O 21 - The influence of ultrasound treatment on structure and electrical properties of plant tissue

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Abstract

Ultrasound treatment (US) in food technology is used to enhance mass and/or heat transfer that occurs extraction, drying, freezing, osmotic dehydration, etc. The literature shows that the sonication impacts on physical and chemical properties of plant tissue and provokes some changes in the tissue structure [1,2].

The aim of this study was to investigate the impact of ultrasound treatment on the structure and electrical properties of plant tissue such as apple, carrot and mushroom. The influence of power and duration of sonication was analyzed. The slices of the apple, carrot and white mushroom hat were subjected to 21 kHz ultrasound treatment for 10, 20, 30, 45 and 60 minutes at 180 and 300 W. After ultrasound application the material was blotted out of the water and then subjected to measurements of selected electrical properties such as impedance, resistance, electrical capacity and conductivity. In order to analyze the microstructure by scanning electron microscopy, the samples were freeze-dried prior to analysis.

Based on the obtained results, it was found that the electrical properties of apple tissue changed significantly as a result of the ultrasonic treatment. It was found that the time of US treatment significantly influenced the values of all tested parameters. No significant impact of ultrasound power has been found. Based on obtained electrical properties, it can be assumed that the cell membrane integrity of apple tissue was violated. Such findings were confirmed by the SEM images, where differences in the destruction of the microstructure were noticeable after 45 minutes of treatment, while the effect of power could be observed after 60 minutes of processing.

In the case of carrot different dependencies were observed. The electrical conductivity of sonicated samples remained unchanged in comparison to intact material. There is a possibility that the continuity of the cell membrane and the integrity of the cell structure has not been affected, but some changes in the organization of cell organelle might occur. Such a theory was supported and indicated by changes of other electrical parameters. As shown by microscopic analysis, US treated carrot tissue was characterized by distance between cells residues and the formation of microscopic channels. The structure of the sonicated carrot's cortex was homogeneous with increased porosity, regardless of processing time, while the largest changes in the core layer were noted after 30 min sonication.

Results obtained for sonication of mushroom were ambiguous. For the vast majority of electrical parameters and variants of experiment, results were irrelevant when compared to untreated samples. However, microstructure SEM analysis showed that the structural changes were more pronounced when treatment time was longer.

The research showed that the structure of plant tissue has an effect on electrical properties.

References

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