungicidal activities.

Antioxidant activity

Ethanol, acetone and water extract of *Quercus infectoria* were evaluated for antioxidant activity via DPPH radical scavenging and metal chelating assays. Ethanolic extract have the highest antioxidant activity with 94 0.05 using DPPH assay, other extracts had less activity. Potent antioxidant activities may be due to high presence of flavonoid and tannins.

CNS depressive activity

The methanolic fractions of the galls of *Quercus infectoria* exhibited neuropharmacological activity in laboratory animals. Chemical characterization of the CNS active component identified it as syringic acid. Isolated and pure syringic acid was studied and it suggest significant local anesthetic and sedative activity of the compound.

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