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CEREAL BY-PRODUCTS AS AN IMPORTANT FUNCTIONAL INGREDIENT: EFFECT OF ENZYMATIC TREATMENT

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Recently, great attention in food industry has been given to upgrades of existing technologies to improve the effectiveness of complex processing of raw material (particularly grain raw material) and to increase production of high-quality products. For example, it is possible to obtain a number of physiologically functional ingredients from grain bran using modern innovational approaches to their biotransformation. This allows obtain biologically active substances of various chemical nature with a broad range of physiological effects.

The purpose of this work was to convert vegetable raw material by fermentative hydrolysis. The cell wall of a plant cell of grain raw material is a complex system which includes combinations of various polymeric compounds and low-molecular substances. Their ratios in each structural part of the cell depend on the functional tasks and features.

The first stage was the screening of hydrolytic enzymes and determination of their activity: α-amylase (*Bacillus subtilis*) – 2000 units/g of preparation, glycoamylase (*Aspergillus awamori*) – 6000 units/g, protease (*Bacillus subtilis*) – 70 units/g, and multienzyme preparation Viscozyme L (*Aspergillus aculeatus*), which contains: β-glucanase at 100 units/g, xylanase at 50 units/g, cellulase at 70 units/g, pectinesterase at 40 units/g and some feruloesterase.

In order to destruct the bran more effectively, were used various combinations of hydrolytic enzymes to increase the extraction of desired components from vegetable biomass.

The previous treatment of biopolymer complex with amylolytic and proteolytic enzymes in order to further use the multienzyme preparation Viscozyme L was shown to be reasonable. It was proven that the enzyme preparations used during the first stage

of hydrolysis (α-amylase, glucoamylase and protease) catalyzed reactions resulting in destruction of starch granules and proteins in the endosperm. The presence of a buffering solution in the reacting system promotes swelling of hollow cells of seed coats. During the second stage of hydrolysis (by the preparation Viscozyme L), the native structure of hemicelluloses and cellulose fibrils changed and they were destructed. Loosening of cellulose and hemicelluloses microfibrils in the matrix of wheat bran cell walls makes the biopolymers more available for further impact of enzymes.

Optimum parameters of fermentative modification of wheat bran biopolymers were determined:

– starch and protein – α-amylases (C = 0.001%), glycoamylases (C = 0.0006%) and proteases (C = 0.005%) at a hydromodule of 1:1, pH 5 and 55±1°C, duration of hydrolysis was 30 min;

– hemicelluloses – the preparation Viscozyme L (C = 0.001%) at a hydromodule of 1:10, pH 4 and 50±1°C, duration of the process was 4 hours.

Conditions for separation of bran enzymolysate and technology for obtaining xylooligosaccharides and polyphenols have been developed. The list of obtained substances includes:

– carbohydrate-protein concentrate containing 70% of dry matter with 35.6-43.4% of carbohydrates and 24.1-31.4% of raw protein which has good balance of essential and non-essential amino acids;

– concentrate of biologically active substances with 70% of dry matter containing 49.4-51.4% of xylooligosaccharides and 0.5-0.6% of polyphenols;

– a preparation of polyphenols with 94% of dry matter which consists of polyphenols by 90-90.8%;

– a preparation of xylooligosaccharides with 92% of dry matter in which xylooligosaccharides account for 65.4-68%;

– and a concentrate of dietary fibers.

The results of investigation of polyphenol composition with high-performance liquid chromatography show a high content of ferulic acid in hydrolysates. Ferulic acid gives the lysate a potent antioxidative activity. This was confirmed by biomedical researches. The obtained oligosaccharides were tested with thin-layer chromatography, their low level of polymerization gives the bran xylooligosaccharides extremely high prebiotic properties.

The biotransformation of polymeric cereal matrix has been shown to allow to obtain biologically active components that are chemically bound to polysaccharides from plant cell walls and to obtain their concentrates and an activated complex of dietary fibers.

The new approach allowed to develop new biotechnological processes to obtain a number of physiologically functional food ingredients.