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Production of Modified Arabinoxylan from Rice Bran (BioBran/MGN-3)

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Production of BioBran/MGN-3

1) Rice bran as an ingredient of immunomodulatory food

Rice bran consists mainly of components of the cell wall of the coat of rice seeds, which works as a strong barrier protecting the seed. It includes cellulose, hemicellulose, pectin, and lignin, all of which are polymeric. These components are all types of dietary fiber, of which rice bran is a good source. The recent recommendation to take unpolished rice in order to maintain and promote health is certainly correct from the aspect of dietary fiber intake.

Hemicellulose, one of these components, is a heteroglycan comprising several monosaccharides and has a complex structure. Its molecular weight (MW) is lower than that of cellulose. If cellulose is likened to concrete blocks, hemicellulose can be said to play the role of the concrete that glues the blocks together.

Hemicellulose B, one of these types of hemicellulose, has attracted attention as a possible component of immunomodulatory foods. Hemicellulose B is water-soluble and is contained in rice bran in a ratio of 3-5 grams per kilogram.

Hemicellulose B also has a complex structure, consisting of a long xylose chain with arabinose branches,

each of which has further smaller branches such as galactose, glucose, or uronic acids. However, its MW is far lower than those of other hemicelluloses. It is not digested in the human gastrointestinal tract because of its chemical structure, but its size suggests the possibility that the molecule is absorbed without a change in structure. Hemicellulose B is a very interesting potential ingredient of immunomodulatory foods.

There are many reports on BRMs, also known as immunomodulatory substances, including many on dietary fiber BRMs. All these are polymeric. When they administered and absorbed into the blood, antigen-presenting cells recognize them as foreign, which activates the immune system. β-1,3-glucan in various mushrooms and α-1,6-mannan in baker's yeast produce high activity. However, many dietary fiber BRMs are not effective when taken orally, i.e. they are not absorbed from the gastrointestinal tract. This may be because of their MW and chemical structure. Even if they have high activity as BRMs, ingredients which cannot be absorbed cannot be used in immunomodulatory foods, but must be injected intravenously as purified molecule. In recent years, it has been reported that polymeric components are effective in stimulating the intestines but the causal relationship has not been shown quantitatively.

2) The preparation of a derivative of rice bran hemicellulose B by modification

Rice bran hemicellulose B has a complex sugar composition. Its main constituent sugars are arabinose and xylose and its other sugars include rhamnose, galactose, mannose, glucose and uronic acid. Hemicellulose B itself has no immunomodulatory action. We have tried to produce its derivatives by modification using a food processing technique. The constituent sugars, apart from arabinose and xylose, were hydrolyzed enzymatically to obtain a derivative of hemicellulose. As the carbohydrase allows reactions under very mild conditions including low temperature, a derivative can be produced without causing changes in the basic structure of complex hemicellulose.

Enzymes are widely used in food- processing. Representative examples are glucoamylase, used in the saccharification of starch in alcohol fermentation, pectin esterase, in the clarification of apple juice, and 5-phosphodiesterase and adenylic acid deaminase, in the production of nucleic acid flavourings. Although enzyme preparations are generally used in these products, in some cases a culture of enzyme-producing microorganisms is incorporated into the production process, and the culture filtrate then goes through a rough purification process and is used in production. Since rice bran hemicellulose B, with its complex structure, has a wide variety of hydrolysable linkages, we thought it better for efficient production to use an enzyme complex obtained from a culture fluid of microorganisms that produce enzymes which can degrade many types of plant tissue, rather than combined enzyme preparations.

The obvious choice for microorganisms that degrade plant tissue are basidiomycetes in the fungal group, in other words, mushrooms. Most basidiomycetes grow using wood as a source of nutrition. They hydrolyze polymeric fibers and lignin into lower-level molecular substances by means of a range of enzymes and use them as a source of nutrition. As a result, culture filtrates of asidiomycetes contain many carbohydrases. These work as an enzyme complex that catalyzes serial hydrolytic reactions changing polysaccharides to monosaccharides. The use of the enzyme complex accelerates the reaction, resulting in the efficient production of the final, desired product.

A shiitake fungus was fluid-cultured, the culture filtrate partially purified to obtain a carbohydrase complex, and the enzyme complex used to modify rice bran hemicellulose B. This enzyme complex contains α-glucosidase, β-glucosidase, and galactosidase, but no enzymes that catalyze hydrolysis of xylose

or arabinose-xylose linkages. The enzyme complex was reacted with rice bran hemicellulose B to obtain the rice bran hemicellulose derivative BioBran/MGN-3, which has an interesting immunomodulatory action.