Stability of mushroom polyphenol oxidases and horseradish peroxidases under supercritical carbon dioxide

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Supercritical carbon dioxide (SCCD) technology is the novel non- or mild-thermal method of food preservation. The microbial stability of fruit and vegetables (F&V) products preserved by SCCD technique has been proved by many researchers, but inactivation of tissue enzymes is still under study.

The aim of this work was to investigate the influence of SCCD treatment on the inactivation kinetic parameters of mushroom polyphenol oxidases (PPO) and horseradish peroxidases (POD), as representatives of enzyme groups mainly responsible for deterioration of F&V quality, at their optimal pH.

Material for this study were commercially available enzymes (Sigma-Aldrich, USA) diluted in 0.05 M phosphatate buffer (pH 7.0) and immediately processed by CO_2 in supercritical state, using Spe-ed^{TM} SFE apparatus (Applied Separations, USA) at up to 60 MPa, 30 min and 65°C. PPO and POD activity were measured spectrophotometrically and the kinetic rate constant: *k – value*; decimal reduction time: *D – value*; pressure and temperature increase needed for a 90% reduction of *D – value*: z_P and z_T – values; activation volume: V_a; and activation energy: E_a were calculated.

Increasing the temperature and pressure during SCCD processing resulted in increasing of the *k* – and decreasing of *D – value* for both types of enzymes. POD turned out to be more thermal and pressure resistant compared to PPO. The lowest *D*, z_P and z_T – values were noted for the highest pressure and temperature of the process of PPO inactivation: 60.6 min, 260.6 MPa and 111.4 °C, respectively. The E_a – value of PPO decreased with increasing the pressure whereas changes of *Ea* of POD did not show a clear trend. The V_a calculated for PPO and POD decreased with increasing the temperature of inactivation.

According to our best knowledge this is the first study concerning determination of kinetic parameters of inactivation of mushroom PPO and horseradish POD under SCCD treatment. It shows that this technique allows to significantly decrease oxidoreductases activity. These are complementary studies to our earlier work on the inactivation kinetics of native and commercial PPO and POD in apple juice matrix. Comprehensive research shows that the stability of enzymes depends on the type of enzyme, source, matrix and SCCD treatment conditions.

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