“Rare sugars” are monosaccharides that occur only rarely in nature, and they come in about 50 types, including D-psicose and D-allose. We have perfected a strategy called “izumoring” to produce these systematically and have completed design schemes for producing all rare sugars. The rare sugars produced using izumoring have been discovered to have previously unreported bioactivity and new physical and chemical properties.

Our aim is the creation of a new “sugar life science” and a “sugar bio-industry” via the mass production of rare sugars and a detailed examination of their bioactivity and physico-chemical properties.

Project Overview

We have perfected the world’s first “izumoring” production strategy for all rare sugars. All six-carbon rare sugars can be produced using this method. We are making progress in basic and applied research on the bioactivity of rare sugars that we have produced by ourselves. Kagawa (Takamatsu Rare Sugar Biocluster) is the sole area that can produce all rare sugars using the “izumoring” regime, and we have promoted globally pioneering applications development based on bioactivity and physico-chemical properties.

Rare sugar production (We produce all rare sugars independently!) The process works as follows: from starch to D-glucose, to D-fructose, and then on to the world of rare sugars. D-psicose is the gateway to that world. With D-psicose as a raw material, other new rare sugars, including D-allose and allitol, are then produced. Fourteen types of rare sugars, including D-psicose, an 8-lysine-chose kit, and a 10 sugar alcohols kit are now on sale.

Applications in food products and sweeteners (More than just sweetness!) Rare sugars, as sugars, are naturally sweet. But they are more than just sweet: they have also been discovered to have a positive effect on human health. We have revealed that rare sugars prevent diabetes, atherosclerosis and obesity by suppression of lipid accumulation and hyperglycemia. In this way, rare sugars have the potential to be used in sweeteners and as food products with new functional characteristics.

Applications in pharmaceuticals (Creating new pharmaceutical products!) Rare sugars can be used in other applications in addition to foodstuffs and sweeteners. We have also confirmed their functionality as pharmaceuticals as D-allose. D-allose has a potent inhibitory effect on the production of reactive oxygen species. Its use to protect against ischemia and preserve cells and organs is being studied, and our dreams continue to expand regarding the use of these sugars in new types of drugs.

Applications in plants (Plants recognize monosaccharides) Research has confirmed that plants recognize D-psicose. The fact that monosaccharides have bioactivities on plants was a completely unexpected discovery. Our project has been granted subsidies from the Agriculture, Forestry and Fisheries Research Council, and we have started applied research on safe agricultural chemicals, "A new world created by rare sugars".

Main Results

1. Establishment of production techniques for all rare sugars: Now on sale, fourteen types of rare sugars, including D-psicose!!

We have perfected the “izumoring” production strategy for all six-carbon rare sugars. Participating industry has begun the sale of fourteen types of rare sugars regents, including detailed examination of the bioactivity of D-psicose.

2. Applications in functional foodstuffs: Development of new foodstuffs (specified health foods) has been promoted using the function of D-psicose (non-calorie, suppression of lipid accumulation and hyperglycemia). Functional sweeteners have been developed to prevent obesity and “metabolic syndromes.”

3. Development of pharmaceuticals with protective action against ischemic disorders: The antidiabetic action of rare sugars provides effective protection against internal organ disorders that arise from oxygen radicals. We are investigating their effectiveness in various organs and plan to develop applications in injection and intravenous drip fluids.

4. The development of environmentally friendly plant regulators (“eco” agricultural chemicals): We have determined that rare sugars help to control the growth of plants and that even small concentrations of rare sugars are effective. We have also learned that rare sugars act to increase the resistivity of plants. Development of novel agricultural chemicals using this action has begun.