URTICA DIOICA HERBAL TEAS AND INFUSIONS: NUTRITIONAL VALUE, HEALTH BENEFITS AND SAFETY

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REVIEW

Abstract
In many cultures, plants used for herbal preparation have played an important role. Their use has been for both nutritional practices and traditional remedies. One notable herb is Urtica dioica, also known as stinging nettle, which is commonly used to prepare herbal beverages. The leaves are usually harvested and dried, and afterwards they can be used to prepare teas or infusions. During the infusion process, hot water helps extract various natural compounds from the plant material, which become part of the final beverage. Because of these components, nettle tea is often included among natural drinks that people can consume as part of a balanced diet.
The aim of the study is to review herbal teas and infusions made from Urtica dioica leaves and to highlight their possible nutritional value. Nettles contain several components, such as minerals, vitamins and antioxidant substances that can influence the composition of the infusions. By discussing these components, the study highlights the main characteristics and potential nutritional benefits of beverages from nettle leaves.
Moreover, the research also considers common preparation practices and the reasons why nettle tea continues to be consumed both in traditional use and in contemporary dietary patterns.
Interest in plant-based beverages has increased in recent years as more people seek simple and natural options for everyday consumption. In this context, nettle tea remains a well-known herbal preparation that combines traditional use with potential nutritional benefits.
Safety aspects of Urtica dioica herbal teas and infusions include the potential presence of heavy metals or other contaminants depending on the harvesting environment, emphasizing the need for careful quality control and monitoring to ensure safe consumption.

Keywords: nettle leaves, nutritional properties, plant extracts, herbal beverages, quality control and monitoring
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INTRODUCTION

Plant drinks have been known for centuries and have been consumed by human beings since ancient times (Huda et al., 2024). In ancient times, when people wanted to have a drink, they used local plants. Infusions were widely consumed and it was a routine part of daily life (Dzień et al., 2025). They were not only used as a food product but also for medical purposes and that's the reason why plant drinks have been consumed for thousands of years and this tradition is still continuing. Especially today, when people prefer to consume more natural products (Winkler et al., 2020).

In recent years, the consumption of herbal infusions has increased worldwide, influenced by the growing interest in natural products and preventive nutrition. Alongside water and coffee, tea-based beverages are among the most widely consumed drinks globally (Huda et al., 2024).

The biological effects of these beverages are mainly related to their content of bioactive compounds, which can help reduce oxidative stress and support normal physiological functions (Muceniece et al., 2025). Herbal infusions are widely consumed and are closely related to a healthy life style. They are rich in different types of bioactive compounds, such as polyphenols, flavonoids, vitamins and minerals (Wójciak et al., 2024). These compounds contribute to the maintenance of the human body through their antioxidant and anti-inflammatory activities (Wilmers et al., 2026). Furthermore, herbal teas can be considered as a

supplementary food for nutrition (Tola et al., 2025). Apart from their traditional uses, new studies are now conducted on herbal infusions to determine their contribution to immuno-protective nutrition and to a healthy cardiovascular system (Huda et al., 2024). Thus, their investigation is not only based on their traditional use but also on their new role in modern nutrition.

However, the composition of herbal infusions is not constant and may vary depending on factors such as plant species, geographical origin, harvesting conditions, and preparation methods. Even differences in temperature or infusion time can influence the transfer of compounds into the final beverage (Dzień et al., 2025).

Urtica dioica L., also known as stinging nettle, is a plant species which has been subject to considerable research. It is represented in various parts of the world including Europe, Asia, Africa and North America (Parente et al., 2025). *Urtica dioica* has been also widely used in food and folk medicine. Leaves are used most frequently in preparations, especially tea (Sahal et al., 2025). According to the current knowledge, nettle leaves are a valuable source of various bioactive compounds. They contain, among others, vitamin C, B and K as well as calcium, iron and magnesium (El Kahkahi et al., 2025). Additionally, they are rich in amino acids and phenolic compounds (Baumli et al., 2025). Depending on the respective biological system and target these compounds exert various activities such as antioxidant and anti-inflammatory, antimicrobial or immunomodulatory (Wilmers et al., 2026).

In addition to its traditional medicinal use, *Urtica dioica* is increasingly considered a functional food due to its high nutritional value and diverse phytochemical composition. Traditionally, nettle has been used to treat various conditions such as anemia, kidney disorders, rheumatism, and skin diseases, and it continues to be widely consumed as herbal tea in many cultures (Aumeeruddy & Mahomoodally, 2021). Recent scientific studies have also highlighted its potential role in preventing oxidative stress and inflammation, as well as its possible anticancer properties, attributed mainly to its polyphenolic content (Muceniece et al., 2025).

These biological effects are associated with the ability of nettle compounds to modulate inflammatory pathways and oxidative processes involved in the development of chronic diseases (Hodroj et al., 2020; Akl et al., 2024).

Despite the increasing number of studies, there is still limited consistency in the reported results due to variations in plant material and extraction methods (Popov et al., 2020). Even though the numerous reported benefits, the composition and quality of herbal infusions, including nettle tea, may vary depending on factors such as plant origin, harvesting conditions, and preparation methods (Shonte & de Kock, 2017). Additionally, there are concerns regarding the presence of potentially harmful elements, such as heavy metals, which may accumulate in plant material and be transferred into the infusion. Therefore, evaluating both the nutritional value and safety aspects of herbal beverages is essential (Dzień et al., 2025).

In this context, the present review aims to analyze herbal teas and infusions obtained from *Urtica dioica* leaves, focusing on their nutritional composition, bioactive compounds, potential health benefits, and safety considerations. By integrating information from recent scientific studies, this paper seeks to provide a comprehensive overview of nettle-based beverages and their relevance in contemporary nutrition.

MATERIAL AND METHODS

The present work is based on the analysis of existing scientific literature related to herbal teas and infusions obtained from *Urtica dioica* leaves. Relevant articles were identified using databases such as Google Scholar, PubMed, Scopus, and Web of Science, using search terms associated with nettle infusions, their composition, and nutritional aspects.

The selected papers were reviewed in order to identify the main compounds found in nettle leaves, including minerals, vitamins, and antioxidant substances, and to observe how these may influence the composition of the infusions. The information was then organized and summarized to outline the main characteristics and potential nutritional value of these beverages.

RESULTS AND DISCUSSIONS

The analysis of the selected literature highlights that the method of preparation plays a crucial role in determining the chemical composition and biological activity of *Urtica dioica* products (Wilmers et al., 2026). In particular, significant differences can be observed between aqueous infusions (herbal

teas) and various types of extracts (hydroalcoholic or alcoholic), mainly due to their extraction efficiency and selectivity toward bioactive compounds (Muceniece et al., 2025).

From the point of view of composition, nettle infusions contain water-soluble compounds such as polyphenols, flavonoids, vitamins and minerals. These components determine the main nutritional and functional properties of the drink (Huda et al., 2024). Nettle leaves are rich in essential nutrients, including vitamins (A, B, C and K) and minerals (Ca, Fe, Mg) and amino acids which are partially transferred to the infusion depending on the preparation conditions (Sahal et al., 2025). Extracts obtained with the use of organic solvents have a higher content of bioactive compounds, including in particular phenolic acids and flavonoids due to higher extraction efficiency of these methods (Wójciak et al., 2024). Table 1 was created to present the differences between nettle infusion and extracts, which reviews the main aspects related to composition, biological activity and influencing factors.

Table 1

Comparative characteristics of *Urtica dioica* infusions and extracts

Parameter	Infusion (herbal tea)	Extract (Aqueous/ hydroalcoholic/ alcoholic)
Preparation method	Stepping plant material in hot water (traditional method) (Dzień et al., 2025; Shonte & de Kock, 2017)	Extraction using solvents (water, ethanol) or advanced techniques (e.g. ultrasound-assisted extraction) (Muceniece et al., 2025)
Extracted compounds	Mainly hydrophilic compounds such as polyphenols, flavonoids, vitamins and minerals (Sahal et al., 2025; Dzień et al., 2025)	Broad spectrum of compounds including phenolic acids, flavonoids, terpenes and carotenoids (Sahal et al., 2025; Wilmers et al., 2026)
Extraction efficiency	Limited extraction yield due to water solubility constraints (Dzień et al., 2025)	Higher extraction efficiency depending on solvent and technique used (Muceniece et al., 2025)
Polyphenol content	Moderate levels of phenolic compounds (Wójciak et al., 2024)	High concentration of phenolic compounds (Baumli et al., 2023; Flórez et al., 2022; Sancar et al., 2026)
Antioxidant activity	Moderate antioxidant capacity associated with polyphenols (Wójciak et al., 2024)	Strong antioxidant activity due to higher concentration of bioactive compounds (Flórez et al., 2022; Çakmak Sancar et al., 2026)
Anti-inflammatory activity	Mild anti-inflammatory effect (Wilmers et al., 2026)	Significant inhibition of inflammatory pathways and cytokine production (Wilmers et al., 2026; Çakmak Sancar et al., 2026)
Anticancer activity	Demonstrated in vitro through apoptosis induction and reduced proliferation (Abi Akl et al., 2024; Nafeh et al., 2025)	Enhanced cytotoxic and antiproliferative effects in cancer models (Hodroj et al., 2020; Abi Akl et al., 2024; Nafeh et al., 2025)
Mechanisms of action	Mainly antioxidant-related effects and mild modulation of biological pathways (Wójciak et al., 2024)	Apoptosis induction, ROS modulation, inhibition of cell migration and proliferation (Hodroj et al., 2020; Nafeh et al., 2025)
Nutritional contribution	Important source of vitamins, minerals and amino acids (Sahal et al., 2025; Tola et al., 2025)	Limited nutritional contribution, mainly pharmacological effects (Sahal et al., 2025)
Mineral content	Transfer of minerals such as Ca, Mg, Fe and Zn into infusion (Dzień et al., 2025)	Variable mineral content depending on extraction method and plant material (Dzień et al., 2025)
Variability factors	Influenced by infusion time, temperature and plant origin (Popov et al., 2025; Barbhuiya et al.,2023)	Influenced by solvent type, extraction method, plant maturity and processing conditions (Popov et al., 2025; Tola et al., 2025)
Bioavailability	Moderate and dependent on preparation conditions (Dzień et al., 2025)	Potentially higher due to concentrated bioactive compounds (Muceniece et al., 2025)
Safety	Generally safe for daily consumption (Dzień et al., 2025; Winkler et al., 2020)	Dose-dependent; requires controlled administration (Tola et al., 2025)

Application	Functional beverage used for preventive health (Dzień et al., 2025)	Therapeutic, nutraceutical and pharmacological applications (Wilmers et al., 2026)

Antioxidant activity of plant-derived *Urtica dioica* products is closely linked with the content of polyphenols. The evaluation showed that infusions as well as extracts of the plant-derived products exerted antioxidant activity, with generally significantly higher activity being exhibited by plant-derived extracts due to the higher content of phenolic compounds (Muceniece et al., 2025). Nettle extracts are abundant in chlorogenic acid and its derivatives as well as caffeic acid derivatives and exert significant scavenging activity on free radicals thus exercising an inhibitory effect against the development of oxidative stress – a process crucial in the prevention of development of oxidative stress-related chronic diseases (Wójciak et al., 2024).

Biological activity of nettle infusions and extracts were found to contain anti-inflammatory and possible anticancer properties. However, extracts include a higher bioactivity than their infused form. It was discovered that aqueous extracts of nettle inhibited the growth of cancer cells and triggered apoptosis via inducing DNA fragmentation and the modulation of apoptotic proteins (Hodroj et al., 2020). Abi Akl et al., 2024 also revealed that the use of nettle-based preparations can aid in increasing the anticancer activities and the reduction of tumor growth in vitro studies (Abi Akl et al., 2024). Polyphenols and flavonoids found in the leaves of nettle also shown anti-inflammatory properties in which they modulate the production of cytokines and oxidative stress (Wilmers et al., 2026).

Another important aspect is the safety and applicability of these preparations. Nettle infusions are generally considered safe for daily consumption and are widely used as functional beverages (Shonte& Kock, 2017). On the other hand, extracts, although more potent, require careful dosage due to their higher concentration of active compounds (Baumli et al., 2023). This distinction is particularly relevant when considering the use of nettle products in dietary versus therapeutic contexts.

As recent studies demonstrated, in some cases only trace amounts of hazardous heavy metals such as lead, cadmium or arsenic may be found in herbal teas resulting from either environmental or technological factors (Winkler et al., 2020). Although the quantified levels are typically low, over time they can amount to quite considerable levels of bioaccumulation as a result of prolonged consumption. Hence, it is vital to establish and guarantee the control of these parameters in infusions used as tea, especially in the case of consumption on an everyday basis as part of the standard diet (Dzień et al., 2025).

Furthermore, variations in chemical composition play an essential role in determining the quality and effectiveness of nettle-based products. The content of bioactive compounds in both infusions and extracts is not uniform and can be influenced by multiple factors, including plant origin, harvesting conditions, drying techniques, and extraction parameters such as temperature, duration, and solvent type, as reported in studies analyzing the impact of species, origin, and maturity stage on nettle composition (Tola et al., 2025). In addition, the method of extraction and the processing conditions are crucial in shaping the final composition of *Urtica dioica* preparations, as they directly affect the release and concentration of active constituents (Wilmers et al., 2026). Even for simple herbal infusions, preparation conditions (particularly water temperature and steeping time) can meaningfully influence the extent to which minerals and phytochemicals are transferred into the final beverage (Dzień et al., 2025).

Nettle infusions are usually considered safe and can be included in the daily diet. They also contribute with a range of nutrients that support general health (Bhusal et al., 2022).

In comparison, extracts tend to have a more pronounced biological effect. This is mainly because they contain a higher concentration of active compounds (Baumli et al., 2025).

For this reason, the choice between them mainly depends on their intended use. Infusions are more suitable for daily consumption, whereas extracts are preferred when a more specific therapeutic effect is needed (Wilmers et al., 2026).

CONCLUSIONS

Nettle infusions are generally mild and can be consumed regularly, while extracts tend to have stronger effects because they are more concentrated. Even so, it is important to keep in mind that these preparations can contain

different elements, so their safety should be considered, especially with long-term use.

Future studies should focus on improving extraction methods so that results become more consistent. It is also important to better identify which compounds are responsible for particular biological effects. At the same time, there is a need to develop more efficient products for both food and pharmaceutical use.

Another important aspect is safety. The presence of potentially harmful elements in infusions should be carefully monitored. In addition, their long-term effects on human health still need further investigation.

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