Review Article

Exploring the Diverse Ethnopharmacological Applications of *Urtica dioica* L.: An Extensive Review

Nabin Dhakal[1], Rajeev Joshi[1,*], Sagar Acharya[1], Sushil Bhandari[1], Anuska Subedi[1], Mohit Nath[2]

[1]*College of Natural Resource Management, Faculty of Forestry, Agriculture and Forestry University, Katari-56310, Udayapur, Nepal*
[2]*Purwanchal University College of Environment and Forestry (PUCEF), Gothgaun-56600, Morang, Nepal*

Citation Nabin Dhakal, Rajeev Joshi, Sagar Acharya, Sushil Bhandari, Anuska Subedi, Mohit Nath. Exploring the Diverse Ethnopharmacological Applications of *Urtica dioica* L.: An Extensive Review, Journal of Agricultural Sciences and Engineering, 2024, 6(2), 60-72.

https://doi.org/10.48309/jase.2024.192244

ARTICLE INFO

Received: 2024-10-31

Accepted: 2024-03-04

Checked for Plagiarism: Yes.

Checked for Language Editor: Yes.

Editor who approved publication: Editorial board

***Corresponding Author:**
Chong Tet Vun
(chongtv@mardi.gov.my)

Keywords:
Ethnopharmacology, Traditional uses, *Utrica dioica*.

ABSTRACT

Stinging nettle (*Urtica dioica*, Urticaceae) is a herbaceous plant that thrives abundantly in Asia, Africa, and Europe. It holds a rich history of traditional uses in both culinary and medicinal realms. Despite its widespread presence and versatility, the wild potential of this plant is often underestimated. To guide future research priorities and assess gaps in the current study landscape, a systematic literature review was conducted, covering 42 English-language journal articles published over a 23-year period (1999-2022). With its towering height of 1-2 meters and elongated leaves measuring 3-15 centimeters, stinging nettle typically features erect and unbranched stems. The tender young leaves are utilized in various culinary preparations, such as curries, herb soups, and sour soups. Furthermore, the plant's root is harnessed for addressing urinary difficulties associated with benign prostatic hyperplasia, while its leaves are applied in treating conditions like arthritis, rheumatism, and allergic rhinitis. This comprehensive review aims to explore various aspects, including traditional applications in food and medicine, ethnopharmacological attributes, antioxidant and nutrient properties, anti-inflammatory characteristics, reported functional food activities, and potential cardiovascular, and anticancer effects. Serving as a valuable resource, this review is intended to benefit scientists, farmers, and academicians involved in the collection, cultivation, research, and development of stinging nettle, providing updated insights for future endeavors.

Introduction

Urtica dioica L., commonly known as stinging nettle and belonging to the Urticaceae family, is a perennial medicinal plant [1]. It features an extensive sympodial system of rhizomes and stolons, rooting at the nodes, and giving rise to aerial shoots in spring, reaching heights of 1.5-2 m or occasionally even 3 m or more [2]. This plant is distributed in temperate regions across Asia, Europe, America, and certain cool regions of Africa, thriving at altitudes up to 1800 m [3]. In intensive agriculture, it is considered as a weed due to its rapid growth and high density, facilitating spreading and soil saturation [4]. According to Dreyer & MuÈssig (2000), stinging nettle is a perennial crop with satisfactory yields for 10-15 years, low input requirements, soil improvement capabilities for overfertilized soils,

and benefits for biodiversity. The dyeing, textile, and energy industries can also utilize stinging nettle to create new, high-quality raw materials [5]. In Nepal, where it is known as Sisnu, the plant is found between 500 meters and 4500 meters of elevation in damp places [6]. Contact with the stems and leaves of the plant causes the release of stinging trichomes that result in blisters, attributed to the presence of formic acid, acetylcholine, serotonin, and histamine [7].

Stinging nettle has been a wild vegetable for centuries [8]. Ethnomedically, it has been used for treating coughs, colds, cuts, wounds, and has documented importance in various ethnomedicinal studies [9]. The plant holds significant pharmacological importance, with its leaves and roots being used for blood purification, as emmenagogues, diuretics, nasal and menstrual drains, stiffness, skin irritation, iron deficiency, nephrosis, haematuria, jaundice, menorrhagia, and diarrhea [10]. Numerous pharmacological effects have been attributed to Urtica dioica, including antioxidant [11], anti-inflammatory, antiulcer [10], anti-colitis, antiviral [12], anticancer, antibacterial, antimicrobial, antifungal, antiandrogenic, insecticidal, immunomodulatory [13], hypocholesterolemic [14], hypoglycemic [15], cardiovascular effects [14], analgesic, natriuretic, hypotensive [16], hepatoprotective [17], and rheumatoid arthritis [18].

The main objective of this review article is to introduce an updated and comprehensive overview of the studies worldwide, as well as to present new data, with particular attention to ethnopharmacological applications of *Urtica dioica* with the aim of providing base support for the implementation of new projects and research activities.

Methods

A comprehensive literature review was conducted, encompassing all peer-reviewed journal articles published until 2022, utilizing four electronic databases: Google Scholar, Web of Science, Scopus, and Sci-Hub. The search employed a combination of terms such as *Utrica dioica*, *Utrica dioica* in Nepal, *Urtica dioica* ethnobotanical uses, or *Urtica dioica* in South Asia. The inclusion criteria focused on original research articles primarily investigating *Utrica dioica* and research articles analyzing *Utrica dioica* data from secondary sources (survey data and records) (see Figure 1). Although research findings on *Utrica dioica* are also present in books, conference proceedings, and grey literature, emphasis was placed on peer-reviewed articles in academic journals due to their high level of quality control and scientific credibility [19].

This approach helps ensure consistency in research standards and methodological details, including sampling and analytical methods [20]. Initially, 450 articles were generated, followed by screening for publication type, with only peer-reviewed journal articles being included. Subsequently, duplicates were removed, and the remaining articles were screened based on titles and abstracts, excluding those that did not primarily focus on *Utrica dioica.*

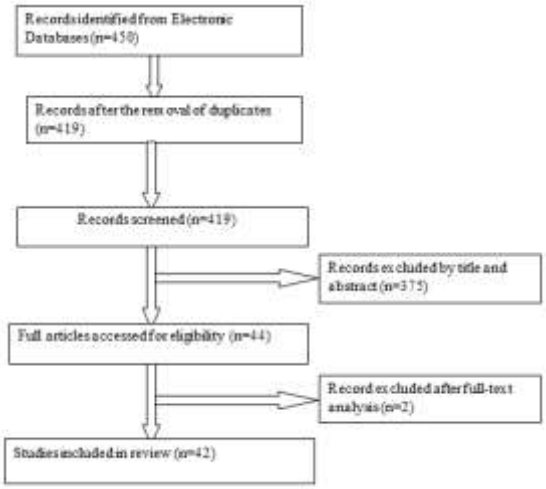

Figure 1. Flowchart of the study and steps followed during the review process

Results and Discussion

Trends of research on Urtica dioica: Yearwise

The publication of *Urtica dioica* as a journal article started in 1999. The number of publications published per year remained constant till 2012 and reached a maximum in 2022. Till 2012, the number of publications per year was (n=1) and in 2022, it increased to (n=8) (Figure 2; Annex 1).

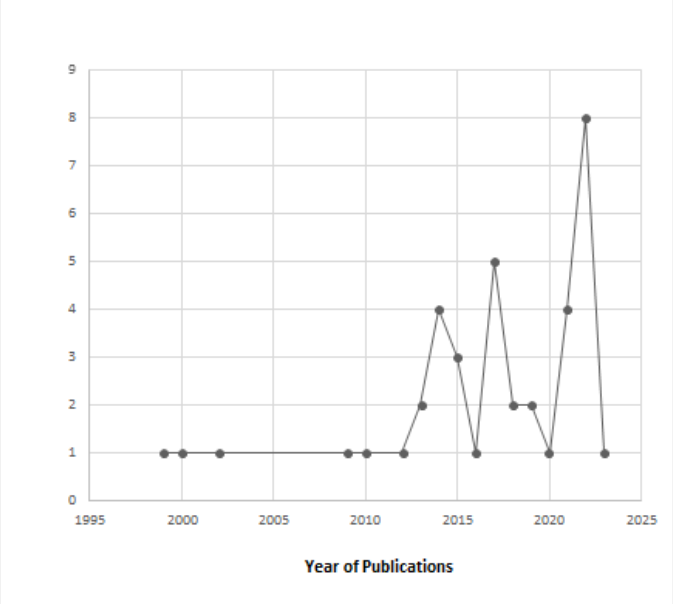

Figure 2. Graph showing year of publications vs. number of publications

Trends of research on Urtica dioica: Countrywise

India leads in the highest number of publications on *Urtica dioica* by country, followed by Nepal and others. Out of the 42 review articles, 9 are attributed to India, with 4 originating from Nepal, (as indicated in Figure 3; see detailed explanation in Annex 1).

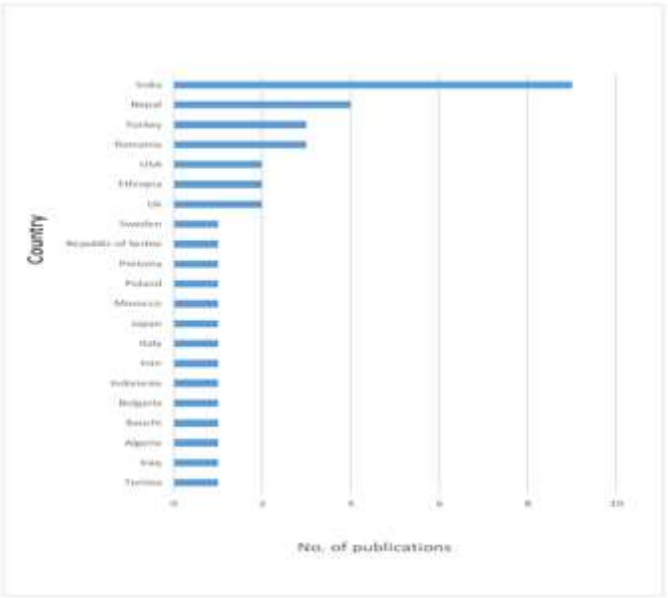

Figure 3. Bar diagram showing the number of publications vs. country

Uses

Traditional uses

Urtica dioica, a plant with a long history in household remedies and dietary practices, is commonly consumed in tea, salads, and vegetables [21]. In Nepal and India, people gather tender plant shoots and leaves using bamboo or iron pincers and boil them to make vegetables or soup [9]. Nettles are used in traditional veterinary treatments, energy enhancement, jaundice treatment, antihemorrhagic medicine, diarrhea, dysentery, and in menstrual flow and nasal bleeding [22]. Rural residents use this plant for colds, high blood pressure, and diabetes, as its peels manage sugar levels and act as a diuretic [23]. Stem juice in Nepal is utilized for fever relief, diuretics, astringents, emmenagogues, anthelmintics, cough, cold, jaundice, and asthma treatment [6]. Externally, the plant is used for neuralgia, hemorrhoids, sciatica, and hair problems [24]. The seeds, traditionally used for treating tuberculosis and kidney stones, are believed to have aphrodisiac and galactagogue properties when consumed orally [25].

Ethnopharmacology

U. dioica reduced carbon tetrachloride, and increased blood potassium and calcium levels, but decreased red platelets, platelet weight, pressed cell volume, and hemoglobin levels in pre-clinical animal trials [26]. In addition, studies highlighted the hepatoprotective effects of *U. dioica* in cases of carbon tetrachloride-induced cirrhosis and liver fibrosis [27]. The findings revealed the extract's efficacy in inducing GST, DTD, and SOD, along with CAT activity [28]. *U. dioica* fluid concentrations led to robust bradycardia via non-cholinergic and non-adrenergic pathways, potentially compensating for its vascular impact and contributing to its hypotensive activity [15].
The study confirmed the antioxidant, antimicrobial, antiulcer, and analgesic properties of *U. dioica's* aqueous concentrate, confirming its effectiveness in various medical conditions [16]. Another investigation found that *U. dioica* roots alleviate hypotensive effects by lowering vascular pressure [17]. *Urtica dioica* leaf tea is used as a cleansing tonic, blood purifier, and externally for treating skin conditions, gout, sciatica, hemorrhoids, neuralgia, and hair-related issues [10].

Antioxidant properties

An antioxidant is defined as "a substance that significantly delays or inhibits the oxidation of an oxidizable substrate when present in low concentrations relative to that substrate" [29]. Antioxidants play a crucial role in mitigating oxidative damage caused by free radicals in blood, cells, and tissue fluids [30]. The presence of flavonoids and phenolic compounds in plants endows them with natural antioxidant properties Several earlier studies have noted that nettle extract contains bioactive elements responsible for antioxidant activity [31]. (Semalty et al., 2010) explored the *in vitro* antioxidant activity of sequential methanolic and direct ethanolic extracts of Himalayan nettle roots [32]. Urtica root extract showed high free radical scavenging activity (46.71% and 45.03%) and a strong positive correlation between antioxidant activity and product antioxidant characteristics, indicating polyphenols' importance [33].

Nutrient properties

Urtica dioica, a nutritional powerhouse with high energy levels and abundant protein content, is a promising solution for addressing Protein Energy Malnutrition. The fresh leaves of Stinging nettle (*Urtica dioica*) can be utilized as a protein and fiber source in vegetarian, diabetic, or other specialized diets [34]. Sisnu ko saag, a popular form of the stinging nettle in Nepal, is known for its flavor, nutritional value, and therapeutic properties. The chemical composition of sisnu is influenced by geographic environments, as well as taxonomic, morphological, and genetic variables [35]. The nutrient content of sisnu includes Carbohydrate=7%, Protein=5.5%, and Fat=0.7-3.3% [36]. Despite its nutritional density and diverse medicinal properties [37], some experts categorize it as a weed species [38]. Adhikari *et al. (*2016) conducted a comparative analysis of the nutritional qualities of flour made from stinging nettle leaves and flour made from wheat and barley [39].

Inflammatory properties

Nettles have demonstrated efficacy in addressing various inflammatory disorders, including arthritis and chronic myalgia. Scientific investigations underscore nettle's ability to impede inflammatory reactions, leading to a reduction in the synthesis of lipid mediators and inflammatory cytokines through multiple pathways [40]. According to the findings of (Hajhashemi & Klooshani, 2013), *Urtica dioica* leaf extract exhibits significant anti-inflammatory and analgesic activities, providing pharmacological evidence for its use in folk remedies for arthritis and other inflammatory complications [41].

Cardiovascular effects

El Haouari *et al.* (2006) found that *Urtica dioica*, traditionally used for preventing and treating cardiovascular diseases, has an antiplatelet effect linked to flavonoids [42]. Legssyer *et al.* (2002) identified an immediate hypotensive action of *Urtica dioica*, indicating a direct influence on the cardiovascular system [43]. However, the hypotensive effect of the low dose was reversible after 1 hour, while the high effect concentration persisted, suggesting a potential adverse impact [26]. The results imply that nettle exhibits a potent hypotensive activity, signifying direct effects on the cardiovascular system. The cardiac and vascular effects of an aqueous stinging nettle extract (1 and 2 g/L) were investigated in the isolated, spontaneously beating Langendorff rat heart and the isolated rat thoracic aorta [43]. Testai *et al.* (2002) explored the cardiovascular effects of nettle root preparations on aortic preparations with or without prior endothelial vasoconstriction. The study suggests that stinging nettle may induce hypotension through vasodilatory effects, endothelial nitric oxide release, negative inotropic action, and potassium channel activation, despite its inotropic effect in guinea pigs [44].

Anticancer effects

Stinging nettle stands out as one of the most commonly utilized herbal supplementary and alternative therapies among cancer patients in Turkey [45]. Durak *et al.* (2004) explored the effects of an aqueous extract of *Urtica dioica* on adenosine deaminase activity in the prostate tissue of patients with prostate cancer [46]. Fattahi *et al.* (2018) found that *Urtica dioica* induces apoptosis in breast cancer cells by modulating the expression of Ornithine decarboxylase and the genes for adenosine deaminase and estrogen receptors [47]. The antiproliferative activity of *Urtica dioica* leaf aqueous extract on the human breast cancer cell line (MCF-7) has been observed, suggesting its potential as a promising chemotherapeutic treatment for breast cancer [48].

Herbicidal effects

Lorenzo *et al.* (2022) explored the use of Agri-Food Waste as a method for weed control [49]. The results from the Spring-Summer pot experiment revealed the effectiveness of *Urtica dioica* waste in reducing biomass for nearly all weed groupings. However, in the Autumn pot trial, *Urtica dioica* waste lost its inhibiting function [49]. The impact of four pyrazine derivatives on the rutin content of Fagopyrum Esculentum Moench and phenolic compounds in *Urtica dioica* L. showed a slight reduction in above-ground biomass only after the application of Si and S_2. Following pyrazine treatment, all treated plants displayed dark necrosis on the margins and centers of their leaves. These findings suggest that all pyrazine derivatives possess herbicidal properties [50].

Antidiabetic uses

The leaf extract helps to enhance insulin production and reduce blood sugar levels [51]. Several studies suggest that stinging nettle acts as an alpha-glucosidase inhibitor and PPAR gamma agonist [52]. Medications such as acarbose, miglitol, and voglibose are currently used as -glucosidase and -amylase inhibitors. Patients using stinging nettle for diabetes management should be advised to monitor their blood sugar levels regularly [34]. In addition, research on the islets of Langerhans has revealed that nettle has a stimulatory effect on insulin release, leading to a reduction in blood sugar [51]. In alloxan-induced diabetes, the cold methanolic extract of leaves (250 mg/kg) has demonstrated notable antihyperglycemic activity [53].

Top of form hepatoprotective activity

U. dioica exhibited hepatoprotective effects in a carbon tetrachloride-induced model of liver fibrosis and cirrhosis. The results indicate that UD treatment prevents renal damage induced by renal I/R [54]. Hepatoprotection involves the ability to prevent liver damage, forestalls prophylactic hepatic diseases, and maintains the balance of liver enzymes [55]. The seed extract of *Urtica dioica* exhibited liver protection effects by increasing paraoxonase, arylesterase, and liver tissue catalase activity. It also demonstrated protective effects against hepatic damage induced by ischemia-reperfusion [56]. The absence of coagulation necrosis, hydropic degeneration, or fibrosis in the liver parenchyma of animals given the stinging nettle preparation suggests its hepatoprotective effect [27].

Antibacterial

Numerous studies have highlighted the antimicrobial properties of *Urtica*. The ethanolic extract of *U. dioica* seed exhibited a greater impact on gram-positive bacteria, while the extract of the leaves had the most significant effect on gram-negative bacteria [57]. Ghaima *et al.* (2013) explored the antibacterial effects of *Urtica dioica*'s ethyl acetate extract against *Salmonella typhi, Escherichia coli, Staphylococcus aureus, Bacillus cereus*, and *Aeromonas hydrophila [58]*. The high concentration of hydroxycinnamic acids (chlorogenic acid, caffeic acid, and rosmarinic acid) and flavonoid (quercetin) in *U. dioica* may have contributed to its potential antibacterial activity [59].

Antimicrobial

Antimicrobials, as defined by Cowan (1999), are compounds that inhibit the growth or kill germs. The plant extract's antimicrobial activity against various microorganisms has been observed, and the antimicrobial assay of nettle aqueous and ethanol extracts was conducted using the agar well diffusion method [60]. Gülçin *et al.* (2004) investigated the antibacterial activity of the aqueous extract of *U. dioica* against nine different microbial species (*P. aeruginosa, Proteus mirabilis, E. coli, S. aureus, Citrobacter koseri, S. pneumonia, Enterobacter aerogenes, M. luteus*, and *S. epidermidis*) and one yeast species (*Candida albicans*) [22].

Antifungal

The effectiveness of *Urtica dioica* as a potential antifungal agent is demonstrated by the successful performance of the combined hot water extract when orally administered to individuals with ectopic eczema. Any of the treated individuals reported any noticeable adverse effects. The antifungal properties of this herb are attributed to the plant lectin *Urtica dioica* agglutinin [61], which has been shown to inhibit the replication of the Human Immunodeficiency Virus and the Cytomegalovirus *in vitro* strongly and selectively [62].

Antiallergic

The leaf extract of *U. dioica* shows promise as a treatment for allergic responses and cyclooxygenase-induced neurotransmitter release [63]. Extracts from the leaves and roots of nettle are used to treat rheumatic and allergic (seasonal) disorders. Nettle is considered as a safe remedy for various ailments, including allergic rhinitis and hypertension. Anti-allergenic phytoconstituents of nettle, absorbed easily by the body, are excreted in the urine after taking nettle extract in the form of a lozenge. Traditionally, herbalists in Australia recommend starting a three-month course of stinging nettle herbs in anti-allergy combinations specific to the individual before the allergy season begins [64]. In the United States, Dr. A. Weill suggests taking 1-2 capsules of freeze-ground nettle leaf extract every 2-4 hours to address fever and allergy sinus issues [16].

Analgesic

This analgesic property is particularly beneficial in reducing inflammation and alleviating moderate to severe chronic pain in anti-arthritic therapy [22]. Stinging nettle is commonly used to create an herbal diuretic and to address muscle and joint pain. Direct application of nettle leaves has been shown to decrease joint pain and provide relief for arthritis [65]. Application of nettle leaves, producing weals, and repeating the treatment daily

for several days likely led to the development of an analgesic effect [66]. A study suggests that the aqueous leaf extract of *U. dioica*, by inhibiting inflammatory pathways responsible for pain, may have analgesic properties [67]. Nettles can assist in managing osteoarthritis symptoms and joint discomfort, often in the hands, knees, hips, and spine [68].

Insecticidal properties

Alhmedi *et al.* (2007) observed an increase in the diversity of aphid predator species with the cultivation of nettles [69]. As per regulations governing basic substances, nettle extract can serve as an insecticide, fungicide, and acaricide. Utilizing nettle extract as an insecticide proves effective against spider mites, diamondback moths, and codling moths. Its fungicidal properties make it useful in preventing Alternaria leaf spot, grey mold, powdery mildew, septoria blight, early blight, late blight, and pythium root rot [9]. The thorn and needle-like structures in the leaves, when introduced into the mix, render the insect's ovipositor undesirable, resulting in reduced insect invasion. Reports from Nepal indicate that sisnu is incorporated into Integrated Pest Management (IPM) practices to repel pests such as aphids, hairy caterpillars, cutworms, red ants, and termites [70].

Food and feed application

Young leaves of stinging nettle serve as a nutritious culinary herb usable both in herbal therapy and as a cooked vegetable [71]. In Nepal, underprivileged and marginalized ethnic groups incorporate stinging nettle into their diets as a green vegetable, with the plant being rich in calcium, iron, protein, phosphorus, and vitamins A and C. "Sisnu saag (in Nepali language)," a common wild vegetable, thrives as a weed in wastelands, on walls, and along hedges in Nepal's mid-western hills. The tender young leaves and shoots, akin to other green vegetables, are prepared for cooking [72]. Beyond culinary uses, it is employed in soups, teas, juices, and medicines both within and outside the country. The addition of nettle leaf powder to bread enhances its nutritional content, significantly boosting fiber, calcium, copper, and iron [73].

Nettle leaf powder, acting as a high-protein supplement, is incorporated into starchy diets through bread and pasta [74]. Historical usage of nettle roots in meat tenderization during the Greek and Roman periods echoes its continued presence in modern recipes [75]. Cooked nettles serve as a spinach substitute in various recipes, including soups [76]. Nettle leaves can also be employed to make a nutrient-dense herbal tea rich in vitamins and minerals, offering a flavor profile ranging from mild to robust, resembling vegetable broth [77].

Additional applications of *Urtica dioica* are illustrated in Figure 5, supplementing the ones previously mentioned.

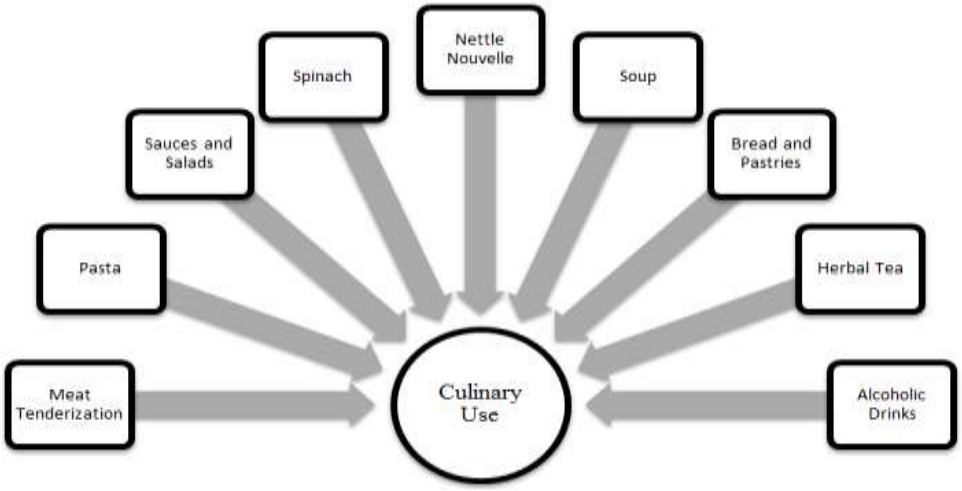

Figure 4. Culinary uses of *Urtica dioica*

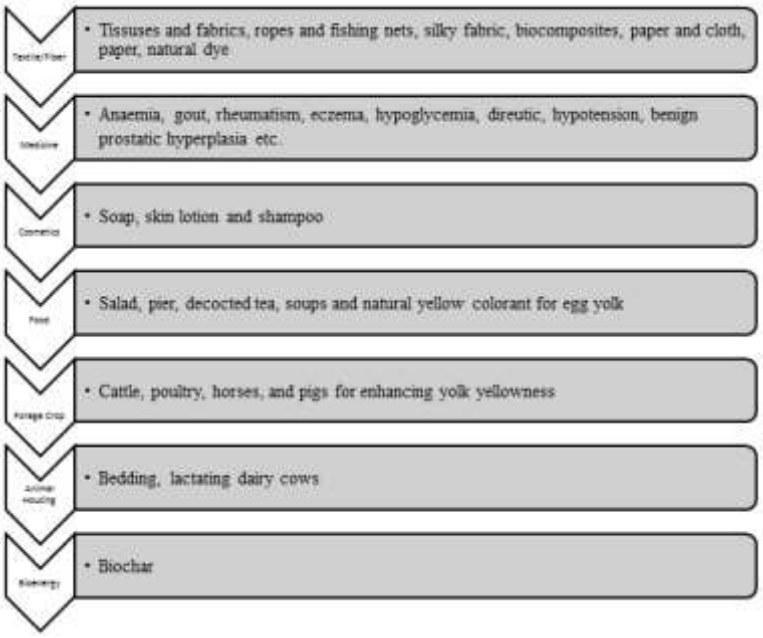

Figure 5. Potential uses of *Urtica dioica*

Conclusion

The study surrounding *Urtica dioica* has witnessed a gradual but steady rise in interest from both individual researchers and institutions. Nevertheless, this inquiry has remained relatively limited in scope, primarily concentrated in countries like India and Nepal. The increasing number of publications over the years attests to the growing research activities in this field. *Urtica dioica*, renowned for its historical use as a traditional remedy, a functional food, and a leafy vegetable with diverse medicinal applications worldwide, has exhibited substantial pharmacological potential in the form of antioxidative, anti-inflammatory, anti-ulcer, antihyperglycemic, anti-bacterial, and cardiovascular protective properties within its extracts. To establish its credibility as traditional medicine and harness its potential as functional food ingredients, further research is essential to elucidate the mechanisms of action of the bioactive compounds found in *Urtica dioica*. The absence of studies pinpointing pure active components for specific diseases leaves room for future research endeavors that could pave the way for the commercial utilization of *Urtica dioica* in the near future.

Orcid

Nabin Dhakal
https://orcid.org/0009-0005-6293-1892
Rajeev Joshi
https://orcid.org/0000-0003-1106-9911
Sagar Acharya
https://orcid.org/0009-0005-9816-2415
Sushil Bhandari
https://orcid.org/0009-0009-0630-9344
Anuska Subedi
https://orcid.org/0009-0001-7066-0034
Mohit Nath
https://orcid.org/0009-0002-3974-1677

References

1. Genc Z, Yarat A, Tunali-Akbay T, Sener G, Cetinel S, Pisiriciler R, Caliskan-Ak E, Altıntas A, Demirci B. The effect of stinging nettle (Urtica dioica) seed oil on experimental colitis in rats. Journal of medicinal food. 2011 Dec 1;14(12):1554-61. [Crossref], [Google scholar], [Publisher]
2. Vijaykumar R. *Evaluation of Anti Asthmatic Activity of Urtica Dioica (Linn.) Leaves and Its Phytochemical Studies* (Doctoral

dissertation, JKK Nattraja College of Pharmacy, Komarapalayam). [Google scholar]
3. Grauso L, de Falco B, Lanzotti V, Motti R. Stinging nettle, Urtica dioica L.: Botanical, phytochemical and pharmacological overview. Phytochemistry Reviews. 2020 Dec;19:1341-77. [Crossref], [Google scholar], [Publisher]
4. Klimešová J. Population dynamics of Phalaris arundinacea L. and Urtica dioica L. in a floodplain during a dry period. Wetlands Ecology and Management. 1995 Mar;3:79-85. [Crossref], [Google scholar], [Publisher]
5. Dreyer J, Müssig J. New horizons in natural fibre production: separation of hemp and nettle with enzymes. In3rd International Symposium Biorohstoff Hanf and Andere Faserpflanzen Wolfsburg, Germany 2000 Sep. [Google scholar]
6. Watanabe T, Rajbhandari KK, Malla KJ, Yahara S. A hand book of medicinal plants of Nepal. [Google scholar]
7. Bisht S, Bhandari S, Bisht NS. Urtica dioica (L): an undervalued, economically important plant. Agric Sci Res J. 2012 May;2(5):250-2. [Google scholar]
8. Uprety Y, Poudel RC, Shrestha KK, Rajbhandary S, Tiwari NN, Shrestha UB, Asselin H. Diversity of use and local knowledge of wild edible plant resources in Nepal. Journal of Ethnobiology and Ethnomedicine. 2012 Dec;8:1-5. [Crossref], [Google scholar], [Publisher]
9. Bhusal KK, Magar SK, Thapa R, Lamsal A, Bhandari S, Maharjan R, Shrestha S, Shrestha J. Nutritional and pharmacological importance of stinging nettle (Urtica dioica L.): A review. Heliyon. 2022 Jun 1. [Crossref], [Google scholar], [Publisher]
10. Halder S, Sharma A. A review on Urtica Dioica L. World J Pharm Sci. 2017 Aug 7;6:404-21. [Crossref], [Google scholar], [Publisher]
11. Mavi A, Terzi Z, Özgen U, Yildirim A, Coşkun M. Antioxidant properties of some medicinal plants: Prangos ferulacea (Apiaceae), Sedum sempervivoides (Crassulaceae), malva neglecta (malvaceae), Cruciata taurica (Rubiaceae), Rosa pimpinellifolia (Rosaceae), Galium verum subsp. verum (Rubiaceae), urtica dioica (urticaceae). Biological and Pharmaceutical Bulletin. 2004;27(5):702-5. [Crossref], [Google scholar], [Publisher]
12. 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.). International journal of environmental research and public health. 2010 Oct;7(10):3804-15. [Crossref], [Google scholar], [Publisher]
13. Beintema JJ, Peumans WJ. The primary structure of stinging nettle (Urtica dioica) agglutinin A two-domain member of the hevein family. FEBS letters. 1992 Mar 9;299(2):131-4. [Crossref], [Google scholar], [Publisher]
14. Obertreis B, Giller K, Teucher T, Behnke B, Schmitz H. Anti-inflammatory effect of Urtica dioica folia extract in comparison to caffeic malic acid. Arzneimittel-forschung. 1996 Jan 1;46(1):52-6. [Google scholar], [Publisher]
15. Does MP, Ng DK, Dekker HL, Peumans WJ, Houterman PM, Van Damme EJ, Cornelissen BJ. Characterization of Urtica dioica agglutinin isolectins and the encoding gene family. Plant molecular biology. 1999 Jan;39:335-47. [Crossref], [Google scholar], [Publisher]
16. Mittman P. Randomized, double-blind study of freeze-dried Urtica dioica in the treatment of allergic rhinitis. Planta medica. 1990 Feb;56(01):44-7. [Crossref], [Google scholar], [Publisher]
17. Bnouham M, Merhfour FZ, Ziyyat A, Mekhfi H, Aziz M, Legssyer A. Antihyperglycemic activity of the aqueous extract of Urtica dioica. Fitoterapia. 2003 Dec 1;74(7-8):677-81. [Crossref], [Google scholar], [Publisher]
18. Almasi H, Zandi M, Beigzadeh S, Haghju S, Mehrnow N. Chitosan films incorporated with nettle (Urtica Dioica L.) extract-loaded nanoliposomes: II. Antioxidant activity and release properties. Journal of microencapsulation. 2016 Jul 3;33(5):449-59. [Crossref], [Google scholar], [Publisher]
19. Fox JL, Diezmann CM. What Counts in Research? A Survey of Early Years' Mathematical Research, 2000–2005. Contemporary Issues in Early Childhood. 2007 Dec;8(4):301-12. [Crossref], [Google scholar], [Publisher]

20. Ballantyne M, Pickering CM. The impacts of trail infrastructure on vegetation and soils: Current literature and future directions. Journal of environmental management. 2015 Dec 1;164:53-64. [Crossref], [Google scholar], [Publisher]
21. Otles S, Yalcin B. Phenolic compounds analysis of root, stalk, and leaves of nettle. The Scientific World Journal. 2012 Oct;2012. [Crossref], [Google scholar], [Publisher]
22. Gülçin I, Küfrevioğlu Öİ, Oktay M, Büyükokuroğlu ME. Antioxidant, antimicrobial, antiulcer and analgesic activities of nettle (Urtica dioica L.). Journal of ethnopharmacology. 2004 Feb 1;90(2-3):205-15. [Crossref], [Google scholar], [Publisher]
23. Riehemann K, Behnke B, Schulze-Osthoff K. Plant extracts from stinging nettle (Urtica dioica), an antirheumatic remedy, inhibit the proinflammatory transcription factor NF-κB. FEBS letters. 1999 Jan 8;442(1):89-94. [Crossref], [Google scholar], [Publisher]
24. Bombardelli E, Morazzoni P. Urtica dioica L. Urtica dioica L. *Fitoterapia (Milano)*,1997; *68*(5), 387–402. [Google scholar], [Publisher]
25. Bellakhdar J. La pharmacopée marocaine traditionnelle. Médicine arabe ancienne et savoirs populaires. 1997. [Google scholar], [Publisher]
26. Kanter M, Meral I, Dede S, Cemek M, Ozbek H, Uygan I, Gunduz H. Effects of Nigella sativa L. and Urtica dioica L. on lipid peroxidation, antioxidant enzyme systems and some liver enzymes in CCl4-treated rats. Journal of Veterinary Medicine Series A. 2003 Jun;50(5):264-8. [Crossref], [Google scholar], [Publisher]
27. Türkdoğan MK, Ozbek H, Yener Z, Tuncer I, Uygan I, Ceylan EB. The role of Urtica dioica and Nigella sativa in the prevention of carbon tetrachloride-induced hepatotoxicity in rats. Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives. 2003 Sep;17(8):942-6. [Crossref], [Google scholar], [Publisher]
28. Özen T, Korkmaz H. Modulatory effect of Urtica dioica L.(Urticaceae) leaf extract on biotransformation enzyme systems, antioxidant enzymes, lactate dehydrogenase and lipid peroxidation in mice. Phytomedicine. 2003 Jan 1;10(5):405-15. [Crossref], [Google scholar], [Publisher]
29. Boots AW, Haenen GR, Bast A. Health effects of quercetin: from antioxidant to nutraceutical. European journal of pharmacology. 2008 May 13;585(2-3):325-37. [Crossref], [Google scholar], [Publisher]
30. Stanković M, Terzić J, Stefanović O. Synergistic antibacterial activity of Curcuma longa L. and Urtica dioica L. extracts and preservatives. [Crossref], [Google scholar], [Publisher]
31. Komes D, Belščak-Cvitanović A, Horžić D, Rusak G, Likić S, Berendika M. Phenolic composition and antioxidant properties of some traditionally used medicinal plants affected by the extraction time and hydrolysis. Phytochemical analysis. 2011 Mar;22(2):172-80. [Crossref], [Google scholar], [Publisher]
32. Semalty M, Semalty A, Rawat BS, Singh D, Joshi GP, Rawat MS. In-vitro antioxidant activity of roots of Urtica dioica (Nettle). Indian Drugs. 2010;47(5):55-8. [Google scholar]
33. Bagade P, Pant V, Pandey ST. Nutritional and antinutritional profiling of stinging nettle (Urtica dioica L.). International Journal of Food Science and Nutrition. 2021;6(4):111-6. [Google scholar], [Publisher]
34. Hughes RE, Ellery P, Harry T, Jenkins V, Jones E. The dietary potential of the common nettle. Journal of the Science of Food and Agriculture. 1980 Dec;31(12):1279-86. [Crossref], [Google scholar], [Publisher]
35. Esposito S, Bianco A, Russo R, Di Maro A, Isernia C, Pedone PV. Therapeutic perspectives of molecules from Urtica dioica extracts for cancer treatment. Molecules. 2019 Jul 29;24(15):2753. [Crossref], [Google scholar], [Publisher]
36. Sapkota S, Shrestha S. An explorative survey on Sisnu: a wonder but highly underutilized crop of Nepal. Journal of Pharmacognosy and Phytochemistry. 2018;7(1S):832-3. [Google scholar], [Publisher]
37. De Vico G, Guida V, Carella F. Urtica dioica (Stinging Nettle): A neglected plant with emerging growth promoter/immunostimulant properties for farmed fish. Frontiers in physiology. 2018 Mar 26;9:285. [Crossref], [Google scholar], [Publisher]

38. Di Virgilio N, Papazoglou EG, Jankauskiene Z, Di Lonardo S, Praczyk M, Wielgusz K. The potential of stinging nettle (Urtica dioica L.) as a crop with multiple uses. Industrial Crops and Products. 2015 Jun 1;68:42-9. [Crossref], [Google scholar], [Publisher]
39. Adhikari BM, Bajracharya A, Shrestha AK. Comparison of nutritional properties of Stinging nettle (Urtica dioica) flour with wheat and barley flours. Food Science & Nutrition. 2016 Jan;4(1):119-24. [Crossref], [Google scholar], [Publisher]
40. Baeuerle PA, Henkel T. Function and activation of NF-kappaB in the immune system. Annual review of immunology. 1994 Apr;12(1):141-79. [Google scholar], [Publisher]
41. Hajhashemi V, Klooshani V. Antinociceptive and anti-inflammatory effects of Urtica dioica leaf extract in animal models. Avicenna journal of phytomedicine. 2013;3(2):193. [Google scholar], [Publisher]
42. El Haouari M, Bnouham M, Bendahou M, Aziz M, Ziyyat A, Legssyer A, Mekhfi H. Inhibition of rat platelet aggregation by Urtica dioica leaves extracts. Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives. 2006 Jul;20(7):568-72. [Crossref], [Google scholar], [Publisher]
43. Legssyer A, Ziyyat A, Mekhfi H, Bnouham M, Tahri A, Serhrouchni M, Hoerter J, Fischmeister R. Cardiovascular effects of Urtica dioica L. in isolated rat heart and aorta. Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives. 2002 Sep;16(6):503-7. [Crossref], [Google scholar], [Publisher]
44. Testai L, Chericoni S, Calderone V, Nencioni G, Nieri P, Morelli I, Martinotti E. Cardiovascular effects of Urtica dioica L.(Urticaceae) roots extracts: in vitro and in vivo pharmacological studies. Journal of Ethnopharmacology. 2002 Jun 1;81(1):105-9. [Crossref], [Google scholar], [Publisher]
45. Kültür Ş. Medicinal plants used in Kırklareli province (Turkey). Journal of ethnopharmacology. 2007 May 4;111(2):341-64. [Crossref], [Google scholar], [Publisher]
46. Durak I, Biri H, Devrim E, Sözen S, Avcı A. Aqueous extract of Urtica dioica makes significant inhibition on adenosine deaminase activity in prostate tissue from patients with prostate cancer. Cancer biology & therapy. 2004 Sep 1;3(9):855-7. [Crossref], [Google scholar], [Publisher]
47. Fattahi S, Ghadami E, Asouri M, Ardekanid AM, Akhavan-Niaki H. Urtica dioica inhibits cell growth and induces apoptosis by targeting Ornithine decarboxylase and Adenosine deaminase as key regulatory enzymes in adenosine and polyamines homeostasis in human breast cancer cell lines. Cellular and Molecular Biology. 2018 Feb 28;64(3):97-102. [Crossref], [Google scholar], [Publisher]
48. Fattahi S, Ardekani AM, Zabihi E, Abedian Z, Mostafazadeh A, Pourbagher R, Akhavan-Niaki H. Antioxidant and apoptotic effects of an aqueous extract of Urtica dioica on the MCF-7 human breast cancer cell line. Asian Pacific Journal of Cancer Prevention. 2013;14(9):5317-23. [Crossref], [Google scholar], [Publisher]
49. Lorenzo P, Guilherme R, Barbosa S, Ferreira AJ, Galhano C. Agri-food waste as a method for weed control and soil amendment in crops. Agronomy. 2022 May 14;12(5):1184. [Crossref], [Google scholar], [Publisher]
50. Moravcová Š, Fiedlerová V, Tůma J, Musil K, Tůmová L. Effect of Selected Pyrazine Derivatives on the Production of Phenolics and Rutin in Urtica dioica and Fagopyrum esculentum. Natural Product Communications. 2016 Apr;11(4):1934578X1601100409. [Crossref], [Google scholar], [Publisher]
51. Farzami B, Ahmadvand D, Vardasbi S, Majin FJ, Khaghani SH. Induction of insulin secretion by a component of Urtica dioica leave extract in perifused Islets of Langerhans and its in vivo effects in normal and streptozotocin diabetic rats. Journal of ethnopharmacology. 2003 Nov 1;89(1):47-53. [Crossref], [Google scholar], [Publisher]
52. Kianbakht S, Khalighi-Sigaroodi F, Dabaghian FH. Improved glycemic control in patients with advanced type 2 diabetes mellitus taking Urtica dioica leaf extract: a randomized double-blind placebo-controlled clinical trial. Clin Lab. 2013 Jan 1;59(9-10):1071-6. [Crossref], [Google scholar], [Publisher]

53. AL–wasfi RM, jabaar AL–Kaabee HJ, Dergham M, Hameed AF. Studying the hypoglycemic and the antibacterial activity of various plant extract of Urtica dioica. Al-Kufa J Biol. 2012 Nov 20;4(2):1-3. [Google scholar], [Publisher]
54. Sayhan MB, Kanter M, Oguz S, Erboga M. Protective effect of Urtica dioica L. on renal ischemia/reperfusion injury in rat. Journal of molecular histology. 2012 Dec;43:691-8. [Crossref], [Google scholar], [Publisher]
55. Sarma Kataki M, Murugamani V, Rajkumari A, Singh Mehra P, Awasthi D, Shankar Yadav R. Antioxidant, hepatoprotective, and anthelmintic activities of methanol extract of Urtica dioica L. leaves. Pharmaceutical Crops. 2012 Jan 20;3(1). [Crossref], [Google scholar], [Publisher]
56. Kandis H, Karapolat S, Yildirim U, Saritas A, Gezer S, Memisogullari R. Effects of Urtica dioica on hepatic ischemia-reperfusion injury in rats. Clinics. 2010;65:1357-61. [Crossref], [Google scholar], [Publisher]
57. Motamedi H, Seyyednejad SM, Bakhtiari A, Vafaei M. Introducing Urtica dioica, a native plant of Khuzestan, as an antibacterial medicinal plant. Jundishapur journal of natural pharmaceutical products. 2014 Nov;9(4). [Crossref], [Google scholar], [Publisher]
58. Ghaima KK, Hashim NM, Ali SA. Antibacterial and antioxidant activities of ethyl acetate extract of nettle (Urtica dioica) and dandelion (Taraxacum officinale). Journal of Applied Pharmaceutical Science. 2013 May 30;3(5):096-9. [Crossref], [Google scholar], [Publisher]
59. Zenão S, Aires A, Dias C, Saavedra MJ, Fernandes C. Antibacterial potential of Urtica dioica and Lavandula angustifolia extracts against methicillin resistant Staphylococcus aureus isolated from diabetic foot ulcers. Journal of herbal medicine. 2017 Dec 1;10:53-8. [Crossref], [Google scholar], [Publisher]
60. Cowan MM. Plant products as antimicrobial agents. Clinical microbiology reviews. 1999 Oct 1;12(4):564-82. [Crossref], [Google scholar], [Publisher]
61. Vanparijs J, Broekaert Wf, Peumans Wj. Urtica-Dioica agglutinin- A Plant Lectin with antifungal properties. Inarchives Internationales De Physiologie De Biochimie Et De Biophysique 1988 Mar 1 (Vol. 96, No. 1, Pp. Pp31-Pp31). Po Box 825, 2160 Sz Lisse, Netherlands: Swets Zeitlinger Publishers. [Google Scholar] Q4
62. Yongabi KA, Dukku UH, Agho MO, Chindo IY. Studies on the Antifungal properties of Urtica dioica uritcaceae (Stinging Nettle). Journal of phytomedicine and Therapeutics. 2000;5(1):39-43. [Google scholar], [Publisher]
63. Körpe DA, İşerİ ÖD, Sahin FI, Cabi E, Haberal M. High-antibacterial activity of Urtica spp. seed extracts on food and plant pathogenic bacteria. International Journal of Food Sciences and Nutrition. 2013 May 1;64(3):355-62. [Crossref], [Google scholar], [Publisher]
64. Ayers S, Roschek Jr B, Williams JM, Alberte RS. Pharmacokinetic analysis of anti-allergy and anti-inflammation bioactives in a nettle (Urtica dioica) extract. Online Journal of Pharmacology and Pharmaco Kinetics. 2008;5:6-21. [Google scholar], [Publisher]
65. Hansen F. Echinacea unter verdacht. Die Zeit. 1996 May;10. [Google scholar], [Publisher]
66. Randall C, Meethan K, Randall H, Dobbs F. Nettle sting of Urtica dioica for joint pain—an exploratory study of this complementary therapy. Complementary therapies in medicine. 1999 Sep 1;7(3):126-31. [Crossref], [Google scholar], [Publisher]
67. Safari VZ, Ngugi MP, Orinda G, Njagi EM. Anti-pyretic, anti-inflammatory and analgesic activities of aqueous leaf extract of Urtica dioica L. in albino mice. Med Aromat Plants. 2016;5(237):2167-0412. [Crossref], [Google scholar], [Publisher]
68. Kregiel D, Pawlikowska E, Antolak H. Urtica spp.: Ordinary plants with extraordinary properties. Molecules. 2018 Jul 9;23(7):1664. [Crossref], [Google scholar], [Publisher]
69. Alhmedi A, Haubruge E, Bodson B, Francis F. Aphidophagous guilds on nettle (Urtica dioica) strips close to fields of green pea, rape and wheat. Insect Science. 2007 Oct;14(5):419-24. [Crossref], [Google scholar], [Publisher]
70. Shreejana KC, Thapa R, Lamsal A, Ghimire S, Kurunju K, Shrestha P. Urtica Dioica: A Ostracized Neglected Plant in agriculture serving as a best Medicinal And Insecticidal Property. Tropical Agrobiodiversity (TRAB). 2022;3(1):08-11. [Crossref], [Google scholar], [Publisher]

71. Singh M, Kali G. Study on morpho-anatomical and histo-chemical charaterisation of stinging nettle, Urtica dioica L in Uttarakhand, India. Journal of Pharmacognosy and Phytochemistry. 2019;8(3):4325-31. [Google scholar], [Publisher]
72. Shonte TT, De Kock HL. Descriptive sensory evaluation of cooked stinging nettle (Urtica dioica L.) leaves and leaf infusions: Effect of using fresh or oven-dried leaves. South African Journal of Botany. 2017 May 1;110:167-76. [Crossref], [Google scholar], [Publisher]
73. Maietti A, Tedeschi P, Catani M, Stevanin C, Pasti L, Cavazzini A, Marchetti N. Nutrient composition and antioxidant performances of bread-making products enriched with stinging nettle (Urtica dioica) leaves. Foods. 2021 Apr 25;10(5):938. [Crossref], [Google scholar], [Publisher]
74. Perez-Riverol Y, Bai J, Bandla C, García-Seisdedos D, Hewapathirana S, Kamatchinathan S, Kundu DJ, Prakash A, Frericks-Zipper A, Eisenacher M, Walzer M. The PRIDE database resources in 2022: a hub for mass spectrometry-based proteomics evidences. Nucleic acids research. 2022 Jan 7;50(D1):D543-52. [Crossref], [Google scholar], [Publisher]
75. Kavalali G. Urtica: therapeutic and nutritional aspects of stinging nettles. (No Title). 2003. [Google scholar], [Publisher]
76. Costa HS, Albuquerque TG, Sanches-Silva A, Vasilopoulou E, Trichopoulou A, D'Antuono LF, Alexieva I, Boyko N, Costea C, Fedosova K, Hayran O. New nutritional composition data on selected traditional foods consumed in Black Sea Area countries. Journal of the Science of Food and Agriculture. 2013 Nov;93(14):3524-34. [Crossref], [Google scholar], [Publisher]
77. Sánchez-Mata D, Morales R. The Mediterranean landscape and wild edible plants. Mediterranean Wild Edible Plants: Ethnobotany and Food Composition Tables. 2016:15-31. [Crossref], [Google scholar], [Publisher]