Curcuma longa L: PULSED ELECTRIC FIELD PRETREATMENT FOLLOWED BY SUBCRITICAL WATER EXTRACTION WITH ADDITION OF ACIDIC MODIFIER

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Abstract
In this study, subcritical water extraction (SWE) was applied to the *Curcuma longa* that was subjected to the pulse electric field (PEF) pretreatments. In addition, to investigate the possibility of improving the stability of curcuminoids and considering that curcuminoids are stable in an acidic environment, the addition of the HCl acid as an extraction modifier was investigated.

Introduction
Turmeric (*Curcuma longa* L.) is a perennial herb widely spread in tropical and subtropical regions of the world. Moreover, turmeric is very common in the food industry and also represents one of the most extensively studied plant species because it possesses a large number of pharmacological activities. It has been proven that turmeric has antiinflammatory, antioxidative, antibacterial, hepatoprotective, neuroprotective, cardioprotective, antidiabetic, and anticancer activities [1,2]. Considering its high pharmacological potential, there is a constant need to improve the techniques for obtaining bioactive components of turmeric. At the same time, it is essential to focus on the quality of products and the impact on the environment.

Experimental
In this study, subcritical (100 - 160°C) as well as liquid (80°C) water extraction with added HCl as a modifier (1%) were applied on turmeric powder to obtain extracts with high polyphenolic content. Additionally, for further improvement of the extraction process, pretreatment with PEF with a specific energy input of 14 kJ/kg and field strength 2 kV/cm was applied. The extraction of the sample that was not pretreated (control) was also performed to determine the efficiency of the applied PEF pretreatment. The content of total phenols and flavonoids in the obtained extracts was determined using spectrophotometric methods, as well as the antioxidant activity of the extracts.

Results and discussion
The obtained PEF-treated turmeric extracts had the content of total phenols in the range from 0.538 to 2.141 mg GAE/mL, and the content of total flavonoids was from 0.168 to 0.492 mg CAT/mL. As the extraction temperature increased, an increase in the content of total polyphenols was noted, therefore, the highest yield of polyphenols was measured at a temperature of 160°C. The 80°C was the lowest extraction temperature at which water had the properties of a polar solvent and achieved the lowest yield of polyphenols. The application of PEF pretreatment had a positive effect on the total content of phenols and flavonoids in all extracts obtained with modified water in the subcritical state.
With an increase in extraction temperature, a rise in the antioxidant activity of the PEF extracts was observed, therefore, the highest antioxidant activity was recorded at a temperature of 160°C (1.38 µL/mL). It has been shown that antioxidant activity of the extracts correlates to the content

of total phenols and total flavonoids. Moreover, the application of PEF pretreatment had a positive effect on antioxidant activity of the extracts obtained at temperatures 100 and 160°C.

Conclusion

PEF demonstrated to be an effective pretreatment for enhancing polyphenolic extraction and, in combination with SWE, it represents a green alternative approach for obtaining turmeric extracts. However, further detailed analyses of the chemical profile of extracts are required, as well as the possible presence of contaminants generated during SWE, to ensure the safe application of the obtained extracts.

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References

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