Common nettle processing residues as a valuable source of antioxidants

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Among medicinal plants, common nettle is known as one of the richest sources of antioxidants (Sekhon-Loodu, 2019). Therefore, it has a special place in the human diet. Nettle plants can be consumed in different ways, while it is commercially used in the form of herbal tea. However, in the nettle tea production process, a significant amount of chopped biomass is left behind, which is often discarded or used as fertilizer (Pajura, 2023) or pellet (Obidziński, 2017), without the valorisation of its full potential.

We examined the possibility of extracting antioxidants from nettle biomass residues to create products of added value. We compared the characteristics of extracts obtained from nettle residues and the high-quality biomass of nettle flowers. For the optimization of extraction, we used the Taguchi method, to study the effect of different extraction conditions: solvent type (distilled water, 25% ethanol:75% distilled water, 50% ethanol:50% distilled water), duration of ultrasonic waves treatment (0, 5, 10 min), and temperature (room temperature, 37°C, 50°C). In the obtained extracts, we measured the antioxidant activity spectrophotometrically by the ABTS and DPPH methods, expressed in Trolox equivalents per dry weight of extract. We also determined the polyphenol content of the supernatants spectrophotometrically by the Folin-Ciocalteu method, expressed in gallic acid equivalents per dry weight of extract.

The results have shown that nettle residue extracts represent a valuable source of antioxidants. According to the ABTS method, under the following conditions: 50% ethanol as solvent type, no ultrasonic treatment and a temperature of 50°C, the mean value of the degree of inhibition for nettle residue extracts is 44,45 mM Trolox equivalents, which is 18,58% less than the antioxidant content of the flower extract under the same conditions. Nettle residue extracts obtained when the solvent type was 50% ethanol, ultrasonic treatment lasted 10 min, and temperature was 37°C, showed antioxidant activity of 33,87 mM Trolox equivalents according to the DPPH method, which represents 4,25% more than the antioxidant content of the flower extract under the same conditions. Under the same conditions as the DPPH method, the total polyphenol content in nettle residue extracts totals 5,06 mM gallic acid equivalents according to the Folin-Ciocalteu method, which is 51,5% more than the polyphenol content of the flower extract under the same conditions.

For obtaining high antioxidant activity of nettle residue extracts assayed by ABTS radical, the type of solvent was the most significant parameter, then the duration of ultrasonic treatment, and the least important was temperature. DPPH radical scavenging activity and total phenolics content in nettle residue extracts were the most susceptible to the concentration of ethanol in the solvent, then to temperature, while ultrasound treatment was the least important parameter for obtaining extracts with high activity.

Nettle residue extracts proved comparable or even higher in antioxidant activity to extracts obtained from nettle flower, considered the highest quality nettle biomass, used as a source of antioxidants for the food, pharmaceutical or cosmetic industry. It remains to test other qualitative and quantitative parameters of these extracts in order to fully assess their potential for applications, but the proposed extraction can be attractive for SMEs that produce herbal tea at smaller scales but still generate significant amounts of herbal wastes and residues. The proposed strategy unequivocally promotes the concept of a circular economy, which, among other things, implies the minimization of waste in the process industry, turning it into a valuable resource and can provide additional revenues for companies.

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