Recent Researches

1. Quality Improvement of Food Products by Olive Leaf Polyphenols

Olive leaf contains a large amount of polyphenols (ca5%). The most abundant polyphenol is oleuropein, which exists only in olive. In Kagawa prefecture, olive leaf powder containing high concentration of polyphenol is fed to aquaculture fish yellowtail. In our laboratory, we evaluate the biochemical (protein-level) and mechanical (breaking force) properties of aquaculture fishes (yellowtail and red sea bream) grown with a feed containing olive leaf powder.

2. Effects of Rare Sugars on Food Processing Properties

D-Allulose (Alu), also known as D-Psicose, is the C-3 epimer of D-fructose. It is a rare sugar that exists in small amounts in nature. Alu is a non-caloric sweetener (0.39 kcal g⁻¹) with a suppressive effect on postprandial blood glucose elevation. In our laboratory, we investigate the effects of Alu used as a food additive on various food processing properties (mechanical properties of gels including heat induced egg gel, sausage, and surimi gel, and the effects on lactic fermentation and acetic fermentation).

3. Biological Functions of Egg White Proteins of Chicken Eggs

Chicken egg is a capsule containing all components participating in its embryo development. Some of egg white proteins have antimicrobial activity against bacteria. These antimicrobial proteins prevent bacteria from invading into egg yolk. However, the physiological function of many other proteins except antimicrobial proteins still remain unknown. In our laboratory, we investigate the physiological functions of an egg white protein, called “ovalbumin-related protein X (OVAX)” in chicken egg development.

Publications

- Hadiipernata et al.(2016): Effect of D-allulose on rheological properties of chicken breast sausage, Poultry Science 95(9): 2120-2128
- O’Charoen et al. (2014): Effect of D-Psicose used as sucrose replacer on the characteristics of meringue, Journal of Food Science 79(12): E2463-2469
Food Science

Methods in Food Science

Recent Research

Mycotoxins, the toxic secondary metabolites of some fungi, give healthy damage to humans and domestic animals. These fungi are infected with the crops in farms, and the fungi grow on pre-/post-harvest crops and produce mycotoxins. Mycotoxins remain on the crops after extinction of the fungi, and are heat stable compounds, therefore after cooking, remain in foods. Furthermore, it is known that mycotoxins in animal feeds are transferred to livestock products. A variety of food is contaminated with small quantity of mycotoxins. By an intake of these food for a long term, it is thought that mycotoxins cause the chronic poisoning such as "cancers".

1. Production of monoclonal antibodies against mycotoxins, Development of the immunochemical analysis for mycotoxins in foods, Food contamination investigation, and Risk evaluation

To make clear contamination level of mycotoxins in foods, a simple and easy and high sensitive analysis methods are necessary. Now, the immunochemical methods using antibody are frequently used. We made monoclonal antibodies (mAb) against major mycotoxins, and established immunoaffinity column-HPLC methods using these mAb.

We analyzed mycotoxins in commercial foods, such as rice, coffee, cocoa, and ramen from Japan and Asian countries and feeds for chicken from Brazil and Indonesia. We performed behavior experiments of mycotoxin during food processing. We obtained some new findings.

2. Occurrence of algae toxin (microcystine) in fresh water

Microcystin-Leu-Arg (MC-LR) is one of toxic cyanotoxins, which are contaminated with eutrophicated lakes and ponds. We established a sensitive ELISA method for detection of MC-LR in environmental water using our novel mAb. Our best MC-5-3 mAb was a little strongly reacted to MC-RR than MC-LR, and almost same to MC-YR. The sensitivity of our ELISA was 80 pg/mL of MC-LR. This value was less than 1/10 of the regulation level (1 ng/mL) in drinking water by WHO. Using this ELISA, we perform the pollution investigation into reservoirs of Kagawa.

Publications

A. T. Ishikawa, O. Kawamura et. al.; Exposure Assessment of Infants to Aflatoxin M1 through Consumption of Breast Milk and Infant Powdered Milk in Brazil. Toxins, 8, 246-256 (2016)
Y. Tsuchi & O. Kawamura; Occurrence of microcystins in Oima Pond and Hirata Pond which were reservoirs in the suburbs of Faculty of Agriculture, Kagawa University. (2014), Technical Bulletin of Faculty of Agriculture, Kagawa University, 69, 23-26 (2017).
Recent Research

1. Preparation of nano-emulsion Using a Low Energy Emulsification Method in Food System

Nano-emulsions are emulsions whose droplet diameter typically falls in the range of 20–200 nm. The small droplet size and low polydispersity of nano-emulsions is responsible for their transparent or translucent appearance to the naked eye as shown in the figure. Nano-emulsions are highly stable against gravitational separation.

In general, nano-emulsions can be achieved using either high-energy emulsification methods or low-energy emulsification methods. High-energy emulsification methods involve an intensive energy input using a high-shear stirrer, a high-pressure homogenizer or ultrasound generators. Alternatively, low-energy emulsification methods that utilize thermodynamic driving forces have been developed, enabling the formation of nano-emulsions with minimal energy input of mechanical energy. We study the nano-emulsification in food system.

2. Rheological Properties of Food

Rheological properties of food is important for food texture which is the response of the tactile senses to physical properties of food. In our laboratory, the effect of composition and preparation method on the rheological properties for food system.

Publications

• Enzymatic esterification of tapioca maltodextrin fatty acid ester, Carbohydrate Polymers, 99, 379, 2014, Udomrati, S., Gohtani, S.
• Physical properties of oil-in-water emulsions as a function of oil and soy soluble polysaccharide types, Food hydrocolloid, 39, 34, 2014, Chivero, P., Gohtani, S., Yoshii, H., Nakamura, A.
• Enzymatic modification and characterization of xylo-oligosaccharide esters as potential emulsifiers, International Food Research J., 22, 818, 2015, Udomrati, S., Gohtani, S.
• Effect of temperature on low-energy nano-emulsification and phase behavior in water/polyoxyethylene sorbitan fatty acid ester (Tweens®)/vegetable oil systems, J. Food Engineering, 180, 101, 2016, Prasert, W., Gohtani, S.
• Assessment of soy soluble polysaccharide, gum arabic and OSA-Starch as emulsifiers for mayonnaise-like emulsions, LWT-Food Science and Technology, 69, 59, 2016, Chivero, P., Gohtani, S., Yoshii, H., Nakamura, A.
Research Field in Food Science, Molecular Nutrition and Chemistry on Food materials
Name: TAMURA Hirotoshi

Key Words: Flavor chemistry, Supramolecular Food Chemistry, antiallergy, Antioxidants, Anti-tumor promotion, Antiobesity

1. Physiological function of foods materials

Objectives of my research are to focus on development of new technology for isolation and evaluation of physiologically important food ingredients which are produced in local regions in Japan and other countries. Traditional foods bearing physiological functions are our target materials and then collect database and provide the nutraceutical benefits to the local industries. Currently, we succeeded in isolation of antitumor promotion activity, anti-allergic activity, anti-obesity in local products, specially wasting materials from olive, grape, Perilla leaves, yacon leaves and so on.

2. Supramolecular Food Chemistry for isolation of polyphenols.

Supramolecules are defined as molecule associated with van der Waals force, ionic bond hydrogen bonding and so on without covalent bonding. This self-association molecular can be applied in food chemistry and isolation of polyphenols without any sophisticated instruments. We succeeded in isolation of Perilla extracts and important food components by this method.

3. Flavor analysis

Aroma is one of essential food functions. Flavor is composed of thousands of trace amounts of compounds and form the characteristic aroma and tastes. Sensation of aroma and tastes has different impacts on individual judgments. By means of Limited odor unit (Lod) concept, we succeeded in the characterization of citrus, vanilla, coriander and other food aromas. Lod gives just us the information on aroma intensity of each components.

Main research papers


Recent Research

1. Study of functions of rare sugar D-allulose and rare sugar syrup

D-Allulose (D-psicose), a C-3 epimer of D-fructose, is a rare sugar present in small quantities in nature. We have since demonstrated that D-allulose is a sweet carbohydrate that provides no energy and that it causes little toxic effect in rats. In addition, we suggested that D-allulose controls postprandial hyperglycemia in normal and diabetic animals. Thus, D-allulose may be useful in preventing obesity and diabetes in patients. On the other hand, rare sugar syrup (RSS) containing about 6% D-allulose has been sold as a less expensive sweetener in markets. We also showed that RSS reduced abdominal fat accumulation compared to high-fructose corn syrup. We will study mechanisms about the functionality of D-allulose and other rare sugars except D-allulose in future.

2. Effects of very low carbohydrate diet on body fat and metabolism

Recently, a very low carbohydrate diet (VLCD) become the topic through media as a diet cure of diabetes and have been already adopted at some hospitals. It is reported that the VLCD improves a hyperglycemia of the diabetic dramatically in a short term, but is doubted about effects and safety for long-term (several years - life). In addition, it is hardly reported the effect by the long-term intake of the VLCD using the laboratory animals. We have monitored the condition of rats and lifespan using the Goto-Kakizaki (GK) rats that were hereditary type-2 diabetes model rats, but were not able to confirm the life extension effect. We will examine the effects of VLCD using normal Wistar rats equally in future.

3. Study of functional food ingredients

Anti-obesity and anti-diabetes effects of functional food ingredients were studied as follows: (1) fermented brown rice, (2) soy germ protein, (3) egg white and egg white hydrolysate, (4) bonito fish protein, (5) dried Itea plant powder, (6) others.

Publications

Research Area: Food Science
Research Specialization: Food Engineering
Name: YOSHII Hidefumi

Keywords: spray drying, encapsulation, molecular encapsulation, emulsion

Recent Research

1. Microencapsulation of food and pharmaceutical related ingredients by spray drying and the storage stability

Among various microencapsulation methods, spray drying is the most common technique to produce flavor powders, since it has many merits such as low process cost, wide choice of carrier solids, good retention of flavors, and good stability of the finished flavors. In this research, the main emphasis of the microencapsulation of flavors has concentrated on preventing the flavor losses during spray drying and extending the shelf life of the products. The focus is on the effect of emulsion droplet size, powder size as well as the type of the model flavors. More specifically the aim is to understand the mechanism loss and oxidation of encapsulated flavor from the droplet which directly relate to the shelf life of product. The work is focused on the effect of water activity as well as the change of the capsule structure on the stability of encapsulated flavor. Furthermore, in order to understand the morphology of spray dried powder and encapsulated flavor powder, CLSM was using to view the cross sectional of the spray dried powder and the arrangement of encapsulated flavor in powder without the destruction of the powders.

2. Encapsulation of flavors by molecular inclusion in cyclodextrins

Cyclodextrin (CD) is a family of cyclic oligosaccharides with truncated molecular structure. The relatively hydrophobic cavity of CD provides a less polar microenvironment in CD solution for the appropriately-sized hydrophobic molecules to reside in. Their applications are mainly intended for the entrapment of smaller molecules, stabilization of reactive intermediates and drug delivery device as potential molecular transport. In food related applications, flavor compounds are being encapsulated into CDs for better retention and protection from various possible means of deterioration, as well as for controlled delivery. The aim of this study was to examine the effects of inclusion methods on the properties of inclusion complex powders especially with respect to flavor retention and release of the guest flavor compounds under various temperatures and relative humidities.

Publications

Recent Research

1. Study on production of rare sugar and rare oligosaccharide

Rare sugar defined as sugar not abundant in nature. Some rare sugars such as D-psicose and D-allose shows various functionalities. These sugars have potential applications for functional foods and medical materials. Our laboratory is now studying on development of novel oligosaccharide production containing both rare sugar and oligosaccharide. This research is a specific research because we have the technical development of rare sugar production.

2. Study on production of functional oligosaccharide

Production of functional oligosaccharides derived from unused resources using enzyme reaction are investigated. Oligosaccharides have various functionalities such as prebiotic effects. We are studying on efficient and low cost production of these sugars using enzymatic reaction.

3. Molecular and structural study of sugar related enzyme

Molecular improvement and catalytic mechanism of enzyme, which is used for production of rare sugar or oligosaccharide are investigated. By gene recombination and X-ray crystal analysis, we are trying to know the catalytic functions, substrate specificities and environmental tolerant. Furthermore, to optimize the enzyme structure by introducing mutagenesis, we are trying to enhance the efficiency of productivity.

Publications

Research Area: Food Science  
Research Specialization: Applied Enzymology  
Name: MORIMOTO, Kenji

Keywords: Rare sugar, enzyme, separation of rare sugar

Recent Research

1. Screening novel enzyme for rare sugar-producing enzyme

Many enzyme are utilized for rare sugar production as right figure, Izumoring. Each enzyme is derived from microbe and screened from soil. We aim to obtain novel enzymes and more efficient enzyme than existing enzymes.

2. Separation of rare sugar by boronic acid

We are developing novel separation system with boronic acid. Boronic acid has strong affinity with cis-diol structure in sugar molecule under the alkaline pH. This affinity strength is depend on a number of cis-diol structure and its location in molecule, resulting that retention time of rare sugars are different.

3. Hexose synthesis by aldol reaction

Some hexoses can be synthesized from two kinds of trioses by aldol reaction. We study production of novel rare sugars using this reaction.

Publications

Recent Research

1. Screening of microbe and enzyme. Production of rare sugars using their microbe and enzymes

Microbe produces a lot of enzymes. Rare sugars are produced by their biotransformation. Therefore many researchers isolate microbe for effective production of rare sugars. In this research, we screen various rare sugar producing microbes and enzymes. Optimum condition determine for rare sugar production, We try to produce a lot of rare sugars.

2. Production of rare sugar derivatives using microbial and enzymatic reaction

Rare sugars are produced by several enzymes. These enzymes are able to classify into following four groups.

- Isomerase catalyzes reversible aldose-ketose isomerization
- Epimerase catalyzes reversible ketose C-3 epimerization.
- Dehydrogenase catalyzes the oxidation of polyols to corresponding ketoses.
- Oxidase catalyzes the oxidation of polyols to corresponding aldoses.

In this research, we try to produce novel rare sugar derivatives that have physiologically activity by microbial and enzymatic reactions. We focus to deoxy monosaccharides, azido monosaccharides and their derivatives.

Publications

Akihide Yoshihara et al. (2013) Isomerization of deoxyhexoses: green bioproduction of 1-deoxy-D-tagatose from L-fucose and of 6-deoxy-D-tagatose from D-fucose using Enterobacter agglomerans strain 221e, Tetrahedron: Asymmetry, 19 (6), 739-745


Devendar Rao et al. (2009) A concise approach to the synthesis of all twelve 5-deoxyhexoses: D-tagatose-3-epimerase—a reagent that is both specific and general, Tetrahedron Letters, 50 (26), 3559-3563

Andreas F. G. Glawar et al. (2013) An approach to 8 stereoisomers of homonojirimycin from D-glucose via kinetic & thermodynamic azido-γ-lactones, Organic & Biomolecular Chemistry, 11 (40), 6886-6899
Division  Food Sciences
Research Field  Food chemistry and functionality
Name  YONEKURA, Lina

Keywords: Digestion, absorption, bioactive compounds, polyphenols, carotenoids

- Recent research topics

Table olive processing methods for preservation of bioactive compounds

Kagawa prefecture is the largest producer of olives in Japan.

Olive fruits contain important bioactive compounds such as the oleuropein aglycones 3,4-DHPEA-EA and 3,4-DHPEA-EA, which have strong antiallergic effects in addition to their antioxidant properties. However, most of those bioactive compounds are lost with the intensive chemical treatment and rinsing during the process to make table olives. We are studying methods to improve the stability of bioactives in table olives, while reducing the environmental impact of the process by reducing the use of water.

Digestion and absorption of carotenoids and polyphenols

Carotenoids and polyphenols are important food bioactives. Carotenoids are red, orange and yellow pigments that are radical scavengers, antioxidants and have an important role in the prevention of cancer, and age-related macular degeneration. Catechins are also important modulators of the body’s redox status.

Carotenoids are poorly absorbed. Only 10-20% of the ingested amount is actually absorbed. The bioavailability of catechins is even lower. We are investigating the effect of dietary factors that can improve the absorption of carotenoids and catechins.

Selected publications


