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Review on *Humulus lupulus L.*: Hop Is Boon for Human Being



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ABSTRACT

Humulus lupulus L. (Cannabaceae) is a dioecious twining perennial plant, widely cultivated throughout the temperate regions of the world. *Humulus lupulus* called the common hop or hops. It is a hardy climbing perennial plant. In Indian Ayurveda medicine, hops has been recommended for restlessness associated with nervous tension, headache, and indigestion and its actions are reported as sedative, hypnotic, and antibacterial. Also it has widely used in female sexual dysfunction, hops used to make beer, *in-vitro* anti-HIV activity. *Humulus lupulus* or hops possess' estrogenic activity. In Germany, hop bath is used for the treatment of gynecological disorders. Bioactivities of hop extract such as antibacterial, antifungal, antioxidants, cardioprotective, anticarcinogenic, antiviral. Used as a preventative agent in fresh food, extending their shelf life and they can incorporate in cosmetic formulation for skincare. Hops give a positive effect as well as a negative impact on testosterone level. The hop is also well known as a garden plant. It blossoms from June till August and may be propagated by seed or by dividing the roots. It likes a deep, loamy soil and is valuable as an ornamental climber over temporary arbors, trelliswork.

INTRODUCTION

Humulus lupulus L is also known as hops. The dried fruits (strobiles) of *Humulus lupulus* a climbing herb of central and northern Asia, Europe, and North America. Hops is Aromatic bitter, mildly sedative, and a diuretic; primarily used in the brewing industry for giving aroma and flavor to beer. A perennial vine that contains amino acids, flavonoids, glycosides (astralagin, quercitrin, rutin) and various other compounds, such as citral, geranial, humulone, linionine, lupulone, serolidol and bitter resin. Hops are anti-bacterial (due to humulone and lupulone), mildly sedative, and have been used for insomnia, to relax smooth muscle and, in combination with other herbs, to treat irritable bowel syndrome. Hop cones contain different oils, such as lupulin.

Lupulin

The female inflorescences (hop cones or “hops”), Lupulin is the fine yellow resinous powder found upon the strobiles or fruit of hops and containing this bitter principle. Lupulin, the peculiar bitter aromatic principle of the hop also called lupulite. Lupulin an alkaloid found in hops. Lupulin contains lupulone and humulone, which possess antibiotic properties, suppressing bacterial growth favoring brewer's yeast to grow. Therapeutics, lupuline plays an important part, but the properties of the etherized narcotic extract, and those of a crystalline acid, in very bitter silky needles, which might be called humulin, have never been experimented on, and would probably be found powerful substitutes for opium and quinine.

Humulone

Humulone (α -lupulic acid), a vinylogous type of organic acid, is a bitter-tasting chemical compound found in the resin of mature hops (*Humulus lupulus*). Humulone is a prevalent member of the class of compounds known as alpha acids, which collectively give hopped beer its characteristic bitter flavor. Lupulin (Chem) a bitter principle extracted from hops.

Lupulone

Lupulone is one of four beta acid analogues in hop resin, the others being adlupulone, colupulone, and prelupulone. Beta acids oxidize into hulupones, however, which happens as hops age, they become wort soluble and confer bitterness.

History

1. 1000 A.D- Hops introduced to beer-making prior.
2. 1150- First record hop used to bitter and preserve beer.
3. 13th century- Hops were cultivated in the Low Countries (modern Belgium and Holland).
4. 15th century - Cultivation of hops was probably introduced from Flanders to England in the Maidstone area of Kent.
5. 1629- By English and Dutch farmers.
6. Hop cultivation was begun in the present-day United States. Before prohibition, cultivation was mainly centered around New York, California, Oregon, and Washington State.
7. 1830- Messrs, Payen and Chevalier, even before determined that the yellow secretion of hops, a bitter and aromatic element was the sole source of the flavour, strong odour.
8. 1838- George Robert D' Harcourt included it in a patent among various other substances.
9. 1878- Hop acreage continued to increase.
10. 19th century, it was the golden age of the hop industry.

Objective

- 1) Widely used to curing women's body dysfunction.
- 2) Preparing beer.
- 3) Widely used in curing many diseases.
- 4) Useful for medicinal aspect.
- 5) Use to different food preparation.

Plant description

A) Taxonomical classification

Hops-

Domain: Eukaryota

Kingdom: Plantae

Phylum: Spermatophyta

Subphylum: Angiospermae

Class: Dicotyledonae

Order: Urticales

Family: Cannabaceae

Genus: Humulu

Species: *Humulus lupulus*



B) Morphological classification

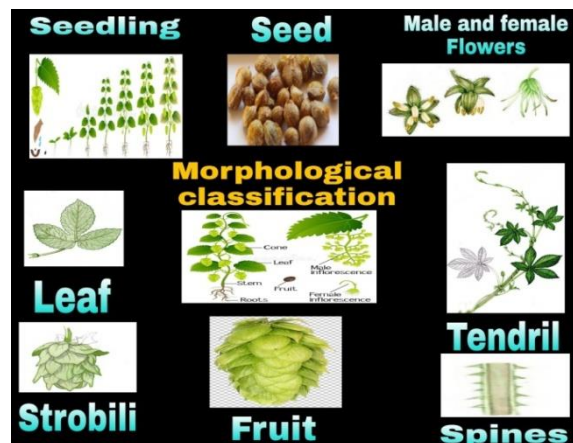


Figure No.1: Morphological Classification

1) Leaves

Leaves are opposite, 1 to 6 inches long, the largest leaves as wide as long or nearly so, sharply toothed around the edges, broadly heart-shaped in outline. Most leaves have 3 to 7 lobes, the lobes with sharply pointed tips; some leaves are unlobed. The dominant number of lobes on a plant depends on the variety (see Notes below) but is usually 3. The upper leaf surface is mostly hairless, the lower surface variously softly hairy along the veins, sometimes also on the surface. Yellow glands dot the lower surface. Leaf stalks are usually shorter than the blade. Leaf nodes are minutely hairy. Surrounding the stalk at the leaf node is a pair of leafy appendages (stipules) that are more or less triangular, soon split down the middle, and eventually wither away.

2) Tendril

Tendril is a thread-like structure found in climbing plants and used for support. It is a modified leaf, stem, or petiole that possesses coiling as its form of thigmotropism. An example of a plant that has tendrils is the *Humulus Lupulus*, or the common hop, shown below. It is an herbaceous climbing vine that can grow quite rapidly, and whose tendrils wrap around the support in a clockwise direction. The part of the tendril that is in touch with the surface will produce a hormone called auxin.

3) Roots

Humulus lupulus L. is a perennial herbaceous vine with horizontal and vertical roots. The horizontal roots spread out at depth of 20 to 30 cm and give rise to fibrous roots in the upper layers of soil. The vertical roots develop downward to a depth of 152 cm with a spread of 183 to 244 cm and no fibrous roots.

4) Stem

The stems are annual, slender, climbing, up to 9 m in length, often with stout hooked hairs. The leaves are opposite, cordate, 3 to 5 lobed, margins serrate, petioles slightly fleshy with stout hooked hairs.

5) Flower

The plants are dioecious with unisexual flowers on separate plants, but occasionally monoecious plants occur, in which case male or female flowers are often infertile. *Humulus lupulus L.* is wind-pollinated. The female inflorescence is cone-like, 2.5 to 5 cm long and the male flowers form in long racemes.

6) Seeds

Hops seeds can be slow to germinate. Use a process called "cold scarification" to encourage hop seed germination. A good method is to put seeds in an equal amount of moist sand and refrigerate from one to three months at about 41 degrees F. After that, plant the seeds at 68 degrees F. for one to two months.

7) Spines

Species are vigorous climbers, aided by their spiny twining stems. They are perennial climbers, sometimes referred to as bines. Their stems are non-woody and have four sides, with backward-pointing prickles that help the plants to climb in a clockwise direction. Interestingly, bines that grow anticlockwise, such as *Virginia creeper*, use suckers and tendrils rather than spines. Japanese hop has hairs on its stem alongside the spines; in common hop these are absent.

8) Strobile

Hop strobile is the common name for the flowers of the plant *Humulus lupulus L.*

Phytochemistry



Figure No. 2: Phytochemistry

Phytochemistry is the study of phytochemicals, which are chemicals derived from plants. In hops chemical composition of lupuline proves the richness of its principles, for analysis has found in it the following-

Water, Chlorophyll, Essential oil, Acetate of lime, Acetate of ammonia, Nitrate and sulfate of potash, Malate of lime, Albumine, Sub - carbonate of potash, Gum, Carbonate and phosphate of lime, Malic acid, Tannic acid, Phosphate of magnesia, resin, Sulphur, Bitter extract, Oxide of iron, A fatty matter, Silica. The part of the tendril that is in touch with the surface will produce a hormone called Auxin.

Cultivation

Hops are also used for various purposes in other beverages and herbal medicine. The hops plant is a vigorous, climbing and herbaceous perennial, usually trained to grow up strings in a field called a hop field or hop garden, when grown commercially. Many different varieties of hops are grown by farmers around the world for different flavours of beer. The hop is also well known as a garden plant. It blossoms from June till August and may be propagated by seed or by dividing the roots. Hops begin to sprout from the ground in March, the stems are plentiful, though they are weak, and need to be pruned. Pruning consists of cutting the plant stems and new wood. The crops should be treated so as not to damage the old wood, which could lead to the wilting of the entire bine. Before planting, the land is carefully dragged and Hop poles and wires are set up Normally, Hop production is limited to regions above 35°N or S latitude. A dormant period with 5 to 6 weeks of near-freezing temperatures is required for optimal growth, and Hop crowns can survive temperatures of -25°C or lower when insulated by snow or soil.

Propagation of hops

Methods Approximately 98% of the world's hops are used in the production of beer. Plants grow from a perennial crown that produces annual shoots, or bines. Bines may grow up to 25 feet in length. Once established, hops are hardy, resilient plants with taproots that penetrate 15 feet into the earth. Growing hops rhizomes is the quickest method to establish new plants but propagating hops plants from bine cuttings or seed is also possible. Experts agree that planting hops from clippings can be challenging but maybe successful if planted immediately after harvest and with several healthy root nodes. Seeds, however, are normally not recommended but can be a fun technique to try.

1. How to Propagate Hops Plant from Rhizomes- Rhizomes grow from the perennial crown and are similar to roots but root at internodes and sprout quickly, producing new plants in no time. Rhizomes can be found under the soil, usually several inches from the base of the main parent plant. Growing hops rhizomes requires well-draining soil and fairly neutral soil pH. Harvest rhizomes for hops plant propagation in late spring and plant immediately. Cut 5 to 6 inches (12 to 15 cm.) of rhizome with a sharp, sterile knife and plant 2 inches (5 cm.) below the soil surface. Keep the area moderately moist for a week. Rhizomes should have sent out roots by this time and begin to produce tiny shoots. Keep the plants moist but not soggy and weed-free. Once shoots are a couple inches high, use stakes or other support to begin training the plants.

2. Planting Hops from Clippings- You may install new cuttings in late spring or summer. Again, make sure your soil drains well and is fairly neutral in pH. Add lime or sulfur if you need to correct the soil pH and incorporate plenty of compost. Outdoor plants should be installed 1 to 2 inches (2.5 to 5 cm.) deep and 3 inches (7.62 cm.) apart. Keep outdoor plants moderately moist and provide new shoots with some sort of support. Alternatively, root cuttings in individual pots. Use a good sterile potting solution and plant cuttings with at least two root nodes beneath the soil. Cover indoor pots with a plastic bag after moistening the soil. Roots develop quickly and indoor plants should be ready for transplant in two weeks.

3. Propagating Hops Plants from Seed Surely someone, somewhere, is growing hops from seed though it is not recommended. Germination isn't the problem so much as the sex of the plant. If you want the flowering stems with cone-like blooms, you will need female vines. Males are important for pollen but only if you wish to produce seed. Should you have some vines that produced seed, by all means, plant them into a flat and see what they will do. You may get male or female plants, but the seeds do well in average potting mix with moderate moisture and plenty of heat. For a surefire method of hops propagation, however, cuttings or rhizomes will be faster, establish more robustly and quickly, and the sex of the vine can be determined by the sex of the parent plant.

Varieties of hops

There are more varieties of Hops are available, for example, Bravo, calypso, lemon drop, zenus, Aramis, Ariana, Bitter gold, callista, chinook, opal, polaris and etc.

"Hop is boon for human being".

Pharmacological aspect

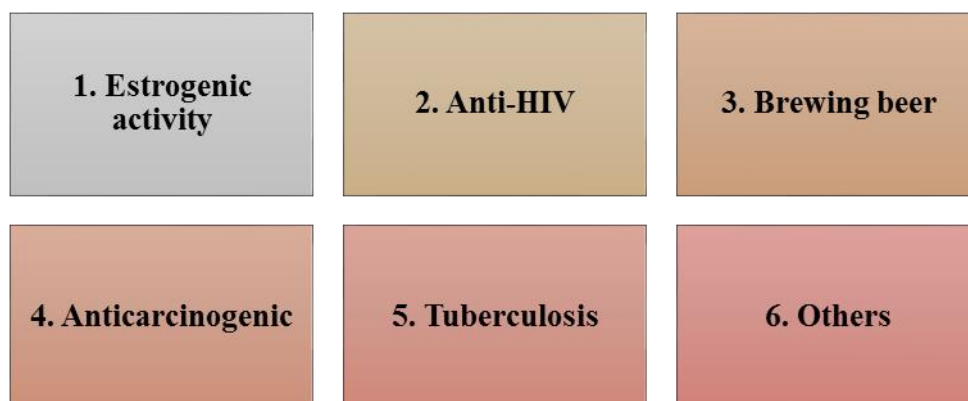


Figure No. 3: Pharmacological Aspect of Hop

1. Estrogenic activity

Hops (*Humulus lupulus*) inhibit Oxidative Estrogen Metabolism and Estrogen-Induced Malignant Transformation in Human Mammary Epithelial cells (MCF-10A). Long-term exposure to estrogen resulting from a combination of early onset of menstruation, null parity or delayed first child birth, short duration of breastfeeding, late menopause, and use of hormone replacement therapy (HRT). Estrogenic activity of hops led to the identification of 8-Prenylnaringenin (8 PN) as one of the most potent phytoestrogen. 8-Prenylnaringenin is a prenylflavonoid. The compound is equipotent at the two forms of estrogen receptors ER α and ER β . As an estrogen, 8PN has the potential - signaling systems within the body, including the reproductive system. Flowers of the hop plant are giving bitter flavor to the beer. Supplements made from hops can be effective for alleviating menopausal symptoms because hops contain phytoestrogens. Phytoestrogens are plant-based compounds that mimic the action of female sex hormones, whose deficiency is at the root of symptoms often felt by women in menopause, which also include sleep disturbances, fatigue and vaginal dryness.

2. Anti - HIV

Xanthohumol, prenylchalcone flavonoid, is a natural product with multi-biofunctions purified from Hops *Humulus lupulus*. Its anti-HIV-1 activity was tested in the present study. Results showed that xanthohumol inhibited HIV-1 induced cytopathic effects, the production of viral p24 antigen and reverse transcriptase in C8166 lymphocytes at non-cytotoxic concentration. The EC50 values were 0.82, 1.28 and 0.50 microg/ml, respectively. The therapeutic index

(TI) was about 10.8. Xanthohumol also inhibited HIV-1 replication in PBMC with EC50 value of 20.74 microg/ml. The activity of recombinant HIV-1 reverse transcriptase and the HIV-1 entry was not inhibited by xanthohumol. The results from this study suggested that xanthohumol is effective against HIV-1 and might serve as an interesting lead compound. It may represent a novel chemotherapeutic agent for HIV-1 infection. However, the mechanism of its anti-HIV-1 effect needs to be further clarified.

3. Brewing beer

Hops provide beer with piquant aroma, a variety of flavors, and a delicate-to-intense bitterness that balances the sweetness of the malt. They are the flowers of a perennial vine resembling soft, green pine cones and contain a yellow powder called lupulin. The resins and oils contained in this powder are vital for beer making.

A hop resin called alpha acid gives beer its bitterness. The oils give certain beer styles, like pale ales, their floral, citrusy, hoppy aromas. When hops are boiled, the alpha acid undergoes some chemical changes that allow it to bitter the beer. The less time the hops are boiled, the less bitterness in the beer. There are many different hop varieties, just as there are different kinds of tomatoes. Each variety has a flavor and aroma of its own.

4. Anticarcinogenic

Anticarcinogenic properties of Xanthohumol (XN), a prenylated chalcone from hop (*Humulus lupulus* L.) with an exceptional broad spectrum of inhibitory mechanisms at the initiation, promotion, and progression stage of carcinogenesis. Consistent with anti-initiating potential, XN potently modulates the activity of enzymes involved in carcinogen metabolism and detoxification. Antiproliferative mechanisms of XN to prevent carcinogenesis in the progression phase include inhibition of DNA synthesis and induction of cell cycle arrest in S phase, apoptosis, and cell differentiation.

i. Breast cancer

Xanthohumol has shown potential benefit against breast cancer, both *in-vitro* and *in-vivo*, and in estrogen-positive and estrogen-negative cancers. In various studies, xanthohumol has shown inhibition of DNA synthesis, cell.

ii. Ovarian Cancer

Ovarian cancer is the fifth most common cancer in the United States and is the deadliest gynecologic malignancy. Xn treatment in SKOV3 and OVCAR3 cells. However, it has been reported that metastasis is the major cause of morbidity and mortality in patients with ovarian cancer, especially epithelial ovarian cancer. Many efforts can be made to evaluate the metastasis ability upon Xn treatment, in addition to cytotoxicity and proliferation.

iii. Prostate cancer

The natural compound xanthohumol blocks the effects of the male hormone testosterone, therefore aiding in the prevention of prostate cancer.

5. Tuberculosis

Tuberculosis is caused by *Mycobacterium tuberculosis* bacteria. Is contagious infection that usually attacks your lungs? Lupulone is a compound extracted from Hops (*Hurnulus lupulus*), which exhibits a good antimicrobial activity against *M. tuberculosis* with minimal inhibitory concentration (MIC) value of 10 µg/mL. Xanthohumol, a major prenyl chalcone present in hops, has diverse biological activities including antibacterial and hepatoprotective activities. Xanthohumol had more effective bacteriostatic and hepatoprotective activities on *Mycobacterium tuberculosis*-infected mice. Xanthohumol has the potential to be an effective adjuvant in tuberculosis treatment. It has been determined that pharmaceutical plant, hops (*Humulus lupulus*), possesses some antibacterial effect. In this study, the antimycobacterial effect of this plant on rifampin-sensitive and resistant strains of *Mycobacterium tuberculosis* were examined. The sensitivity and resistance of 37 Iranian isolates of *M. tuberculosis* to rifampin was determined by proportion method. Ethanolic extract of hops was prepared using maceration method. PCR-SSCP and direct sequencing were used for confirming existence of mutations in 193-bp rpoB amplicons related to the rifampin resistance in *Mycobacterium tuberculosis* isolates. Two different concentrations of hops alcoholic extract (4 and 8 mg/ml) were prepared and its effects against 21 resistant and 15 sensitive isolates was determined using proportion method. Six different mutations in the 193-bp amplified rpoB gene fragments and seven distinguishable PCR-SSCP patterns in 21 Iranian rifampin-resistant isolates were recognized. This study showed that the percentage of resistance and the type of mutations were correlated with the PCR-SSCP patterns and the type of mutations in rpoB gene ($P < 0.05$). The results of hops antimycobacterial effect showed that different

concentrations of hops ethanolic extract (4 and 8 mg/ml) had a remarkable inhibitory effect on rifampin sensitive and resistant isolates of *Mycobacterium tuberculosis*. Identification of the effective fraction of hops against *Mycobacterium tuberculosis* is a further step to be studied.

6. Insomnia

Some research suggests that taking a combination of hops extract plus valerian extract at bedtime helps some people fall asleep faster. It appears to take 28 days of treatment to see these benefits. However, a combination of valerian extract and hops extract seems to improve sleep quality similarly to bromazepam (Lexotanil) when taken for only 14 days. Sleep quality does not appear to be improved by taking a combination of hops, soya oil, soya lecithin, and Cannabis sativa (Cyclamax) for one month. Several scientific studies suggest that hops do have sedative effects. For example, a study reported in the journal PLOS One examined the effects of drinking non-alcoholic beer with hops at dinnertime.

7. Others

Anxiety, Insomnia, Hyperactivity disorder (ADHD), Nervousness, Antimicrobial, Anti-inflammatory, Antioxidant, Bladder infection, Intestinal cramps, intestinal disorders (mucous colitis), Antiviral, Antifungal, Antibacterial, Indigestion, Overactive bladder, Body odor, Breast-feeding, Excitability, High levels of cholesterol or other fats (lipids) in the blood (hyperlipidemia), Improving appetite, Indigestion (dyspepsia), Leg sores caused by weak blood circulation (venous leg ulcers), Nerve pain, Nervousness, Pain and swelling (inflammation) of the bladder.

Disadvantages of hops

"Hops show positive as well as negative impact".

1. Toxicity

Hops plugs (which typically are dried) tend to be more toxic than hops pellets. The exact toxic principle is unknown but may be related to essential oils, resins, phenolic compounds, or nitrogenous constituents within the plant. When ingested by dogs (or rarely, cats), signs of hop poisoning include malignant hyperthermia (with temperatures exceeding 105°F/40.6°C),

increased breathing, a racing heart rate, anxiety, vomiting, abnormal clotting, and even death. Death has been reported in dogs poisoned by hops within 6 hours of ingestion.

2. Affect on Testosterone

In boys increased breast size to decreased sexual function, some experts are pointing to hops as a culprit. This may occur because hops contain Estradiol, a sticky estrogen that has an adverse effect on free testosterone. The concept is that hops may have a negative impact on male hormone balancing.

3. **Highly expensive-** Hop is a highly expensive plant.

CONCLUSION

With an increased understanding of the medicinal properties of hops, its use beyond beer is increasing. Scientific and clinical findings point to the possibility of hops' becoming even more widely used in the future both in medicine as well as in nutrition. New uses as food for health are just as conceivable as the processing of individual hops components in pure form for use as dietary supplements and medicines. Considerable work has been done investigating the antibiotic, antiseptic, and tuberculocidal properties of hops and their constituents. Hop bitter acids have proven to be especially effective against gram-positive bacteria.

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