

# *Urtica dioica* L., (*Urticaceae*): A Stinging Nettle

Mueen Ahmed KK<sup>1</sup> and Subramani Parsuraman<sup>2</sup>

<sup>1</sup>Phcog.Net and SCIBIOLMED.ORG, Bore Bank Road Cross, Benson Town, Bangalore, India.

<sup>2</sup>Unit of Pharmacology, Faculty of Pharmacy, AIMST University, Bedong 08100, Kedah, Malaysia.

## ABSTRACT

*Urtica dioica* L., is a perennial herb with a long history of traditional medicinal uses in many countries in the world, especially in the tropical and subtropical regions. A wide range of chemical compounds including flavonoids, agglutins, lignans, carotenoids, phenolic compounds and terpenoids have been isolated from this species. Extracts and metabolites from this plant have been found to possess various pharmacological activities. In recent years, there has been growing interest in alternative therapies and the therapeutic use of natural products, especially those derived from natural products. Based on literature, *U. dioica* and its phytoconstituents were reported for various pharmacological activities which includes hypoglycemic and anti-inflammatory activities. A thorough review is required to avoid repetition of future research on this plant. Further, this review will also help to continue research based on previous reports. This review will also provide comprehensive information on *U. dioica* which could be useful article for researchers on this plant. The comprehensive account of the chemical constituents and the biological activities are presented in this review such

that the potential use of this plant for the future drug.

**Key words:** *Urtica dioica*, Stinging nettle, Phytochemistry.

**Abbreviations used:** BPH: Benign prostatic hyperplasia, NF-κB Nuclear factor kappa-light-chain-enhancer of activated B cells, DNA: Deoxyribonucleic acid, GC-MS: Gas Chromatography-Mass Spectrometry, HPLC: High-performance liquid chromatography, CO<sub>2</sub>: Carbon dioxide, CST: Glutathione S-transferase, DTD: DT-diaphorase, SOD: Superoxide dismutase, CAT: Catalase.

## Correspondence:

**Dr. S. Parasuraman**

Unit of Pharmacology,  
Faculty of Pharmacy, AIMST University,  
Bedong 08100, Kedah, Malaysia.

**Email:** parasuraman@aimst.edu.my

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## INTRODUCTION

Nettle, or stinging nettle, is a perennial plant growing in temperate and tropical wasteland areas around the world. It grows 2 to 4 meters high and produces pointed leaves and white to yellowish flowers and it belongs to the family of Urticaceae.<sup>1</sup> The genus name *Urtica* comes from the Latin verb *urere*, meaning 'to burn,' because of these stinging hairs. The species name *dioica* means 'two houses' because the plant usually contains either male or female flowers. Nettle has a well-known reputation for giving a savage sting when the skin touches the hairs and bristles on the leaves and stems.<sup>2</sup> In the last few years, *Urtica dioica* L., has been accepted as a healing plant because of its considerable effects on human health in many countries all over the world.<sup>2-4</sup>

## TAXONOMY

Kingdom-	Plantae - Plants
Subkingdom-	Tracheobionta - Vascular plants
Superdivision-	Spermatophyta - Seed plants
Division-	Magnoliophyta - Flowering plants
Class-	Magnoliopsida - Dicotyledons
Subclass-	Hamamelidae
Order-	Urticales
Family-	<i>Urticaceae</i> - Nettle family
Genus-	<i>Urtica</i> L.
Species-	<i>Urtica dioica</i> L., - stinging nettle P <sup>[5]</sup>

## PLANT PROFILE

*U. dioica* is originally from the colder regions of northern Europe and Asia, today this herbaceous shrub grows all over the world. Stinging nettle grows well in nitrogen-rich soil, blooms between June and September of every year, and reaches nearly 3 feet high. The stem is erect and green, the leaves are opposite, cordate at the base, oblong or ovate,



*Urtica dioica* – with flowers

finely toothed, dark green above and paler beneath. The flowers are in reddish-brown to greenish-white colour. The small, green, dioecious flowers occur as racemes in the axils of the upper leaves. Usually, the plant has either male or female flowers, in separate inflorescences, hence the specific name of the plant, *dioica*. *U. dioica* flowers from May to September every year.<sup>6</sup>

## TRADITIONAL USES

*U. dioica* 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, anemia, hay fever and used as diuretics, astringents and blood builders in folk medicine.<sup>7,8</sup> Traditionally, a tea made from the leaves of *U. dioica* has been used as a cleansing tonic and blood purifier.<sup>9</sup> Externally, this plant is used to treat skin complaints, gout, sciatica, neuralgia, haemorrhoids, hair problems etc.<sup>9-10</sup> 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.<sup>11</sup>

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.<sup>12</sup> Now- a-days, in Germany this plant was sold as herbal drug for prostate diseases and as a diuretic.<sup>13</sup>

## GENERAL USES

Stinging nettle has been used for hundreds of years to treat rheumatism, arthritis, gout, eczema, anemia, urinary tract infections, kidney stones, hay fever and early stages of an enlarged prostate (called benign prostatic hyperplasia or BPH). Recent laboratory studies and clinical studies on antirheumatic activity on stinging nettle showed possible antiarthritic activity. Riehemann *et al.*, reported the inhibition of NF- $\kappa$ B activation (protein complex that controls transcription of DNA and cytokine production) and Randall *et al.*, reported the clinical possible antiarthritic activity of stinging nettle.<sup>14,15</sup>

### Benign Prostatic Hyperplasia (BPH)

Reports claim that as many as 80% of European men with BPH are given the option of herbal remedies for their symptoms, including saw palmetto and stinging nettle roots, rather than medication or surgery.<sup>16</sup> Studies in people suggest that the root of the stinging nettle, in combination with other herbs especially saw palmetto, may be an effective treatment for BPH, relieving urinary symptoms such as reduced urinary flow, incomplete emptying of the bladder, post urination dripping, and the constant urge to urinate.

**Others:** In animal studies, nettle has been shown to have anti-inflammatory and hypoglycemic effects. The hydro-alcoholic extract of *U. dioica* at 100 and 200 mg/kg showed significant antidiabetic effect against fructose induced diabetics.<sup>17</sup> Active compounds in stinging nettle may act as an expectorant (meaning that it can loosen and break up a cough) and have antiviral properties.<sup>18</sup>

Nettle may also be effective for treating certain individuals with allergic rhinitis (hay fever). This traditional use has had a lot of historical value for individuals. Early studies of people suggest that this historic use is likely scientifically valid. However, while the studies thus far have been favorable, they have not been overwhelmingly so.

## ETHNOPHARMACOLOGY

In pre-clinical animal experiments *U. dioica* along with *Nigella sativa* reduced carbon tetrachloride induced elevated levels of serum potassium and calcium levels and decreased the levels of red blood cells, weight blood cells, packed cell volume and haemoglobin levels.<sup>19</sup> Turkdogan *et al.*, and Kanter *et al.*, also reported the hepatoprotective effects of *N. sativa* and *U. dioica* in carbon tetrachloride induced liver fibrosis and cirrhosis model.<sup>20,21</sup> In another study, the effects of ethanol-water (80%-20%) extract of *U. dioica*. and butylated hydroxyanisole were investigated, for phase I and phase II enzymes, antioxidant enzymes, lactate dehydrogenase, lipid peroxidation and sulfhydryl groups in the liver of Swiss albino mice. It was found that extract was effective in inducing GST, DTD, SOD and CAT activity.<sup>22</sup>

The aqueous extract of *U. dioica* is characterized for the specific cardiac and vascular effects using isolated Langendorff perfused rat heart, and it produced a vasoconstriction of the aorta which is due to activation of alpha1-adrenergic receptors. However, aqueous extract of *U. dioica* also induced a strong bradycardia through non-cholinergic and non-adrenergic pathways that might compensate for its vascular effect and account

for the hypotensive action of *U. dioica*.<sup>23</sup> The aqueous extract of *U. dioica* also studied for its antioxidant, antimicrobial, antiulcer and analgesic properties and the study was concluded for the presence of antioxidant properties, antimicrobial activity, antiulcer activity and analgesic effect.<sup>24</sup> In another study the *U. dioica* roots extract hypotensive effects by decrease of vascular pressure.<sup>25</sup>

### Phytochemistry

The seeds and leaves of *U. dioica* contain vitamins, minerals and amino acids.<sup>1</sup> Chemical interest in *U. dioica* was stimulated by reports that they cause irritation when comes in contact with skin. The leaves of *U. dioica* possess sharp spines with stinging hairs that contains histamine and formic acid, which causes irritation.<sup>1</sup> Many compounds were previously isolated by different researchers on *U. dioica*, viz., phytosterols<sup>2</sup>, lignans<sup>3</sup>, carotenoids<sup>3</sup>, fatty acids<sup>4</sup>, phenolics<sup>5</sup> etc.

The leaves of *U. dioica* are being used a s herbal tea for the treatment of different ailments, such as hypertension, benign prostatic hyperplasia etc. the leaves were reported to contain caffeic acid, chlorogenic acid<sup>6</sup>, high content of chlorophyll and other pigments.<sup>26</sup> Phytochemical literature on *U. dioica* gave a weak indication for the presence of alkaloids, there are no reports published elsewhere.

Rhizomes of *U. dioica* are found to contain agglutin, a series of long chain amino acid linkages.<sup>8</sup> The structure of agglutin was also confirmed as a member of proteins family with two hevein like domains present in each subunit.<sup>7</sup> Studies on phytochemical investigations showed the leaves and rhizomes are rich in phenolic compounds.<sup>10</sup> It was reported to contain different cinnamic acid derivatives, coumarins and homovanillyl alcohol, some of the phenolic compounds were studied in derivatized form using trimethyl silyl esters in GC-MS analysis.<sup>11</sup> The derivatization of phenolic compounds yielded 34 compounds and structures were interpreted by using mass fragmentation, retention time and compared with commercially available compounds. Some of the compounds were identified as homovanillyl alcohol, vanillin, vanillic acid, (+) isolaricininresinol, (-) secolaricininresinol. Methylated derivatives of phenolic compounds and flavonoids from *U. dioica* and with other plants were prepared by using methyl iodide, and subjected chromatographic analysis. Based on derivatization, GC-MS analysis of *U. dioica* methanolic leaf extract resulted in the presence of 3.0 ng/mg of homo vanillic acid, 2.5 ng/mg of vanillic acid, 43.65 ng/mg of 4-hydroxy cinnamic acid and 574 ng/mg of ferulic acid.<sup>27</sup>

Aqueous extract of *U. dioica* leaves yielded two major fractions on preparative HPLC analysis using Sephadex column. One of the fractions was found to contain a mixture of carbohydrates and proteins called glycoprotein.<sup>28</sup> Blumenthal *et al.*, were made an attempt to study the link between protein and carbohydrate by hydrolysing with sodium hydroxide and sodium borohydride. Results indicated that the protein and carbohydrate are connected with *via* serine and O-galactosidic linkages, further methylation indicated the nettle glycoproteins were branched and indicated the presence of 3,5 and 2, 5 di-o-methyl arabinose is linked with 1-2, 1-3 and 1-4/5 arabinose, whereas unbranched galactose are connected mainly 1-3 and some 1-4 and 1-6 linkages. However the second fraction was unsuccessful in its methylation process.<sup>28</sup> The roots of *U. dioica* showed the presence of trans neo-olivil, a lignans glycoside.<sup>29-33</sup>

The leaves of *U. dioica* were used in animal husbandry traditionally, various reports indicated the carotenoids and chlorophyll are used to improve full productive of animals.<sup>34</sup> The traditional methods for extraction from plant material include steam distillation, soxhlet percolation using organic solvents, perhaps these procedures have lots of disadvantages such as degradation, loss of biologically active compounds, duration etc. Sovova *et al* utilized supercritical fluid extraction using liquid CO<sub>2</sub> in order to isolate carotenoids and chlorophyll from the leaves of *U.*

*dioica*.<sup>35</sup> HPLC analysis of extracts resulted maximum yields of chlorophyll a, chlorophyll b, beta carotene, and lutein. This report evidenced the presence of abundant chlorophyll and beta carotene in the leaves of *U. dioica*.

## CONCLUSION

*U. dioica* have rich medicinal value and this plant is most commonly used to cure much of inflammatory disorders. In folk medicine this plant

was used for the treatment of arthritis and this plant is showed presence of antiasthmatic, antidandruff, astringent, depurative, diuretic, galactogogue, haemostatic and hypoglycaemic activities in pre-clinical experiments. This plant has been long used in traditional medicine and food supplement by native Americans and Europeans. The biological activities on traditional claims about this plant are not clear. Exploration of pharmacological and toxicological properties of *U. dioica* and its phyto constituents are required to support its traditional claim.

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