Improved stability of immobilized transglutaminase in supercritical carbon dioxide

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One of the very important enzymes in the food, textile and cosmetic industries is transglutaminase (TGM). TGM is an enzyme that catalyzes the formation of isopeptide bonds between proteins. Its "crosslinking" property is often used in various processes: for the production of cheese and other dairy products, for the processing of meat and for the production of bakery products, in health industry etc. TGM has considerable potential to improve the strength, viscosity, elasticity of foods and the ability to bind water. The use of free enzymes is limited due to their activity lost over time and their sensitivity to external environmental factors (temperature, high pressure, pH, solvents, oxidation and drying). Those factors may cause deactivation of an enzyme, but its immobilization can improve its stability and activity. One of the important enzyme immobilization technique is formation of cross-linked enzyme aggregates (CLEAs), where no carrier is needed.

Magnetic nanoparticles (MNPs) have proven to be a successful tool for immobilizing enzymes, proteins, drugs and other bioactive molecules due to their biocompatibility, biodegradability, colloidal stability, low toxicity and nanometer scale. Combining MNPs with CLEAs technique, more sophisticated and industrial relevant biocatalyst – magnetic CLEAs (mCLEAs) can be obtained.

Some enzyme-catalyzed reactions may be carried out in a non-aqueous medium under extreme conditions. Supercritical fluids (SCFs) are also one of the non-aqueous media suitable for carrying out enzyme reactions. However, the biocatalyst has to be stable in those media.

The stability of TGM immobilized in the form of CLEAs and mCLEAs was studied at different conditions in supercritical carbon dioxide (SC CO_2). The results show that SC CO_2 has a favorable effect on activity and stability of native TGM, and TGM immobilized in the form of CLEAs and mCLEAs, which indicates the possibility of using the tested catalyst forms even under extreme reaction conditions.