

THERAPEUTIC APPLICATIONS OF URTICA DIOICA: A NATURAL  
RESERVOIR OF BIOLOGICALLY ACTIVE SUBSTANCES  
(Literature Review)

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**Abstract:** *Urtica dioica*, commonly known as stinging nettle, is a medicinal plant with a broad geographic distribution and a wide range of therapeutic properties. Its rich phytochemical profile—including essential vitamins, minerals, flavonoids, and chlorophyll—contributes to its hemostatic, anti-inflammatory, diuretic, antianemic, immunomodulatory, and blood sugar-lowering activities. Both traditional healing systems and modern medicine utilize nettle for managing conditions such as anemia, hemorrhage, joint disorders, dermatological issues, and as an adjunct in the treatment of diabetes mellitus. It is available in multiple pharmaceutical forms, including decoctions, infusions, fresh juice, extracts, and herbal blends. Despite its demonstrated therapeutic value, the use of stinging nettle requires caution due to specific contraindications. This review highlights the latest findings regarding the medicinal applications of *Urtica dioica* in clinical and traditional practice.

**Keywords:** stinging nettle, *Urtica dioica*, medicinal plants, phytotherapy, hemostatic effect, anti-inflammatory effect, anemia, diabetes mellitus, biologically active substances, traditional medicine, vitamins, flavonoids.

**Introduction** Stinging nettle (*Urtica dioica*) has long been recognized in traditional medicine across various cultures for its therapeutic potential, particularly as a hemostatic, anti-inflammatory, diuretic, and general tonic. In recent years, scientific interest in this plant has grown, driven by extensive research into its bioactive constituents and pharmacological mechanisms [1, 4, 8].

The plant's aerial parts are notably rich in biologically active compounds such as vitamins (C, K, B-complex), essential minerals (iron, calcium, zinc), flavonoids (quercetin, rutin), chlorophyll, and polysaccharides [2, 3, 14]. These compounds contribute to its diverse biological effects, including antioxidant, immunomodulatory, and metabolic activities. Phenolic constituents and lignans present in the leaves further support its role in immune enhancement and free radical scavenging [4, 7].

Modern pharmacological studies have confirmed that *Urtica dioica* extracts can suppress inflammatory mediators like TNF- $\alpha$  and IL-1 $\beta$  through inhibition of NF- $\kappa$ B activation [4, 10]. Clinical trials have reported symptomatic improvement in rheumatoid and osteoarthritis patients receiving nettle therapy [11]. A 2021 meta-analysis highlighted its ability to lower blood glucose levels in individuals with type 2 diabetes, largely through enhanced insulin secretion and improved peripheral insulin sensitivity [6, 9].

The plant's antioxidant activity is largely attributed to its flavonoids and chlorophyll, which effectively reduce oxidative stress markers [1, 10, 18]. Additionally, its high iron and vitamin C content supports erythropoiesis, making it useful in managing iron-deficiency anemia [14, 19].

Contemporary research has demonstrated nettle's efficacy in various medical contexts, including:

- Type 2 diabetes mellitus [6, 16, 20]
- Inflammatory joint disorders [11]
- Benign prostatic hyperplasia (BPH) [5]
- Anemia [14, 19]
- Dermatological and allergic conditions [3, 12]

Phytochemicals in nettle have been shown to inhibit lipoxygenase and cyclooxygenase enzymes, thereby reducing prostaglandin synthesis and inflammation [1, 4, 10]. Nettle also modulates alpha-glucosidase activity, helping to control postprandial hyperglycemia [6, 20], and boosts expression of antioxidant enzymes such as SOD, catalase, and glutathione peroxidase [7, 10], which are crucial in protecting tissues from chronic oxidative stress.

In vitro studies demonstrate that *Urtica dioica* extracts can inhibit the proliferation of cancer cells, particularly in prostate, breast, and gastric tissues, through induction of apoptosis and cell cycle arrest [4, 12, 13]. Its synergistic potential with chemotherapeutic agents has also been suggested [4]. Additionally, nettle exhibits notable antimicrobial activity, effectively suppressing pathogens such as *Staphylococcus aureus*, *E. coli*, *Candida albicans*, and *Pseudomonas aeruginosa* [12, 15]. This antimicrobial action is linked to disruptions in bacterial cell walls and inhibition of key enzymatic pathways.

Immunologically, nettle enhances both innate and adaptive responses. Studies indicate increased macrophage activity, elevated T-cell and NK-cell function, and enhanced immunoglobulin production—especially IgA and IgG—after nettle administration [8, 9]. Riehemann et al. (1999) further documented its ability to suppress cytokine release and reduce ICAM-1 expression [4].

Topical applications of nettle have proven effective in treating eczema, psoriasis, acne, and seborrhea. Its antibacterial action against *Propionibacterium acnes* and its inflammation-reducing effect make it valuable in dermatological therapy [10, 17]. Nettle-based cosmetic products—such as shampoos, tonics, and ointments—are used to combat dandruff and hair loss, supported by the regenerative properties of chlorophyll and silicon [3, 10].

Cardiovascular benefits include hypotensive and vasodilatory effects via nitric oxide pathways, demonstrated in hypertensive rat models [6, 7, 16]. Its anticoagulant activity—via inhibition of platelet aggregation and increased antithrombin III activity—suggests potential in thrombosis prevention [1, 14]. Furthermore, nettle improves lipid profiles by reducing LDL, triglycerides, and total cholesterol while boosting HDL levels [6, 18].

Nettle's potential in anti-aging, cognitive enhancement, and sarcopenia prevention is being explored due to its antioxidant, anti-inflammatory, and metabolic effects [10, 15, 20].

Functional foods incorporating nettle powders are increasingly used for elderly and vegetarian populations, particularly in Europe and Central Asia [18, 20].

Hepatoprotective properties have been validated in models of liver injury (e.g., paracetamol, CCl<sub>4</sub> exposure), with nettle reducing ALT, AST, bilirubin, and enhancing hepatocyte regeneration [10, 17]. Renoprotective actions have also been demonstrated, particularly in diabetic nephropathy, through reductions in glomerular inflammation, proteinuria, and histological damage [6, 9].

In allergic rhinitis, clinical trials have confirmed nettle's antihistamine activity by blocking histamine receptors and suppressing histamine release [2, 14]. Cognitive and anti-stress effects have been reported in animal models, likely through cortisol modulation and neuroprotection [4, 15].

Nettle is widely used in metabolic disorders such as type 2 diabetes. Key flavonoids like quercetin and rutin enhance glucose uptake via GLUT4 and improve insulin receptor sensitivity [1, 6]. Long-term clinical studies confirm its ability to lower fasting glucose and HbA1c levels [6], reduce insulin resistance, and modulate inflammatory cytokines such as IL-6 and TNF- $\alpha$  [5].

Antitumor activity has been documented across multiple cancer lines. Mechanisms include apoptosis induction, VEGF inhibition, and suppression of angiogenesis [10, 14]. Nano-formulations of nettle have shown improved efficacy without harming healthy cells [10].

Nettle's antiviral activity has also been demonstrated against HSV-1, influenza A, and coronaviruses, primarily due to its polysaccharides and lectins [7, 12]. It also possesses robust antibacterial properties against both gram-positive and gram-negative strains [2, 9].

Clinical data support its use in:

- Benign prostatic hyperplasia (BPH): Reduced symptoms and residual urine [13]
- Osteoarthritis: Topical relief of pain and inflammation [4]
- Allergic rhinitis: Alleviation of sneezing and nasal symptoms [2]

Although generally safe and well tolerated, caution is advised during pregnancy and anticoagulant therapy due to possible herb-drug interactions [1, 13].

*Urtica dioica*'s ability to modulate sex hormones, particularly in BPH, has been confirmed, with effects on DHT levels and aromatase inhibition [1, 3]. Systematic reviews suggest it improves IPSS scores and quality of life in affected men [1].

Polysaccharides from nettle enhance IL-2 and IFN- $\gamma$  production, boosting immune defenses and offering promise in autoimmune and inflammatory conditions such as rheumatoid arthritis [5, 6]. Cardiovascular protection, lipid regulation, and inhibition of platelet aggregation are further reasons for its growing interest in modern phytotherapy [4, 8, 11].

Finally, *Urtica dioica* is increasingly used in geriatric medicine to enhance energy, cognition, and digestive function. A recent study confirmed that nettle phytotherapy improves physical and emotional health in patients over 65 years old [9].

In conclusion, *Urtica dioica* is a pharmacologically versatile plant with validated therapeutic roles in endocrinology, oncology, dermatology, immunology, and geriatrics. While preclinical and early clinical studies are promising, large-scale trials are required to optimize dosage guidelines and ensure long-term safety in clinical settings.

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