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

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Background to the development of BioBran/MGN-3

1) Dietary fiber and immunomodulation

Many polysaccharides in microorganisms used in foods and fermentation have been shown to act as biological response modifiers (BRM) and enhance immunity. These include zymosan (β-1,3 glucan), a component of the cell wall of brewer's yeast; α-1,6 mannan, a component of the cell wall of kitchen and baker's yeast; and β-1,3 glucan, a component of the cell walls in shiitake and enokidake mushrooms and Grifola frondosa. Some of these are taken orally and exert a slight immunomodulatory effect after absorption in the digestive tract. Some are used as immunomodulatory agents in the treatment of cancer.

Most types of dietary fiber are polysaccharides, which are commonly ingested in foods. The ingredients above, on the other hand, are purified and used as pharmaceutical products by health professionals after obtaining manufacturing approval. In this case, they are categorized as drugs rather than food and treated accordingly. However, it is possible that some of the ingredients, taken as dietary fiber in a normal diet, are absorbed in the intestinal tract without changing their structure, and activate immune cells.

2) Immune responses to food ingredients

When foreign material enters the body, the host recognizes it as an antigen and produces antibodies that specifically react against the antigen to provide protection against injury. This is immunity, and it plays an important role in biological defense. The reaction against the antigen may be exaggerated in some cases and acute shock symptoms then appear. This hypersensitivity reaction is called an allergy. As food is a source of foreign matter for the body, it may be antigenic. As shown in the table (**Table 1**), many foodstuffs contain ingredients that can cause allergies.

Food allergies often occur as immediate reactions and mainly consist of type I reactions. These are typical allergic reactions in which IgE antibody plays an important role. However, some food allergies involve a type-IV delayed reaction. In this case, an antigen stimulates lymphocytes, and encourages them to activate, proliferate, and differentiate in to induce sensitized lymphocytes (T cells). When the antigen enters again, T cells react against it and release various lymphokines, proteins with a biological action, which may act on tissue cells and cause inflammation.

Although allergenic ingredients in foods are a negative factor, in that they induce adverse reactions, some of them, in terms of stimulation of immune system, especially those that induce type-IV reactions, and for which the reaction is mild, may enhance immunity, in other words, act as positive factors, as with BRMs. In fact, the cow's-milk protein casein, lysophospholipid, a kind of phospholipid which induces interferon, some fruit such as kiwi fruit and apples, and vegetables such as spinach, onions and carrots cause neutrophils to accumulate. It is fair to say that foods taken daily protect us from infections and malignant tumors.

If an immunomodulatory food that enhances immunity more actively can be conveniently ingested, it could become widely used in the maintenance and promotion of health and the prevention and treatment of disease.

Among the ingredients in immunomodulatory foods, there are those that exist in foods as intact components with immunomodulatory activity, those whose inactive parent compound is degraded into fragments in the digestion process and whose special fragments have an immunomodulatory function, and those that develop their function after undergoing processing. Food ingredients are very complex compounds and are digested into many substances after being taken into the body. In addition, foodstuffs are often processed to make them easier to eat and preserve, which changes their ingredients, resulting in a still wider variety.

Table 1

Foodstuffs that may be allergenic	
Animal and fish foods	Hens' eggs (the whole egg, white and yolk) and egg products, cows' milk and milk products, beef, pork, ham, sausage, bacon, mackerel, bonito, horse mackerel, sardine, saury, tuna, squid, octopus, shrimp, oyster, crab, and steamed fish paste
Plant foods	Soy beans and their products (miso paste, soy sauce, and tofu), sweetcorn, sugarcane, aroid, aubergines, tomatoes, spinach, bamboo shoots, buckwheat and its products, Japanese udon noodles, bread, konjac mannan, citrus fruits (such as satsumas), and cocoa
Others	Yeast (baker's yeast and brewer's yeast), beer, sake, whisky, wine, and chocolate

From Food Hygiene edited by Sawamura, Hamada, and Hayatsu, p. 96, Nankodo, Tokyo (1986)

3) The significance of and requirements for immunomodulatory food products

A number of pharmaceutical products that enhance immune function, such as *Bordetella pertussis* vaccine,

haemolytic streptococcal preparations, and basidiomycetous preparations (from the kawaratake, shiitake, and suehirotake mushrooms) have been developed and used for practical purposes, mainly in the treatment of cancer. Most components of these products are also present in food products but the methods of using foods and pharmaceutical products are very different, even where the same effect is generated. As the amount of food ingested depends on the mental and physical conditions of the individual, it is generally difficult to specify doses. It is therefore undesirable that the amount of active ingredients in foods exceeds a fixed level. In contrast, with pharmaceutical products a proper dose is specified and they are used under medical supervision because they may produce toxic effects if taken in excessive doses.

However, food products used to enhance immunity are different in their function from other foods. They are foods but work almost as medicines. Here, emphasis is placed on their tertiary function, their effect on the immune system, rather than taste or value as energy sources. Therefore, immunomodulatory foods should meet the following requirements:

① Their active ingredients should be known.

② The content and presence of the ingredient in the food should be known.

③ The mechanism of their action should be clear.

④ The food should be highly safe.

⑤ The food should be effective when taken orally.

Foods mentioned above will enable easy health maintenance by adults. We are surrounded with many immunocompromising factors such as stress, smoking, electromagnetic radiation, heat, chemotherapy, and inevitable aging. A compromised immune system lead to problems such as infections, malignant tumors, adult diseases and endocrine-related disorders and delays the return to health. Using immunomodulatory foods properly will make for easy health maintenance and increase our quality of life.