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AN OVERVIEW OF STINGING NETTLE (*URTICA DIOICA*)

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Abstract: *Urtica dioica* is known as stinging nettle and a medicinal herb from ancient time. The medicinal uses were very much familiar to Europe, Rome, Asia and Egypt. It has been used to treat a vast variety of diseases ranging from heart diseases, disorders related to nervous system, skin problems, bowel related diseases, arthritis etc. from hundreds of years. It has also been shown to have vitamins and antioxidants, some metals and minerals. There are a variety of class of compounds are reported from *Urtica dioica* including essential oils, vitamins etc. All parts of the plant have medicinal value. Other than these biological activities, it has the property of growth promoter in farmed fish. It is available in different forms for consumption like nettle tea, juice, tincture, extracts and dry powder.

***Keywords*- Traditional medicine, biological activities, vitamins, antioxidants, nettle plant.**

INTRODUCTION

Urtica dioica is native to Europe, temperate region of Asia and western North Africa. Nettle plant is very common and grow in damp, well fertilized land and along the lake and river side. It grows all over the world and flowers between June and September. The height of the plant is between 2 to 4 feet. The plant leaves have hair like projections having chemical compounds which cause itching and pain and stick to us whenever we touch them. Previous researches have shown this plant to have a variety of chemical compounds which include natural phenolic compounds, such as flavonoids, phenolic acids, anthocyanins, and other phenols, vitamins, polysaccharides, terpenoids, sterols, fatty acids, carotenoids, amino acids, minerals, lectins, coumarins, some metals, glycosides, ceramides, flavones, lignans and many others. Stinging nettle has been reported to show a range of biological activities such as hepatoprotective, antidiabetic, antihyperlipidemic, antioxidant, antiviral, antimicrobial, anticancer, diuretic, anti-inflammatory, analgesic, antiarthritic, hypotensive, immunomodulatory, anthelminthic, antimicrobial and many more. Ethnomedicinal uses of Urtica in different regions have been compiled in review[1]. In Europe it was used as a diuretic and to relieve pain and in India it has been used in treatment of eczema, nosebleeds, skin eruptions, uterine haemorrhages. Leaves of *U. dioica* possess sharp spines with stinging hairs, which cause irritation due to formic acid, and biochemical mediators such as histamine, 5-hydroxytryptamine (serotonin), acetylcholine, and leukotrienes[1,2]. Various researchers have reviewed[1,3-6] the phytoconstituents and pharmacological properties and uses.

CHEMICAL CONSTITUENTS

Essential oil

Chemical composition of the essential oil of Urtica dioica growing wild in Romania has been studied by D. C. Ilies et al[8]. They have reported the presence of Benzaldehyde, 3-Octanone, 2-Pentylfuran, *n*-Octanal, 2,2,6-Trimethylcyclohexanone, 2-(1-Pentenyl)furan, Nonanal, 3,5-Dimethyl-1,2,4-trithiolane, Camphor, Borneol, Menthol, Decan-2-one, Safranal, 2,4,6-Trimethyl-5*H*-1,3,5-dithiazine, Decanal, Cyclocitral, Homocyclocitral, Bornyl acetate, Thymol, Carvacrol ,Longipinene, Caryophyllene, Ionone, Geranyl acetone, Humulene, Ionone, Selinene, Bisabolene, Cadinene, Cadinene, Vetivenene, Copaene-8-ol,5,6-Dihydro-4-pentyl-2,6-dimethyl-4*H*-1,3,5-dithiazine, Isopropyl dodecanoate, Farnesol, Hexahydrofarnesylacetone, Farnesylacetone, Methyl palmitate, Apoatropine, Phytol in the essential oil extracted from aerial parts of *Urtica*. The main components of essential oil of *U. dioica* are carvacrol, carvone, naphthalene, (E)-anethol, hexahydrofarnesyl acetone, (E)-geranyl acetone, (E)-β-ionone and phytol as reported by Gul et al[9]. 9-oxononanoic, hydroxycinnamic, and vanillic acids, free fatty acids, and vanillin, eugenol, apiol, squalene, etc have been reported[10] in addition to other compounds.

Flavonoids

A comprehensive comparative study of dioecious nettle growing both in mountainous areas and in the suburbs of Tashkent was conducted by Raimova et al[11]. Flavonoids such as 2-phenyl 4-benzopyrone, quercetin, hyperin, and apigenin in addition to hyperoside have been reported[12] from ethyl acetate fraction of *Urtica* extract. Beta-sitosterol, trans-ferulic acid, dotriacotane, erucic acid, ursolic acid, scopoletin, rutin, quercetin and p-hydroxylbenzalcohol have been reported from *Urtica*. Flavonoids in *Urtica* generally occur as O-glycosides. All glycosides identified on the basis of their UV/ Vis spectra were flavonol derivatives of quercetin, kaempferol, and isorhamnetin. Many hydroxycinnamoyl-quinic acid conjugates, such as caffeoyl-, feruloyl-, and p-coumaroyl-quinic acids were detected[13] in addition to novel amino acid conjugates such as caffeoyl-threonine. Flavonol glycosides quercetin-3-O-glucoside, quercetin-3-O-rutinoside, isorhamnetin-3-O-rutinoside, and kaempferol-3-O-rutinoside and the phenolic acids 5-O-caffeoylquinic acid, 3-O-caffeoylquinic acid, 5-O-feruloylquinic acid and 2-O-caffeoylmalic acid were identified[14]

Phenolic compounds

Conjugates of hydroxycinnamic acids with quinic acid, malic acid, glucose, and benzoic acids were reported previously from *Urtica*[15]. Many hydroxycinnamoyl-quinic acid conjugates, such as caffeoyl-, feruloyl-, and p-coumaroyl-quinic acids were detected[13] in addition to novel amino acid conjugates such as caffeoyl-threonine. A study on the leaf composition of Urtica revealed[16] the presence of hydroxycinnamic acid derivatives as the most representative constituents, with a 2-caffeoilisocitric acid cyclodimer described for the first time, besides four C-glycosylated flavones, bearing a 3-hydroxy-3-methylglutaryl function. Dihydroxybenzoic acid hexosides esculin (esculetin (6,7-dihydroxycoumarin) glucoside), an hexoside of p-coumaric acid (caffeic acid herein 2-caffeoylisocitric and 2-p-coumaroylisocitric acids were tentatively identified a deep study of their TOF-MS2 fragmentation patterns TOF-MS and MS2 data. *U. dioica* leaves revealed the presence of scopoletin, gentisic acid, proto-catechuic acid, quinic acid, esculetin, quercetin and rutin. The presence of phenolics, 5-O-caffeoyl-quinic acid (chlorigenic acid), quercitin 3-O-rhamnosylglucoside (rutin) 3- O-glucoside (isoquercitrin) and diacanol (new phenol derivative) in the aqueous methanolic extract of infloresence of the *Urtica dioica* species had been reported[17,18]. Krauss and Spitteler identified[19] eighteen phenolic compounds (including homovanillyl alcohol, vanillin, vanillic acid and phenylpropanes. Para Hydroxybenzoic acid, Phenylpropanes, Gentisic acid, Protocatechuic acid, vanillic acid, Quinic Acid, Ferulic acid, para coumeric acid, caffeic acid, chlorogenic acid, 5-O-caffeolylquinic acid. The shikimic acid derivatives like phenylpropanes, caffeic acid and various esters of this acid such as chlorogenic acid and caffeoyl malic acid have been identified[14]. In *U. dioica* samples neochlorogenic acid, chlorogenic acid and caffeoylmalic acid together with the rutinosides and glucosides of quercetin, kaempferol and isorhamnetin could be detected by Bucar et al[15]. Caffeic acid derivative, p-coumaric acid, caffeoylquinic acid, chlorogenic acid, 2-O-caffeoylmalic acid, rutin, quercetin 3-O-glucoside, kaempferol 3-O-rutinoside, isorhamnetin 3-O-rutinoside, peonidin 3-O-rutinoside, peonidin 3- O-(6″-O-p-coumaroylglucoside rosinidin 3-O-rutinoside were separated and identified HPLC-DAD and HPLC-MS analysis[20]. Scopoletin, a coumarin derivative, has also been identified in nettle plant roots[21].

Carotenes

Lutein, lutein isomers, β-carotene and β-carotene isomers were the major carotenoids found in Urtica dioca[22] including xanthophylls, neoxanthin, violaxanthin and lycopene. The carotenoid such as β- carotene, hydroxy- β- carotene, lutoxanthin, lutein epoxide and violaxanthin are reported[14].

Fatty acids and sterols

Various oxygenated unsaturated fatty acid fatty acids such as 9,12,15-octadecatrienoic acid, s 9-hydroxy-10,12-octadecadienoic acid, 9-hydroxyoctadecatrienoic acid have been detected[13] in *Urtica*. Fatty acid analysis had screened presence of Linoleic acid (44.29%) and Oleic acid (34.93%) in the seed oil of *Urtica dioica*. Fatty acids especially palmitic, cis-9,12-linoleic and-linolenic acids were reported[22,23] in nettle plant. Phytosterols[13,18] isolated are lupeol, neophytadiene, phytol, stigma-4-en-3-one and β-sitosterol.

Pyrazine and pyrazole derivatives

Pyrazine and pyrazole derivatives were detected[10] for the first time including 4- ethyl- 4, 5- dihydro- 5- propyl- 1H-pyrazol- 1-carboxaldehyde isomers (I) and derivatives of hexahydropyrrolo- [1, 2-a]pyrazin- 1, 4-dione (II) with -3-alkyl and -3-phenylmethyl substituents in addition to 5, 10-diethoxy-2, 3, 7, 8- tetrahydro-1H,6H- dipyrrolo[1,2-a;1′,2′-d]pyrazine.

Amino acid

Analysis of amino acids shows presence of aspartic acid, asparagines, glutamic acid, alanine, and threonine in homeopathic matrix tincture of Urtica dioica. Histidine was also identified[10,18] in the tincture, indicating that the amino acid is in bound form. Aspartic acid and Alanine amino acids were isolated from the root extract. Arginine, isoleucine and leucine dominated among the free amino acids. An unusual lectin has been isolated[24] from *Urtica dioica* L. rhizomes. It is a small (8.5 kDa) monomeric protein with high contents of glycine, cysteine and tryptophan.

Lignans.

Lignans have been reported[25] in U. dioica root. A lignan glycoside in *U. dioica* root was identified as neo-olivil glycoside. Megastigmane and 2-pinene-9-ol, were identified[13] as minor glycosidic compounds, present at trace levels. Polar extracts of the stinging nettle (*Urtica dioica* L.) roots were screened to have lignans (+)- neoolivil, (-)- secoisolariciresinol, dehydrodiconiferyl alcohol, isolariciresinol, pinoresinol, and 3, 4-divanillyltetrahydrofuran. These compounds were isolated[26] from *Urtica* roots. Nineteen lignans (including isolaric, iresinol, secoisolariciresinol andneoolivil) were isolated in root extracts[19]. 7-hydroxylariciresinol-7-O-hexosideneo-olivil 9-O-hexoside were tentatively identified[16] from *Urtica*.

Vitamins

Thiamine Vitamin B1, riboflavin Vitamin B2, pyridoxine VitaminB6, A nicotinic acid.nicotinic Vitamin PP, folic and ascorbic acids Vitamin C were identified[11] and determined in water extracts and alcoholic extracts of Nettle plant. The highest content of thiamine is 0.089 mg/g and ascorbic acid is 5.864 mg/g were found. In alcohol extraction, the content was found to be relatively small.The leaves are rich in Vitamins B, C, K and minerals such as calcium, iron, magnesium, phosphorus, potassium and sodium[27].

Macro and microelement composition

Studies on content of macro- and microelement composition of the aerial part of the plant *Urtica dioica*, collected in late spring and early summer, showed that it contains more than 25 elements, of which 34% are essential, 21% are salts of heavy metals and 45% are other elements. K, Ca,Mg, Na, Fe,Ba, Mn, Li, Bi, Ni were the major micronutrient found of which highest content of macronutrients was potassium and calcium. The content of salts of toxic heavy metals such as mercury, arsenic, cadmium, and lead were also determined. Cu, Pb, As, Zn content were determined[11]. The highest content of heavy metals was found to be of zinc, its content was 0.0813 mg/kg, and with the minimum copper content is 0.0271 mg/kg. The quantitative analysis of the composition of macro- and microelements, heavy metals was studied by the method of optics – emission spectrometry with inductively coupled argon plasma (ICP OES)

Biological Activities

Stinging nettles have traditionally been used to relieve pain and inflammation as a folk medicine in various regions. This has further been supported by various research reports which showed them to have anti-inflammatory, analgesic activities[28-30]. The aqueous and methanolic extracts of the stinging nettle plants showed antidiabetic activity[31-34] in induced diabetic rats in different experiments by Bnouham M et al, Ahangarpour A et al and Al Wasfi RM et al. The alcoholic and aqueous extracts of the plant have shown antihyperlipidemic activity[35-37] in rats. Hypotensive Effects have been reported[38] in various researches in the aqueous extracts of the nettle plant. Significant immunomodulatory activity[39] has been shown in ethanolic and aqueous extracts of plant. This activity has been attributed to the presence of the compounds quercetin-3-O-rutinoside, kaempherol-3-O-rutinoside and isorhamnetin-3-O-glucoside in the extract of plant. other biological activities reported from *Urtica* are Hepatoprotective Activity[40-42], Antiviral Activity[43-45], Antimicrobial Activity[46-49], Anthelmintic Activity[50-51], Anticancer Activity[52-53] and Antifungal activity[54]. Antimicrobial activity in Urtica reported by various researchers has been compiled by Kreigel et al[7]. It is also reported to have anti-ulcer activity[55]. Effect on Benign Prostatic Hyperplasia has also been studied. The effect of Urtica dioica root on testosterone induced BPH has been studied by invitro studies for assessing the 5α-reductase inhibitory potential[56-57]. The study of Konrad et al[58,59] is the first to demonstrate the beneficial immunomodulatory effect of *U. dioica* experimental Inflammatory Bowel Disease (IBD) in vivo. Yener et al[60] (2009) concluded that the seeds of *Urtica dioica* have a hepatoprotective effect with aflatoxicosis, probably acting through promoting antioxidant defence systems. He concluded that the seeds of *Urtica dioica* have a hepatoprotective effect in rats with aflatoxicosis, probably acting through promoting antioxidant defence systems. The long-term use of *Urtica dioica* is effective in the prevention of chronic murine colitis. According to a study a significant inhibition on adenosine deaminase (ADA) by an extract of *Urtica dioica* can be one of the mechanisms for the beneficial effect observed in prostate cancer[61]. It has also been found effective in Arthritis. Randall et al[62]. used fresh leaves nettle to relieve various joint pain (knee, shoulder, wrist, fingers, elbow, and back. The hydroalcoholic extract obtained from U. dioica has a significant wound-healing activity. the plant has shown to have potential diuretic effect[63, 64]

Industrial and domestic use of Urtica dioica

In addition to its use as traditional medicine, *Urtica* has also been used as feed and fodder for animals. It has also been used in textile industries for fibres and at some places for dyeing also. (Pinelli, P et al) It has been used as fertiliser and fungicide and insecticide. studies on dietary administration of U. dioica, both as a single herb or in combination with other herbs, to enhance growth and stimulate farmed fish immunity, thus enabling the fish to be more resistant against bacterial infections[65]. It has also been used in Cosmetics. Nettle plant has a very strong fibre and high fixed carbon[66]. Used in mouthwash, nettle is also effective against oral infections such as aphtha, gingivitis and tonsillitis[67]. External preparations like fresh nettle poultices are used in cases of acne and to alleviate arthritic and rheumatic pain[67]. Nettle preparations are also applied externally in hair care against dandruff and oily hair. Furthermore, the nettle roots, alone or associated with saw palmetto (Serenoa repens), are used as teas or extracts in mictional disorders due to benign prostatic hyperplasia[68].

CONCLUSIONS

There is a numerous study on the biological activities and commercial uses of stinging nettle. With its multiple uses covering a wide range of treatment of diseases and nutritional value, it is a boon for us. This encourages for the isolation and characterization of its bioactive molecules by various spectroscopic techniques. It has so many uses as traditional medicine and a nutritional supplement that it should be encouraged for cultivation as a commercial crop for its use as a valuable nutraceutical product. Further research may help in the development of new drugs and pharmaceuticals for various diseases.

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