

# TAKAMATSU

## Takamatsu Rare Sugar Bio-cluster

### Outline of the Project

“Izumoring”, a structural framework containing all 34 six-carbon monosaccharides linked by enzymatic reactions, has been proposed following the discovery of a key enzyme which converts abundantly occurring monosaccharides in nature into rare sugars. This has made possible the mass production of rare sugars from inexpensive sugars such as D-glucose or D-fructose. We have started research to elucidate physico-chemical characteristics and biological function of rare sugars. The main objectives of this research are development of “glyco-life science” and of new glyco-bio industries manufacturing various rare sugars based products such as pharmaceutical drugs, functional foods, cosmetics.

Note: Rare sugars are defined by the International Society of Rare Sugars as “monosaccharides and their derivatives that are rare in nature”. They are hardly available for research purposes because of their expensiveness.

### Members of the Headquarters

- President..... MANABE Takeki (Governor of Kagawa Prefecture)
- Vice President..... KONDO Koji (President of Kagawa Univ.)
- Project Director..... TSUJISAKA Yoshio
- Research Director..... IZUMORI Ken (Director, Kagawa Univ. Rare Sugar Research Center)
- Research Vice Director..... TOKUDA Masaaki (Director, Kagawa Medical Univ. Rare Sugar Applied Research Center)
- Science and Technology Coordinator..... SAKAI Syuzo

**Central Project Organization** Kagawa Industry Support Foundation

**Core Institute(s)** Kagawa Univ.,  
Kagawa Medical Univ.

**Participants**

Industry···Fushimi Pharmaceutical Co.Ltd., Teikoku Seiyaku Co. Ltd., Shikoku Research Institute Inc.,  
RyuSyu Industrial Co.Ltd., Hayashibara Co.Ltd., Organo Corporation

Institute···Kagawa Univ., Kagawa Medical Univ.

Government···AIST Shikoku,  
National Agricultural Research Center for Western Region,  
Kagawa Prefectural Industrial Technology Center,  
Kagawa Prefecture Agricultural Experiment Station,  
Kagawa Prefecture Forestry Research Center,  
Research Institute for Solvothermal Technology

**Main Researchers**

IZUMORI Ken (Director of Kagawa Univ. Rare Sugar Research Center)  
TOKUDA Masaaki (Director of Kagawa Medical Univ. Rare Sugar Applied Research Center)  
TAKAHASHI Takeo (Managing Director of Fushimi Pharmaceutical Co Ltd. Research &  
Development Center)

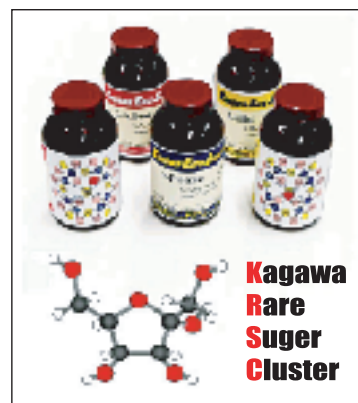
## Outline of Researches

### ●Establishment of a Foundation for Basic Research on Rare Sugars

– Elucidation of basic characteristics and development of analytical methods and an integrative architecture of all rare sugars –

We pursue various lines of research including the development of a method for stabilization of the enzymes and optimization of enzyme reaction condition for mass production of rare sugars, and search for new enzymes which are related to Izumoring structure, thereby leading to systematic research of all processes within the framework of Izumoring. More specifically, methods of producing all six-carbon rare sugars from D-glucose as the starting material will be developed. In addition, we also research physico-chemical characteristics of all rare sugars produced in the laboratory will be studied, and their effects on various biological organisms will be assessed. Through this research, we aim to achieve an efficient supply of rare sugars as novel raw materials for the market.

[ Kagawa Univ., Kagawa Medical Univ., Fushimi Pharmaceutical Co.Ltd., Shikoku Research Institute Inc., RyuSyō Industrial Co.Ltd., Hayashibara Co.Ltd., AIST Shikoku, National Institute of Advanced Industrial Science and Technology (AIST), Kagawa Prefecture Agricultural Experiment Station, Kagawa Prefecture Forestry ResearchCenter, Research Institute for Solvothermal Technology ]



Production of D-psicose, D-allose and allitol has already been started, and we aim to produce all of rare sugars in the near future.

### ●Establishment of Technical Methods for Mass Production of Rare Sugars

– Establishment of optimal bio-reactors and usage of unutilized bio-resources –

We have already developed a method of mass-production of D-psicose which is the starting material for the synthesis of mass production of D-allose, and that of L-tagatose and L-galactose from L-sorbose has also been initiated. In addition, we plan to investigate the possibility of using unutilized plant resources as the raw material for synthesis of rare sugars.

[ Kagawa Univ., Fushimi Pharmaceutical Co.Ltd., Shikoku Research Institute Inc., Hayashibara Co.Ltd., Organo Corporation, Kagawa Prefecture Industrial Technology Center, Kagawa Prefecture Agricultural Experiment Station ]



We aim to produce pharmaceutical drugs and functional foods based on physiological function of rare sugars.

### ●Development of New Medicines and Foods from Rare Sugars

– Elucidation of the functioning mechanisms and development of the application methods –

Since there have been almost no reports on the physiological functions of rare sugars, we plan to study the physiological mechanisms of rare sugars in a wide range of living organisms, plants and animals. In addition, examinations of the stability and toxicity trials of various rare sugars have been undertaken for the applied purpose of using these sugars such as D-psicose and D-allose for the production of pharmaceutical drugs, functional foods, cosmetics and so on. (Specific examples of physiological functions that we have already demonstrated include: inhibition of oxygen radical production, inhibition of cancer cell proliferation, anti-diabetic and anti-atherosclerotic effect in animals, and growth control activity in plants.)

[ Kagawa Univ., Kagawa Medical Univ., Teikoku Seiyaku Co.Ltd., National Agricultural Research Center for Western Region ]

## Expected Results

- Development of production methods of all six-carbon rare sugars, and elucidation of their physiological functions
- Supply several rare sugars such as D-psicose in the market
- Applied utilization of physiologically active rare sugars for the production of pharmaceutical drugs, functional foods, cosmetics and so on
- Development of “glyco-life science” and novel glyco-bio industries