International Research Journal of Pure & Applied Chemistry

21(17): 49-58, 2020; Article no.IRJPAC.61402
ISSN: 2231-3443, NLM ID: 101647669

Urtica dioica (Stinging Nettle): A Pharmacologically Important Medicinal Plant Species of Himalayan Region

Geeta Rawat[1*], Alka Bameta[1] and A. K. Gaur[1]

[1]Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, India.

Authors' contributions

This work was carried out in collaboration among all authors. Author GR designed the study, wrote the whole draft of the manuscript. Authors AB and AKG managed the analyses of the study and done the correction of the manuscript. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IRJPAC/2020/v21i1730265
Editor(s):
(1) Dr. Richard Sawadogo, Research Institute for Health Sciences Ouagadougou, Burkina Faso.
Reviewers:
(1) Dr. Jackson Godwin, Niger Delta University, Nigeria.
(2) Muhammed Mizher Radhi, Middle Technical University, Iraq.
Complete Peer review History: http://www.sdiarticle4.com/review-history/61402

Review Article

Received 19 July 2020
Accepted 23 September 2020
Published 07 October 2020

ABSTRACT

Urtica dioica (Stinging nettle) belonging to the family Urticaceae is a medicinal plantfound in the Himalayas region from Kashmir to Kumaon region (Uttarakhand.). In Himalayan region, this plant is used for the daily purpose as food as well as to serve animals. It contains various phytochemicals like phenolic acid, coumarins, flavanols, bioflavonoids, Flavan-3-ols etc which is used to cure many diseases like arthritis, constipation, Pulmonary, Liver, Intestine, Kidney, Diabetes, Fungal infections, anti-inflammatory, internal injury and wounds. It also has hepatoprotective activity, anti□hyperlipidemic activity, diuretic activity, antimicrobial activity, anticancer activity. Researchers have reported about 30 species with 47 genera and 1,300 species worldwide used to treat different diseases. Medicinal plants have proved to be the "backbone" of traditional medical system which signifies that developing countries depend upon medicinal plants for therapeutic use.

Keywords: Diseases; medicinal plants; phytochemicals; therapeutic; traditional medical system.

**Corresponding author: E-mail: mgeetarawat@gmail.com;*

TAXONOMY

Kingdom: Plantae; Phylum: Spermatophyta; Subphylum: Angiosperm; Class: Dicotyledonae; Order: Urticales; Family: Urticaceae; Genus: Urtica; Species: Urtica dioica.

1. INTRODUCTION

Medicinal plants play an important role in healthcare. Nowadays, they have become a source of income for many people. They reflect a rich resource of ingredients used for drug development and synthesis, pharmaceuticals, medicines, nutraceuticals throughout global population.Medicinal plants are used as raw materials for extraction of active ingredients which may be used in the synthesis of different drugs. Innovative properties of natural substances are generally herbal in origin. Extracts of this plant can be used for the curing of several diseases caused due to the variations in different factors like environment, life style, gene level etc. Researchers have focused on natural products, derived from different parts of plants under different environmental conditions.

Urtica dioica (Stinging nettle) belongs to the family Urticaceae, reported as tetraploid 2n=56 by [1] whereas subsp. *dioica* reported by [2] tetraploid having 2n=48 or 52. *U. dioica* is found in many cooler temperate and tropical parts of the world like in Africa, the Americas, Asia, Australia and Europe. It is basically found in the Himalayas from Kashmir to Kumaon at altitudes of 2,100-3,200 m [3]. In Himalayan region, this plant is used for the daily purpose as vegetable as well as to serve animals. In Kumaon folk language it is called Shisuun. The leaves and stems of this plant contain needle that injects several chemicals including acetylcholine, histamine, 5-HT (serotonin), moroidin, leukotrienes and formic acid [4,5]. Both leaves and stem of this plant are covered with hairs which contain formic acid and histamine which causes unpleasant effects. The sting present on this plant causes redness, itching, bumps and irritation to the skin. Free radical-scavenging action and wound healing process are reported by many researchers [6].

2. BOTANICAL DESCRIPTION

Genus *Urtica dioica*is an erect dioecious herbaceous perennial herb, which reproduces through seed and creeping underground rhizomes. *Urtica dioica* is an aggressive weed usually found in moist soils throughout the Europe and USA [7]. Flowering and fruiting time are from June to October. Rhizomes are cylindrical and tapering, occasionally branched, about 6 mm thick at upper end. Root is grayish brown, irregularly twisted, about 5 mm thick, hollow crossed section, fibrous and tough. Flowers are generally green that blooms from summer into late fall present clusters on strands (Fig. 1). Male and female flowers on separate plants [8]. Panicle inflorescence present, each 2–8 cm long [9,10]. Various plant parts of this plant are described in Table 1. Stinging hairs cover the stem and leaves of the plant. When touched, it injects several chemicals including acetylcholine, histamine, 5- hydroxytryptamine (serotonin), leukotrienes which cause skin irritation and pain [3,4]. Stinging hairs can be destroyed by cooking prior to ingestion. Seeds of this plant reveal physiological dormancy, require a prolonged stratification time to become softer the hard seed coats and break the physiological dormancy [11]. This plant grows in waste places, roadsides, stream banks and ditches, predominantly in nitrogen rich soil.

Chart 1. Description of plant parts

S.No.	Plant parts	Description
1.	Leaf	Opposite, cordate, pointed leaves, covered with stinging trichomes, leaves are bright green color.
2.	Stem	Stem is erect, hollow to solid, fibrous and tough, mostly simple or branched containing stinging hairs approx 1 mm long
3.	Rhizome	Rhizomes are cylindrical and surface is yellowish–brown, Numerous in number
4.	Root	Root is brown, irregularly, fibrous and tough
5.	Flowers	Monoecious, both sexes are present on the plant, Inflorescence is four per node

Fig. 1. Plant parts of *Urtica dioica*(a) whole plant (b) stem with sting hairs (c) leaf (d) roots (e) flowers

3. SPECIES

Researchers reported that there are a number of species belonging to *Urtica* dioica. Many groups of researchers have reported about 30 species with 47 genera and 1,300 species worldwide given in Table 1 [12,2, 13]. These species are widely distributed throughout the world. These species are medicinally well known throughout the world and locally used for consuming as food and used against various diseases. Many surveys regarding various species of Urtica reflect that the genus is medicinally very important due to bioactive compounds. The species of Urtica were employed for the treatment of various ailments like Hepatoprotective Activity, Anti-hyperlipidemic Activity, Diuretic Activity, Antimicrobial Activity, Anticancer Activity allergy, rheumatoid arthritis, cough etc by the local people.

Table 1. Various species of *Urtica*

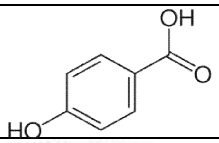
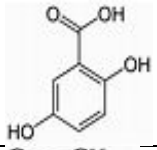
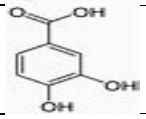
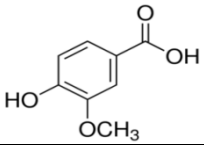
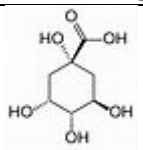
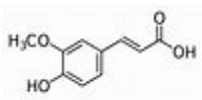
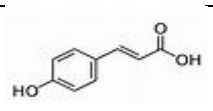
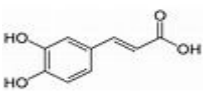
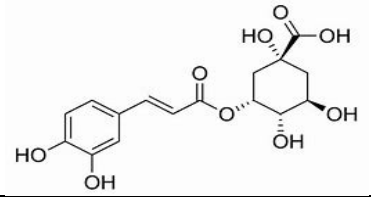
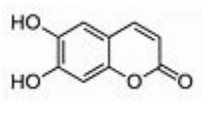
S.NO.	Species of *Urtica*	Diseases	References
1	*Urtica dioica*	Arthritis, constipation, pulmonary, liver, intestine, kidney, diabetes, fungal infection, anti-inflammatory, internal injury, wounds, Hepatoprotective Activity, Anti□hyperlipidemic Activity, Diuretic Activity, Antimicrobial Activity, Anticancer Activity	[2],[14], [15], [16]
2	*Urtica incaica*	Arthritis, antiinflammatory	[2], [15]
3	*Urtica deltoidea*	Arthritis, antioxidant, anti-ulcer, anti-inflammatory, anticancer, antimicrobial, cardiovascular, and hepatic protective	[15], [17]
4	*Urtica atrichocaulis*	Rheumatoid arthritis, anti-inflammatory, anti-arthritic, antioxidant and immunomodulatory	[2], [18]

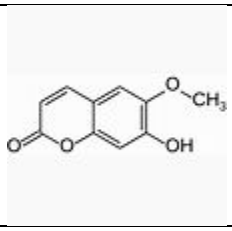
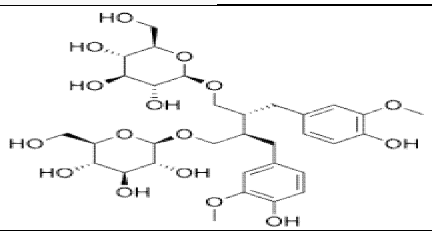
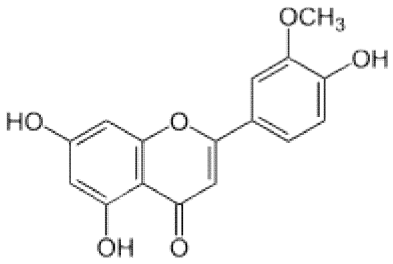
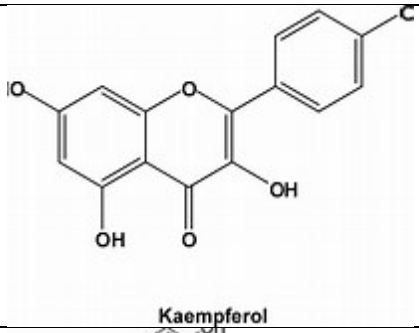
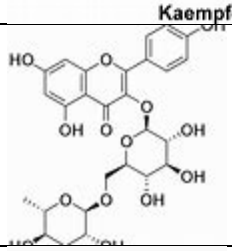
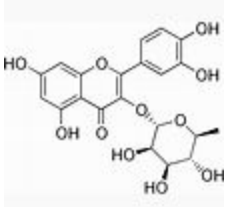
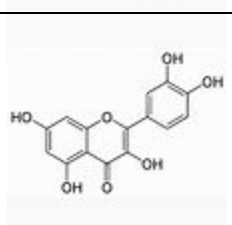
S.NO.	Species of *Urtica*	Diseases	References
5	*Urtica magellanica*	Eczema, gout, urticarial, allergic rhinitis and rheumatoid arthritis	[19]
6	*Urtica longispica*	Fungal infection, antibacterial, antiviral, blood purification, respiratory diseases.	[17]
7	*Urtica pera*	Leucorrhoea, Haemorrhoids, obesity, oligomenorrhoea, gastric ulcers, anti-cholesterol	[20]
8	*Urtica gracilenta*	Anti-inflammatory, arthritis, hyperplasia, fungal infections	[16]
9	*Urtica mairei*	Kidney, diabeties, fungal infections, anti-inflammatory and arthritis.	[15], [16]
10	*Urtica parviflora*	Antitumor, astringent, diuretic, inflammation and arthritis.	[21], [22]
11	*Urtica ardens*	Exorcism, jaundice, sprains, bones fracture, hematuria, neck sore	[16], [22]
12	*Urtica pilulifera*	Inflammation, arthritis, internal bleeding, anemia, excessive menstruation, hemoorrhoids, rhematism, hay fever, kidney problems, pain and skin problems, abdominal pain, antiasthma, antitumor, antidandruff, antihyperglycaemia	[2]
13	*Urtica fissa*	Rheumatoid arthritis	[2]
14	*Urtica dentate*	Rheumatoid arthritis, kidney stones, ant lithic effects	[2], [23]
15	*Urtica sondenii*	Diabetes, fungal infections, anti-inflammatory, arthritis	[15], [16]
16	*Urtica taiwaniana*	Anti-hyperglycemia, antioxidant, hepatic protective, antiviral, diuretic, hypotensive	[24]
17	*Urtica triangularis*	Fungal infections, anti-inflammation, arthritis	[23]
18	*Urtica australis*	Diabetes, eczema, fungal infections, anti-inflammatory, arthritis	[15]
19	*Urtica laetevirens*	Rheumatoid arthritis, rheumatism, eczema, allergic rhinitis	[2], [7]
20	*Urtica massaica*	Eczema, skin rashes, dermatitis and diuretic	[14], [15]
21	*Urtica ferox*	Anti-hyperglycemia, antioxidant, hepatic protective, antiviral, diuretic, hypotensive	[20], [22]
22	*Urtica hyperborea*	Dermatitis, eczema, diuretic	[14]
23	*Urtica andicola*	Anti-hyperglycemia, antioxidant, hepatic protective, antiviral, diuretic, hypotensive	[2]
24	*Urticaflabellata*	Anti-hyperglycemia, antioxidant, hepatic protective, antiviral, diuretic,hypotensive	[25]
25	*Urticastachyoides*	Anti-glycemia, antioxidant, hepatic protective, antiviral, hypotensive	[2]
26	*Urticalalibertadensis*	Anti-hyperglycemic, antioxidant, hepatic protective, antiviral	[26]
27	*Urticaatrovirens*	Anti-hyperglycemia, antioxidant, hepatic protective, antiviral and arthritis	[14]
28	*Urticakioviensis*	Hepatic protective, antiviral, arthritis	[22]
29	*Urticaleptophylla*	Arthritis, fungal infections and antimicrobial	[2]
30	*Urticaurens*	Arthritis	[2]

4. CHEMICAL CONSTITUENTS

Mostly known chemical constituents present in thisplantare flavonoids, tanins, volatile compounds and sterols [27], [28]. This plant also contain starch, sugar, gum, resins, neurotrans-mitters, histamine, choline, acetylcholine, coumarin derivative, and also lignans that improve immune responses Table 2. There are various factors like soil, moisture, harvest time, treatment environment etc which effect the chemical compositions of this plant [29], [30],[31].

Table 2. Chemical constituents

S.No.	Constituents	Compound	Structure	Molecular formula
1.	Phenolic acids	p-Hydroxybenzoic acid		$C_7H_6O_3$
		Gentisic acid		$C_7H_6O_4$
		Protocatechuic acid		$C_7H_6O_4$
		Vanillic acid		$C_8H_8O_4$
		Quinic acid		$C_7H_{12}O_6$
		Ferulic acid		$C_{10}H_{10}O_4$
		p-Coumaric acid		$C_9H_8O_3$
		Caffeic acid		$C_9H_8O_4$
		5-O-Caffeolylquinic acid		$C_{16}H_{18}O_9$
2.	Coumarins	Esculetin		$C_9H_6O_4$

		Scopoletin		$C_{10}H_8O_4$
3.	Lignans	Secoisolariciresinol		$C_{32}H_{46}O_{16}$
4.	Flavones	Chrysoeriol		$C_{16}H_{12}O_6$
5.	Flavonols	Kaempferol		$C_{15}H_{10}O_6$
		Kaempferol 3-O-glucoside		$C_{27}H_{30}O_{15}$
		Quercitrin		$C_{21}H_{20}O_{11}$
		Quercitrin 3-O-glucoside		$C_{15}H_{10}O_7$

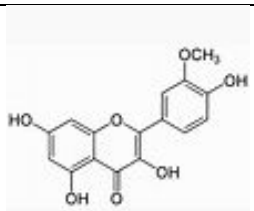
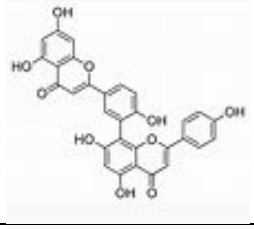
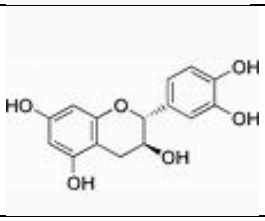
	Isorhamnetin		$C_{16}H_{12}O_7$
6. Biflavonoids	Amentoflavone		$C_{30}H_{18}O_{10}$
7. Flavan-3-ols	Catechin		$C_{15}H_{14}O_6$

Table 3. Pharmacological properties

Pharmacological properties	Effects	References
Antioxidant Activity	Extract of *Urtica dioica* have substantial antioxidant potential and prevent damaging effect.	[34]
Antidiabetic Activity	Role of leaf extract on heightening of insulin secretion so by which decreasing the blood sugar level.	[35]
Hepatoprotective Activity	Report analysis shows that this plant leaves extractsdecreasesthe level of serum alkaline phosphatase (ALP), malonyldehyde (MDA), alanine transaminase (ALT), aspartate aminotransferase (AST), as well as a significant increase in superoxide dismutase (SOD) level. [10,68]	[36], [37]
Anti‐hyperlipidemic Activity	Plant have role onanti-hyperlipidemic activity because some reports showsblood lowering level of lipids and lipoprotein.	[38]
Diuretic Activity	Aqueous extract of U. dioica produced a significant increase in urine flow(diuretic) and an increase in the urinary excretion of Na+ (natriuretic effects).	[39]
Antimicrobial Activity	Plant extract reported for antimicrobial activity against many bacteria.	[40]
Anticancer Activity	Aqueous extract of the plant roots causes inhibition of the globulin binding to its receptor and directly inhibits cell proliferation of HeLa cells and block binding of epidermal growth factor to its receptor.	[41] [96]
Hypotensive Effect	Aqueous extract of this plant reported that it decreases the blood pressure.	[42]

5. PHARMACOLOGICAL PROPERTIES

Many reports give an idea about the pharmacological properties of *U. dioica* such as Antidiabetic Activity which maintain the sugar level in body, Hepatoprotective Activity, Anti-hyperlipidemic Activity, Anticancer Activity, antibacterial, antioxidant property which prevent damaging effect, and antiviral activities Table 3 and also used as a remedy for the treatment of diarrhoea, vaginal discharge, internal and external bleeding [32]. Dried extracts of this plantare also used to relieve asthma and similar bronchial troubles by inhalation and therapy for chronic hepatitis, cholangitis, cholecystitis and habitual constipation [33].

6. CONCLUSION

The information presented in this review has shownthe botanical description, properties of different speciesworldwide, various chemical constituents and pharmacological properties. *U. dioica*has rich medicinal value. Many reports also give an idea about thepharmacological properties of *U. dioica* such as antidiabetic activity which maintain the sugar level in body, hepatoprotective activity, anti‐hyperlipidemic activity, anticancer activity, antibacterial, antioxidant property which prevent damaging effect, and antiviral activities which can be used for further studies.Flavonoids, tanins, neurotransmitters, histamine, choline, acetylcholine, coumarin derivativeare some of the chemical constituents which found in this plant that improves immune responses which may have scope of future research work.Till now, no study is available leading to pure active components for particular disease, hence; there is scope for research work leading to commercial utilization of the *Urtica dioica* L. in near future.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Stace C. New flora of the British Isles. 3rd edition. Cambridge, UK: Cambridge University Press. 2010;1232.
2. Lahigi SH, Amini K, Moradi P, Asaadi K. Investigating the chemical composition of different parts extracts of bipod nettle *Urtica dioica* L. in Tonekabon region. Journal of Physiology. 2011;2(1):337-340.
3. Klaassen Curtis D, Mary O. Amdur, eds. Casarett and Doull's toxicology: The basic science of poisons. New York: McGraw-Hill. 2013;1236.
4. Greenberg MI. Occupational, industrial, and environmental toxicology. Elsevier Health Sci. 2003;180.
5. Süntar Ipek, et al. Wound healing and antioxidant properties: Do they coexist in plants? Free Radicals and Antioxidants. 2012;2(2):1-7.
6. Whitney PJ, Gibbs G, Biologist (London). 2006;53:178–182.
7. Farag MA, Weigend M, Luebert F, Brokamp G, Wessjohann L. A. Phytochemical, phylogenetic, and anti-inflammatory evaluation of 43 Urtica accessions (stinging nettle) based on UPLC–QTOF-MS metabolomic profiles. Phytochemistry. 2013;96:170-183.
8. Available:htpp://www.naturemanitoba.ca/sites/default/files/ StingingNettle.pdf [Last accessed on 2014 June 14].
9. Bisset NG. Herbal drugs and phytopharmaceuticals. Boca Raton: CRC Press. 1994;105.
10. British herbal pharmacopoeia. London: British Herbal Medicine Association; 1996.
11. Baskin CC, Baskin JM. Seeds: Ecology, biogeography, and evolution of dormancy and germination. Academic Press, San Diego. 1998;666
12. Jan H, Jan A, Shinwari ZK. Distribution of weeds in wheat fields of district Banu, Khyber Pakhtunkhwa Pakistan. Pakistan Journal of Weed Science Research. 2012; 18(3):393-411.
13. Lalitharani S, Mohan VR, Regini GS. GC-MS analysis of ethanolic extract of Zanthoxylumrhetsa (roxb.) dc spines. J Herbal Med Toxicol. 2010;4:191-2.
14. Alluri VK, Rao CBM, Sundararaju D, Sengupta K, Trimurtulu G. Anti-inflammatory activity of Urtica dioica bark extracts against arthritis in Sprague Dawley rat. Am. Journal of Infectious Diseases. 2009;5(2):68-73.
15. Tiwari JK, Ballabha R, Tiwari P. Ethnopaediatrics in Garhwal Himalaya, Uttarakhand, India (Psychomedicine and Medicine). New York Science. Jornal. 2010;3(4):123-126.
16. Kanakavalli K, Thillaivanan S, Parthiban P, Vijayalakshmi G, Sudha M, Sutha J. Anti-hyperlipidemic herbs in siddha system of medicine. International Journal of Pharmaceutical Science. 2014;4:541-545.

17. Corsi G, Masini A. Anatomical and ecological aspects in Italian taxa of the genus Urtica. Dipartimento di Scienze Botaniche. 1997;104(1):1-8.
18. Funayama S, Tanaka R, Kumekawa Y, Noshita T, oriI T, Kashiwagura T, Murata K. Rat small intestine muscle relaxation alkaloids from Orixa japonica leaves. Biological and Pharmaceutical Bulletin. 2001;24(1):100-102.
19. Newbould BB. Chemotherapy of arthritis induced in rats by mycobacterial adjuvant. British Journal of Pharmacology and Chemotherapy. 1963;21(1):127-136.
20. Gilani AH, Ghayur AN. Pharmacological basis for many activities of Urtica dioica leaves. Journal of Ethnopharmacology. 2004;95(3):169–172.
21. Yiiksel K, İlkay O, Ufuk K, Berrin O, Sinem A, Murat K, Senay K. Fatty acid profile and antimicrobial effect of theseed oils of Urtica dioica and U. PILULIFERA Turkish Journal of. Pharmaceutical Science. 2009;6(1):21-30.
22. Wang W, Yan XG, Duan LX, Zhou Y, Tang L, Wang YQ, Feng BM. Two new secolignans from the roots of Urtica maireiLevl. Chinese Chemical Letters. 2008;19(10):1212-1214.
23. Pande PC, Tiwri L, Pande HC. Ethnoveterinary plants of Uttaranchal-a review. Indian. Journal. Tradition. 2003; 6(3):444-458.
24. Kavalali G, Tuncel H. Anti-inflammatory activities of Urtica pilulifera. International Journal of Pharmacognosy. 1997;35(2): 138140.
25. Curtis C, Shah SP, Chin SF, Turashvili G, Rueda OM, Dunning MJ, Gräf S. The genomic and transcriptomic architecture of 2,000 breast tumours reveals novel subgroups. Nature. 2012;486(7403):346.
26. Huffman MA, MacIntosh AJ. Radical scavenging and ironchelating activities of some greens used as traditional dishes in Mediterranean diet. International Journal of Food Science. Nutrition. 2011;55(2):67–74.
27. Krystofova O, Adam V, Babula P, Zehnalek J, Beklova M, Havel L, Kizek R. Effects of various doses of selenite on stinging nettle (*Urtica dioica* L.). Int. J. Environ. Res. Public Health. 2010;7:3804-3815.
28. Gul S, Demirci B, Başer KH, Akpulat HA, Aksu P. Chemical composition and in vitro cytotoxic, genotoxic effects of essential oil from *Urtica dioica* L. Biol. Pharm. Bull. 2005;18(5):523-527.
29. eFloras.org. Available:http://www.efloras.org/browse.aspx?flora_id=0&name_str=urtica&btnSearch=Search (Accessed on 5 April 2018).
30. Plants for a Future. Earth. Plants. People. Available:https://www.pfaf.org/user/DatabaseSearhResult.aspx (Accessed on 5 April 2018).
31. Augspole I, Duma M, Ozola B, Cinkmanis I. Phenolic Profile of fresh and frozen nettle, goutweed, dandelion and chickweed leaves. In Proceedings of the 11th Baltic Conference on Food Science and Technology. Food Science and Technology in a Changing World, Jelgava, Latvia; 2017.
32. Tucakov J. Lecenjebiljem-fitoterpija. Beograd: Rad. 1997;405.
33. Kirtikar KR, Basu BD. Indian medicinal plants. 2nd ed. Dehradun: International book distributors. 2008;2340.
34. Jinous A, Mohajerani R. Phytochemistry and pharmacological properties of *Urtica dioica* L. J Med Plants Res. 2012;6:5714-9.
35. Farzami B, Ahmadvand D, Vardasbi S, Majin FJ, Khaghani Sh. Induction of insulin secretion by a component of Urtica dioica leave extract in perfused Islets of Langerhans and its *in vivo* effects in normal and streptozotocin diabetic rats. J Ethnopharmacol. 2003;89:47-53.
36. Kataki MS, Murugamani V, Rajkumari A, Mehra PS, Awasthi D, Yadav RS. Antioxidant, hepatoprotective and anthelmintic activities of methanol extract of *Urtica dioica* L. Leaves. Pharm Crops. 2012;3:38□46.
37. Sidana J, Deswal G, Nain P, Arora K. Liver toxicity and hepatoprotective herbs. Int J Pharm Sci Rev Res. 2011;9:121□61.
38. Daher CF, Baroody KG, Baroody GM. Effect of *Urtica dioica* extract intake upon blood lipid profile in the rats. Fitoterapia. 2006;77:183-8.
39. Dizaye K, Alberzingi B, Sulaiman S. Renal and vascular studies of aqueous extract of *Urtica dioica* in rats and rabbits. Iraq J Vet Sci. 2013;27:25-31.
40. Rawat G, Bameta A. Phytochemical determination and antibacterial activity of *Urtica dioica* leave extracts against isolated food borne bacteria. Int. J. Curr. Microbiol. App. Sci. 2019;8(12):1704-1712.

41. Durak I, Biri H, Devrim E, Sozen S, Avci A. Aqueous extract of *Urtica dioica* makes significant inhibition on adenosine deaminase activity in prostate tissue from patients with prostate cancer. Cancer Biol Ther. 2004;3:855-7.

42. Tahri A, Yamani S, Legssyer A, Aziz M, Mekhfi H, Bnouham M, et al. Acute diuretic, natriuretic and hypotensive effects of a continuous perfusion of aqueous extract of *Urtica dioica* in the rat. J Ethnopharmacol. 2000;73:95-100.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/61402