

Urtica dioica L. (Stinging Nettle): Morphological, Phytochemical, Cultivation Practices and Biological Potential: A Review

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ABSTRACT

Stinging nettle (*Urtica dioica* L., Urticaceae) ecologically benign, grow as a weed plant widespread in the world, predominantly in wasteland areas with characteristically unpleasant stinging hairs on the stems and leaves is characterized by important economical potentials. This perennial plant grows to between 1-3 m tall with dark green leaves in an opposite pattern that are oval to heart shaped and saw-toothed and are sparsely covered with stinging hairs. Leaves are simple (i.e., lobed or unlobed but not separated into leaflets), opposite, coarsely toothed and there are two or more ways to evenly divide the flower i.e., the flower is radially symmetrical, lamina is 1.5-20 cm long and 0.6-12 cm broad. Propagation of nettle can either take place by seed or vegetative by divisions. The compounds responsible for burning sensation properties of leave's trichomes are acetylcholine, histamine, serotonin (5-hydroxytryptamine) and formic acid. The high nutritive values caused stinging nettle leaves to be included in the human consumption, as a tonic for strengthening the body, in the preparation of soups and various dishes and as a natural source of food favouring. This herb, which is known for its therapeutic and healing properties also has several side effects such as affects blood regularity, lowers the blood pressure level, insomnia and drowsiness, stomach discomfort, severe allergic reactions etc. Therefore, the present studies revealed that the plant has wild adaptability with effective pharmacological action and has proven its potential for future research for several biological potential.

Keywords: *Urtica dioica* L., Urticaceae, Stinging nettle, phyto constituents, biological potential, trichome

INTRODUCTION

Urtica dioica L. ecologically benign, given its natural resistance to disease and pests and hence needs no pesticides and man-animal conflict is rare. It is perennial and requires minimum care and protection.

The world is presently over-dependent on a few plant species for a study of value chain and processing. Diversification of production and consumption habits to include a broader range of plant species, particularly those currently identified as under-utilized, could significantly contribute to improve health and nutrition, livelihoods and ecological sustainability. Wild plants have played a significant role in supplementing staple foods by supplying trace elements, vitamins, and minerals in order to obtain a balanced diet, and they may do so again in the future. Several epidemiological studies suggest that a high intake of foods rich in natural antioxidants reduces the risk of some cancers, heart, and degenerative diseases. Stinging nettle (*Urtica dioica* L., Urticaceae) as a weed plant widespread in the world, predominantly in wasteland areas with characteristically unpleasant stinging hairs on the stems and leaves is characterized by economical important potentials^{1,2}.

The presence of valuable biologically important compounds such as proteins, vitamins, phenolic components, macro and microelements, tannins, flavonoids, sterols, fatty acids, carotenoids and

chlorophylls contributes to the utilization of stinging nettle in different ways^{3, 4, 5, 6, 7}.

Nettles contain flavonoids, fatty acids, terpenes, protein, vitamins, and minerals. Stinging nettle leaves are rich in vitamin C, B groups vitamins, vitamin K, and some minerals mainly calcium, iron, magnesium, phosphorus, potassium, and sodium. Nettle leaves contain nine carotenoids. Of these, Lutein, lutein isomers and β -carotene are the basic carotenoids.

The family name Urticaceae comes from the genus *Urtica* which includes about 2625 species, grouped into 53 genera according to the database of the Royal botanic garden, Kew and Christenhue. The largest genera are *Pilea* (500 to 715 species), *Elastostema* (300 species), *Urtica* (80 species) and *Cecropia* (75 species) (The Editors of Encyclopaedia Britannica).

DESCRIPTION OF PLANT

Geographical distribution and altitudinal range and habitat

Urtica dioica L. is abundant in North Europe and much of Asia. It is low widespread in Southern Europe and North Africa. It is also abundant in North America, Canada, U.S. and Mexico. In Europe, nettles have strong association with human habitation and buildings.

In India, *Urtica dioica* found growing in temperate and sub-tropical Himalayas, from Kashmir to Sikkim between

1200 to 3500 m above sea level. In Uttarakhand, it grows wild as undergrowth in almost all the districts.

Botanical description

Urtica dioica or stinging nettle is a broadleaf angiosperm of the Urticaceae family. This perennial plant grows to between 1-3 m tall with dark green leaves in an opposite pattern that are oval to heart shaped and saw-toothed and are sparsely covered with stinging hairs. Rhizomes are cylindrical and tapering, occasionally branched. Root is greyish-brown, irregularly twisted, about 5 mm thick, hollow in cross section. Stem is erect, hollow to solid, fibrous and tough, mostly simple or branched, bluntly square with 4 deep vertical grooves. Stinging hairs 1 mm long, tapered to a fine sharp point, few to numerous, pointing upward, thick at base. Leaves are simple (i.e.,

lobed or unlobed but not separated into leaflets), opposite, coarsely toothed and there are two or more ways to evenly divide the flower i.e., the flower is radially symmetrical, lamina is 1.5-20 cm long and 0.6-12 cm broad.

Petiole is 0.7-7 cm long, grooved above and along the sides of stinging hairs, stipules pale green, paired, entire, pointed, erect and hairy. Flowers are green, blooming. Inflorescence is panicle, each 2-8 cm long from the upper leaf axils. There are 4 petals and sepals in the flower and both the sepals and petals are separated and not fused. Stamen number is four.

Fruit is dry but does not split open when ripe (achene), 1-seeded, length is 1-1.4 mm and 0.7-0.9 mm in width, smooth, very thin walled^{8,9}.



Figure.1. Aerial view of *U. dioica* L



Figure 2. Leaves of *Urtica dioica* L



Figure.3. Stem of *Urtica dioica* L. showing arrangement of stings (Enlarged view)

CULTIVATION PRACTICES:

Basically the nettle is considered as a weed, most people don't bother to cultivate them. They have a perennial root system that spreads quickly and makes it very difficult to eradicate once it's established. Seeds can be collected from

the wild and then divide roots in almost any time of the year. Gloves and knives/scissors are used at the time of harvesting. The whole herb can be collected in May and June, just before coming into flower, and dried in bunches or frozen. Ripe seeds are collected. During the summer season, the aerial parts of the herb and especially the leaves

are plucked when the plant is in full bloom. Autumn is the time when nettle roots are harvested and used in the preparation of various herbal remedies⁸.

Soil or medium requirements

Information on cultivation of nettle crops is limited although it is thought that the plant prefers loose soil, preferably with a layer of organic matter to encourage growth.

Stocks should be grown in rich potting medium with regular fertilization to ensure healthy nursery stock is produced. Another reported method is imbibing seed on 1% agar for 56 days at 06 °C with a germination medium of 1% Agar and germination conditions of 33-19°C¹⁰.

Maintenance

The soil stays damp in the spring up to when the harvesting is finished. After the harvest season, it doesn't need much maintenance. After the harvesting is over, the plant can cut back by taking off about one third of the stalks with a pair of hedge clippers. Just leave the cut off sections on the ground around them. This keeps the plants shorter, which means they are less likely to topple over later in the year - they can get very tall if left. The other thing needs to be done is cut off the flower/seed heads as they form. This makes the plant spend less energy on seed production, and the next year crop will be a better. Once the leaves start to yellow in the fall, the pair of hedge clippers are used to cut them back to about 10 cm (4 inches) high, leaving the stalks on the ground and cover with a layer of composted manure. All this organic material helps keep the soil damper in the spring, and perennial clump will get bigger and bushier each year.

Propagation methods

Propagation of nettle can either take place by seed or vegetative by divisions.

Once completing their after-ripening process, seeds should be warm stratified. Seeds germinate at 20-15°C in light. Also, germination is reported to occur at alternating temperatures of 25 and 15°C following warm stratification and in the presence of light on seeds that were dry stored. Alternatively, seeds can be planted in late fall to allow for germination to take place the following spring or summer¹⁰.

Propagation of nettle can also take place vegetative by divisions. Vegetative propagation is simple but labour intensive. Seedlings initiate vegetative spread in the first growing season.

For sowing and planting of *Urtica* mainly three techniques can be used: A) Direct sowing, B) Growing seedlings in nurseries with subsequent transplantation and C) Vegetative propagation via stolon or head cuttings.

- **Direct sowing:** The seedbed should have a loose and fine structure, but should be reconsolidated using a packer roller imminently prior to sowing. Sowing time can be either in autumn or in spring. The disadvantage of direct sowing is that it usually leads to incomplete plant coverage. This drawback can be mitigated by covering the seedbed with transparent perforated foil in order to improve seed germination. Further, weed control can be problematic as the stinging nettle has a slow seedling development time.

- **Growing seedlings:** For this technique pre-germinated seeds are sown between mid/end February and beginning of April and grown in nurseries. A fastened germination is achieved by alternating high temperature during daytime (30⁰ C for 8 hrs) and lower temperature during night-time (20⁰C for 16 hrs). Before transplanting, the seedlings should be fertilized and acclimated to cold temperatures. Transplantation should start around mid-April with row spacing of 42-50 cm and plant spacing with rows of 25-30cm.

- **Vegetative propagation:** Stolens (with several buds) of 10 cm should be planted from mid-April in a depth of 5-7 cm. Head cuttings are grown in nurseries starting between mid-May and mid-June. Growing tips with two leaf-pairs are cut from the mother plant and treated with root-growth inducing hormones. Transplantation can be delayed in comparison to the growing seedling techniques.

Alterations in chemical composition and quantity of components of stinging nettle is related to environmental growth factors such as temperature, moisture, light, soil type and nutrients¹¹.

Water requirement

If not in a moist area, *Urtica dioica* L. may need supplemental watering through its first summer of establishment.

FLOWERING SEASON

The flowers of the plant nettle are in full bloom between early summers to early autumn^{8,9}.

PHYTOCHEMICAL CONSTITUENTS

The main chemical constituents of *Urtica dioica* L. are flavonoids, tannins, volatile compounds and fatty acids, polysaccharides, isolectins, sterols, terpenes, protein, vitamins and minerals¹². The compounds responsible for burning sensation properties of leaves trichomes are acetylcholine, histamine, serotonin (5-hydroxytryptamine) and formic acid. The main component of essential oils of plant are carvacrol, carvone, naphthalene, (E)-anethol, hexahydrofarnesyl acetone, (E)-geranyl acetone, (E)- β -ionone and phythol. The flavonoids are mainly kaempferol, isorhamnetin, quercetin, isoquercetin, astragalin and rutin. The carotenoids such as β -carotene, hydroxy- β -carotene, lutoxanthin, lutein epoxide and violaxanthin are reported^{13,14,15}. The leaves are rich in vitamin B, C, K and minerals such as calcium, iron, magnesium, phosphorus, potassium, sodium. Other chief constituents present are amino acids, glucokinnins and a very high content of chlorophyll¹⁶.

The constituent profile of nettle is said to vary depending upon the plant part. As far as the roots are concerned, the principle chemicals of interest are the sterols and steryl glycosides, including beta-sitosterol. Nettle root also contains lignans (e.g., secoisolariciresinol) and six isolectins collectively referred to as UDA (*Urtica dioica* agglutinin). Other constituents in the root include phenylpropanes, polyphenols, polysaccharides, tannins and the coumarin scopoletin¹⁷. The fresh leaf contains a similar range of constituents, with smaller amount of plant

sterols, but proportionally higher levels of flavonal glycosides such as quercetin, as well as carotenoids, chlorophyll, acids (e.g. carbonic and formic acid), vitamins (C,B and K) and minerals(e.g. calcium, magnesium and potassium). The stinging trichomes are stated to be fashioned primarily from silica and contain a mixture including formic acid, acetyl choline, histamine and serotonin. Flowers are also stated to possess scopoletin. Nettle leaves contain flavanoids (isoquercitin, rutin), acid

components, particularly in the stinging hairs (including histamine and 5-hydroxytryptamine i.e., serotonin), formic acid, silica, glucoquinone, tannins, ascorbic acid and other minerals and vitamins in appreciable levels. Nettle root have polysaccharides, sterols and sterol glucosides, lignans, ceramides, fatty acids, monoterpene diols and glucosides.

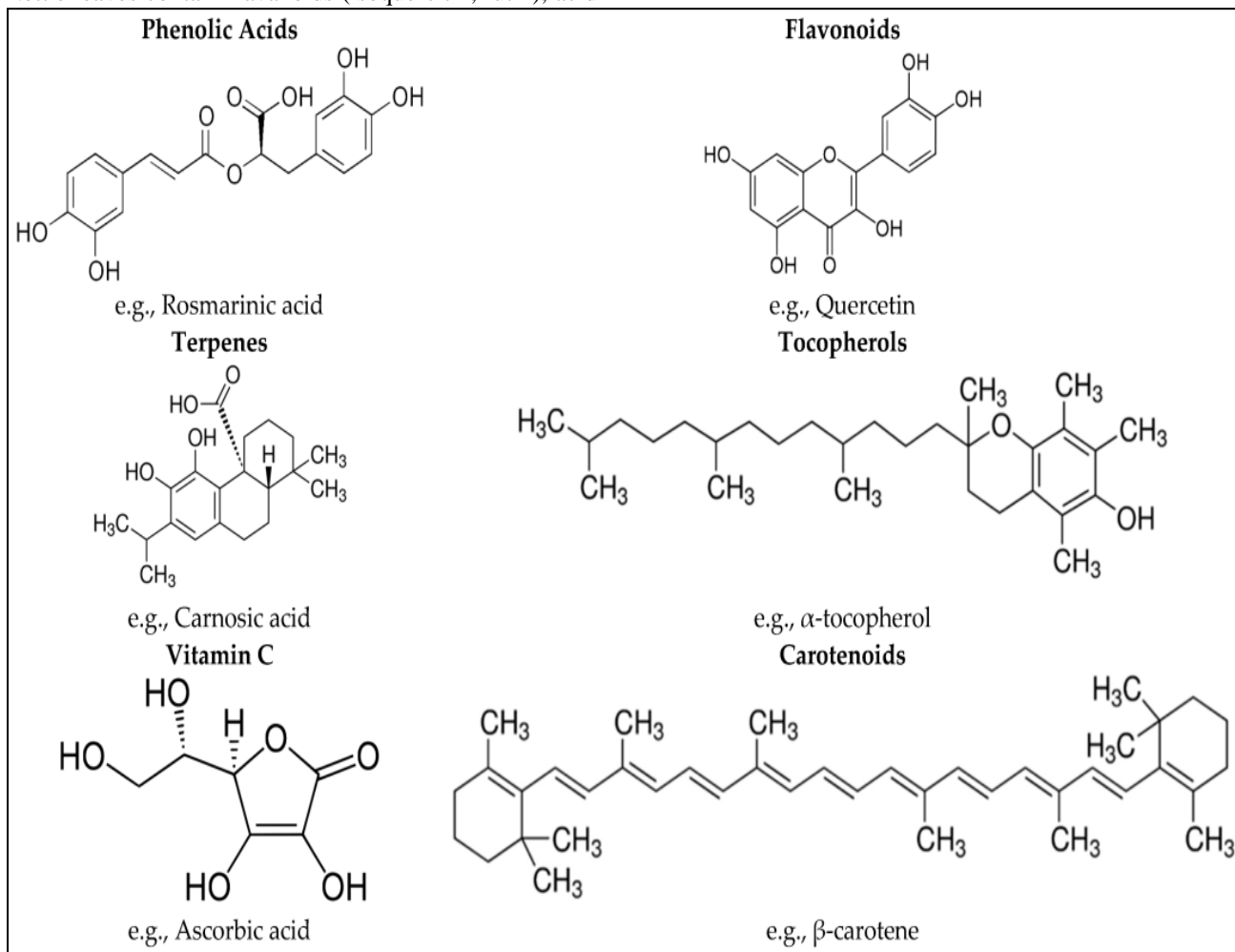


Figure 4. Chemical compounds found in *Urtica dioica* L

NETTLE STING MECHANISM:

The nettle sting is an adaptation to provide protection from predators. The sting causes any predator that may eat the plant or uproot it to stay clear. The way the sting works is like hypodermic needle. When the hairs embed themselves into the skin, they break off the plant and then release a concoction of formic acid, histamines and other chemicals which causes the stinging affect.

Urtica dioica L. produces its inflammatory effect on skin (stinging, burning sensation often called “contact Urticaria”) both by impaling the skin via spicules-causing mechanical irritation-and by biochemical irritants, such as histamine, serotonin and choline, among other chemicals¹⁸. Anti-itch drugs, usually in the form of creams containing antihistamines or hydrocortisone, may provide relief from nettle dermatitis. The use of dock leaves on the nettle stings is an established folk remedy, and revolves

around the sap released from rubbing the leaf over affected areas of skin, which provides a cooling sensation. Docks and nettles regularly grow in the vicinity of each other due to both plants favouring the same soil conditions, and this may have aided the dock’s popularity as a treatment for nettle stings. Dock leaves come from the genus *Rumex* and there are several species. The most common species that grown in the UK is the broadleaved dock. It is characterized by its large oval leaves that have rounded tips. Some of the stems and leaves may have a reddish hue. It can be found in a lot of similar places to nettles such as in meadows and in damp understorey areas. There are few theories to suggest why dock leaves appear to help nettle stings. It has been found that the sap in dock leaves contains an antihistamine and this can soothe the stinging sensation. It has also been suggested that the cooling

sensation of the sap evaporating from the skin affected by the sting can relieve some of the sensations.

ECONOMIC IMPORTANCE OF *URTICA DIOICA* L.:

Urtica as a food and drink:

Urtica dioica is a rich source of vitamin A and C, iron, potassium, manganese and calcium. Soaking stinging nettles in water or cooking removes the stinging chemicals from the plant, which allows them to be handled and eaten without injury. The leaves are also dried and may then be used to make herbal tea, as can also be done with nettle's flowers. Nettle soup is common in Northern and Eastern Europe. Nettles are used in Albania as a part of the dough filling for the borek. The top baby leaves are selected and simmered, then mixed with other ingredients such as herbs and rice, before being used as a filling between dough layers.

The high nutritive values caused stinging nettle leaves to be included in the human consumption, as a tonic for strengthening the body, in the preparation of soups and various dishes and as a natural source of food favouring¹⁹. Nettle leaves are steeped in a concentrated sugar solution to extract the flavour. The leaves are then removed and a source of citric acid is added to help to preserve the cordial and add a tart flavour. Commercially produced cordials are generally quite concentrated and are usually diluted by one part cordial to ten parts water. The high concentration of sugar in nettle cordial gives it a long shelf life.

Textile and fibre use:

The potential of the stinging nettle's fibre in the production of natural textiles is investigated, also^{20, 21}. Unlike cotton, nettles grow easily without pesticides. Historically, nettles have been used to make clothing for 2,000 years, and German army uniforms were almost all made from nettle during world-war I due to potential shortage of cotton. More recently, companies in Austria, Germany and Italy have started to produce commercial nettle textiles. The fibre content in nettle shows a high variability and reaches from below 1% to 17%. Under Middle-European conditions, stem yield typically between 45 and 55 dt/ha, which is comparable to flax stem yield. Nettles may be used as a dye-stuff, producing yellow from the roots, yellowish green from the leaves²⁰.

BIOLOGICAL HEALTH BENEFITS OF STINGING NETTLES:

As more and more research is done on stinging nettle, it is becoming even more popular because of the diverse range of its proven medicinal effects. Some of its health benefits are:

Eczema

Eczema is characterized as dry and swollen, itchy rash that can sometimes cause blisters that can crust over. The anti-inflammatory and antihistamine qualities of stinging nettle make it a natural treatment for inflammatory conditions like eczema, as stated in the *American Journal of Contact Dermatitis* in 2003.

Detoxifies the body

The wide range of beneficial nutrients found in stinging nettle makes it an ideal detoxifier for the body and it has been known to gently cleanse the body of toxins. As a diuretic, stinging nettle can also ensure that those toxins being neutralized in the body are then eliminated quickly. It is known as an alternative, meaning that it can improve the nutrient uptake efficiency of the gut and ensure that the digestive processes run smoothly, thereby preventing the accumulation of dangerous toxins. It also stimulates the lymphatic system, helping rid of the body of excess toxins in the kidneys as well.

Promotes feminine health

Stinging nettle has a number of active components that affect feminine health. For painful premenstrual symptoms, it can soothe cramps and bloats, while also minimizing blood flow during menstruation due to its astringent capabilities. For women undergoing menopause, stinging nettle can smooth the transition and act as a restorative, so the hormonal shift isn't as dramatic in the body.

Improves circulation:

The combination of high vitamin C iron content in stinging nettle makes it ideal for stimulating red blood cell production. Vitamin C optimizes iron uptake in the gut, while iron is the crucial component of haemoglobin. By increasing the RBC count in the body, blood circulation increases, wound healing speeds up, and the body's extremities receive essential oxygenation to boost energy levels. For the same reason, stinging nettle is often recommended to relieve fatigue or anaemia, which is characterized by general muscle weakness, exhaustion, cognitive difficulties and headache.

Anti-inflammatory activity

Stinging nettle is a stimulant and a rubefacient substance, making it very effective against various inflammatory conditions, such as arthritis or chronic muscle pain. Research has shown that stinging nettle tea or herbal supplementation can effectively treat gout, soothe muscle pain, and reduce symptoms of arthritis.

Osteoporosis or bone health

Although we don't hear much about boron, it is still an important mineral found in stinging nettle. Boron has been scientifically linked to maintaining calcium content in our bones, which means that stinging nettle, can help to slow the onset of osteoporosis. When you combine that effect with the hormone-regulating impact that stinging nettle has, which helps to regulate and monitor bone health as well, it seems like this herb truly can do it all.

Treats respiratory issues

Stinging nettle has also been connected to the treatment of a variety of respiratory condition, including hay fever, asthma and seasonal allergies. Studies have shown that certain extract combination from stinging nettle can significantly reduce allergic reactions. Regular consumption of its tea has been associated with curing asthma in Australia for generations.

Protects heart health

It only makes sense that this amazing cure-all herb would also be able to positively affect the heart. Research has revealed that regular consumption of stinging nettle tea can

help to lower systolic blood pressure and relieve tension and stress on the cardiovascular system.

Improves prostrate health

Stinging nettle is used in medicines for the treatment of BPH and other prostate related diseases. Though the studies have found that nettle does not effectively reduce the size of an already enlarged prostate, it is effective in reducing and treating the disease in its early stage when symptoms begin to show. This herb helps in stopping cell growth and division around the area and help in improving prostate health. Prostate enlargement and cancer are both serious factors to consider as men age and stinging nettle has proven to be an effective means of preventing prostate growth. However, due the chemical pathways that this treatment takes, stinging nettle can only prevent the growth, not reverse it once the growth factor and testosterone-stimulation have occurred.

Skin care

When the extracts are applied to the skin, stinging nettle has been proven to reduce the severity of acne and can even prevent bacterial infections. Due to its antioxidant properties, it can also speed healing, reduce the appearance of scars and blemishes, and promote anti-aging effects to reduce wrinkles and age spots.

The great nutritive values produced by the leaves to be involved in the human consumption as a tonic for strengthening the body. Nowadays, in form of leaves and roots extracts, stinging nettle is used as supportive therapy to help relieve rheumatic complaints and seasonal allergy symptoms in reducing difficulties in urination associated with early stages of benign prostatic hyperplasia^{22, 23, 24} and in control of glucose level in diabetes^{25, 26, 27, 28}. Antimicrobial and antioxidant activities the possibilities for decreasing of cardiovascular risks and investigations of chemo preventive properties of stinging nettle extracts in breast cancer cells are still researched^{29, 30}.

TRADITIONAL USES

U. dioica L. have a long history of use in the household home remedies and nutritious diet. The powered leaf extract used as antihemorrhagic agent to reduce excessive menstrual flow and nose bleedings. This plant was used for the treatment of arthritis, anaemia, hay fever and used as diuretics, astringents, vaginal discharge, internal bleeding³¹. Traditionally, a tea made from the leaves of *U. dioica* has been used as a cleansing tonic and blood purifier. Externally, this plant is used to treat skin complaints, gout, sciatica, neuralgia, haemorrhoids, hair problems etc. 9-10 for medicinal purposes, the plant is harvested between May and June of every year as it is coming into flower and dried for later use. The root has a beneficial effect upon enlarged prostate glands and it is used for the treatment of rheumatic gout, nettle rash and chickenpox, externally is applied to bruises. The plant has been widely used by herbalists around the world for centuries. In the first century, Greek physicians Pedanius Dioscorides and Galen reported the leaf of *U. dioica* had diuretic and laxative properties and was useful for treatment of asthma, pleurisy and spleen illnesses. The nettle leaves is used as a nutritious supplement and as weight loss aid. Now- a-days,

in Germany this plant was sold as herbal drug for prostate diseases and as a diuretic³¹.

Young leaves of the plant are used to cure goitre and associated pain. Young twigs with stinging hairs are applied to cure goitre or pain. The vegetable is eaten to cure cold and cough. The leaves are also used to cure the allergic disorders such as cold and cough. The fresh juice of the leaves is used to cure fracture, dislocation of bone; and boils. The plant decoction has been reported as febrifuge. Plant decoction used in the treatment of fevers, root juice applied in case of throat pain, also taken for gonorrhoea, roots decoction given in dog bite. Branches with leaves applied externally on sprains and swelling for their counter-irritant properties. Young leafy shoots taken as vegetables to get relief from rheumatic pain. Veterinary medicine, poultice form the root applied to alleviate inflammation of the fractured or injured parts of domestic animals. The stem fibre is of high quality and used to make cloth, fishing nets, and ropes and for some industrial materials. It also used in fever and illnesses to women following to child birth. The leaves are used in dysentery, joint pain and liver disorders. The leaf extract is used in hair wash to prevent baldness¹⁶.

OTHER USES

The leftover plant matter used as a good source of biomass and has been used in the manufacture of sugar, starch and ethyl alcohol. Although many different species of insects feed on nettles, flies are repelled by the plant so a bunch of freshly cut stems has been used as a repellent in cupboards. The juice of the plant, or a decoction formed by the boiling the herb in a strong solution of salt, will curdle milk and thus act as a rennet substitute. The same juice, if rubbed into small seams of leaky wooden tubs, will coagulate and make the tubs watertight again. A hair wash is made from the leaves and used in antidandruff treatment.

CONCLUSION

Present study revealed that the plant has wild adaptability with effective pharmacological action and has proven its potential for future research for several biological potential. Therefore, further studies may be carried out to prove its promising uses. Besides having economic importance, plant have high demand causing a serious deletion of natural population, there is urgent need for its conservation.

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