ENGINEERING SCIENCE FOR FOOD MANUFACTURING – FOOD ENGINEERING –

Lab. Bioengineering Prof.: Tani F, Assoc. Prof.: Nakagawa K, Assist. Prof.: Kobayashi T

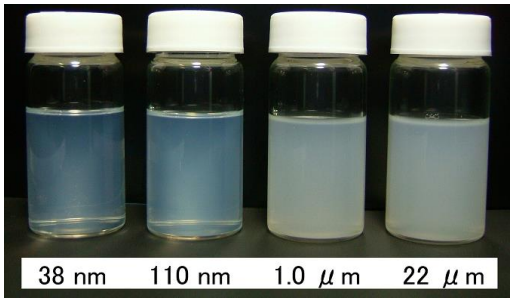
Complex phenomena occur during food processing because food is a multicomponent system. Engineering analysis as well as food science is inevitable for reasonably designing food manufacturing process and processing foods. Our goals are to quantitatively analyze and understand the phenomena occurring in various operations of food processing, to reasonably design the processes and to develop new processes.

Application of Subcritical Fluid to Food Processing

Water is one of the safe solvents which can be used for food processing. Water which maintains its liquid state even at temperatures higher than 100°C under a pressurized condition is called subcritical water. The subcritical water has two distinct features: one is low dielectric constant and another is high ion product. Organic solvents, such as ethanol, and their mixtures with water can be also held in subcritical state. Such fluids are called subcritical ones. Basic and application-oriented researches are conducted to apply the subcritical fluid to food processing.

(Upper) Flow-type reactor
(Left) Pressure-resistant batch reactor

Properties of Nano Emulsion



A nano-emulsion, composed of oil droplets less than 1 μm in diameter, has properties different from those of a micro-emulsion. For example, it looks transparent when the droplet size decreases. There is no accepted notion about whether the lipid oxidation is promoted or retarded in the nano-emulsion system. We aim to understand the phenomena occurring in the nano-world of food dispersion systems and the role of the interface between dispersed and continuous phases, which is of growing interesting around the world.

Drying and Rehydration of Foods

Many food materials such as pasta are dried to improve their shelf life and eaten after rehydration. During the processes, complicated phenomena such as glass transition and gelatinization of starch occur. We analyze phenomena occurring during the drying and rehydration processes of the materials containing many components and with complicated structure from engineering aspect in cereal science.

Liquid Chromatographic Separation

A chromatographic separation of saccharides using cation-exchange resin is a traditional separation process. However, our knowledge seems to be insufficient for reasonably designing the separation process. So, we investigate adsorption isotherm and rate processes from the viewpoints of physical chemistry and separation engineering.

Keywords

Subcritical fluid, nanoemulsion, dispersion science, food engineering, food physical chemistry, chemical reaction engineering

Recent Publications

Kinetic analysis of lactulose production from lactose in subcritical aqueous ethanol.
Soisangwan N, Khuwijitjaru P, Kobayashi T, Adachi S (2017)
Food Sci Technol Res 23: 45-49

Decomposition kinetics of glucose and fructose in subcritical water containing sodium chloride.
Kobayashi T, Khuwijitjaru P, Adachi S (2016)
J Appl Glycosci 63: 99-104

Kinetics of the disappearance of *N*-acetyl-D-glucosamine in subcritical aqueous ethanol.
Kambara C, Kobayashi T, Adachi S (2016)
Japan J Food Eng 17: 99-104

Interconversion between D-glucuronic acid and D-glucuronolactone in subcritical aqueous ethanol.
Kambara C, Kobayashi T, Adachi S (2016)
Food Sci Technol Res 22: 739-742

Effect of polydispersity in oil-droplet size on lipid oxidation in oil-in-water emulsions.
Miyagawa Y, Kikuchi K, Shiga H, Adachi S (2016)
Japan J Food Eng 17: 91-94

Water sorption kinetics of gluten-added wheat noodle.
Fukuzawa S, Ogawa T, Nakagawa K, Adachi S (2016)
Food Sci Technol Res 22: 491-495

Antioxidative property of acyl ascorbate in cookies containing iron.
Watanabe Y, Khuwijitjaru P, Hamai Y, Wiboonsirikul J, Adachi S (2016)
Japan J Food Eng 17: 77-81

Antioxidative properties of stearoyl ascorbate in a food matrix system.
Wiboonsirikul J, Watanabe Y, Omori A, Khuwijitjaru P, Adachi S (2016)
J Oleo Sci 65: 487-492

Preparation of liquid and solid seasonings with shrimp-like flavor from isada krill under subcritical water conditions by steam injection.
Tamiya S, Koomyart I, Kobayashi T, Shiga H, Yoshii H, Khuwijitjaru P, Adachi S (2016)
Food Sci Technol Res 22: 317-323

Swelling pressure of wet rice grains estimated from distribution coefficients of saccharides.
Sha Y, Adachi S (2016)
J Appl Glycosci 63: 47-50

Effects of counter-ion form of a cation-exchange resin and ethanol content of eluent on the distribution coefficients of galactose, tagatose, and talose onto the resin.
Tamura A, Sha Y, Adachi S (2016)
Food Sci Technol Res 22: 205-208

Effects of the oil-droplet size and entire oil fraction in microcapsules on the interior oil fraction.
Kikuchi K, Yamamoto S, Shiga H, Yoshii H, Adachi S (2015)
Japan J Food Eng 16: 303-305

Kinetic analysis for the conversion of fructose to 5-hydroxymethylfurfural in 1-butyl-3-metylimidazolium chloride with lower water contents.
Miyagawa Y, Yoshino M, Kobayashi T, Adachi S (2015)
J Appl Glycosci 62: 143-147

Solubility of D-galactose, D-talose, and D-tagatose in aqueous ethanol at low temperature.
Gao D-M, Kobayashi T, Adachi S (2015)
Food Sci Technol Res 21: 801-803

Production of 5-hydroxymethylfurfural in a eutectic mixture of citric acid and choline chloride and its extractive recovery.
Kobayashi T, Yoshino M, Miyagawa Y, Adachi S (2015)
Sep Purif Technol 155: 26-31

Effects of vegetable oil type and lipophilic emulsifiers on the induction period of fat crystallization.
Miyagawa Y, Ogawa T, Nakagawa K, Adachi S (2015)
J Oleo Sci 64: 1169-1174

Evolution of the size distribution of oil-droplets over time in oil-in-water emulsions.
Katsuki K, Miyagawa Y, Matsuno R, Adachi S (2015)
Japan J Food Eng 16: 231-234

Swelling pressure of tapioca starch gel estimated from distribution coefficients of non-electrolytes.
Sha Y, Adachi S (2015)
Food Sci Technol Res 21: 509-515

Adsorption isotherms of hydrophobic substances onto a chromatographic organic monolith.
Sha Y, Aimoto U, Adachi S (2015)
Japan J Food Eng 16: 167-170

Energy efficiency of different emulsification methods: A comparative evaluation.
Miyagawa Y, Shima M, Matsuno R, Adachi S (2015)
Japan J Food Eng 16: 71-74

Measurement of moisture profiles in pasta during rehydration based on image processing.
Ogawa T, Adachi S (2014)
Food Bioproc Technol 7: 1465–1471

Thermal analysis of drying process of durum wheat dough under the programmed temperature-rising conditions.
Ogawa T, Koizumi S, Adachi S (2014)
Food Bioprod Proc 92: 9-13

Kinetics of sucrose hydrolysis in a subcritical water-ethanol mixture.
Gao D, Kobayashi T, Adachi S (2014)
J Appl Glycosci 61: 9-13

Water sorption kinetics of udon with different diameters.
Roppongi T, Ogawa T, Adachi S (2014)
Food Sci Technol Res 20: 241-246

Effects of various emulsification methods on oxidation of methyl linoleate.
Ma T, Kobayashi T, Adachi S (2014)
Biosci Biotechnol Biochem 78: 147-150

Effects of repeated treatment on the properties of rice stem extract using subcritical water, ethanol, and their mixture.
Tangkhavanich B, Kobayashi T, Adachi S (2014)
J Ind Eng Chem 20: 2610-2614

Characteristics and antioxidative ability of defatted rice bran extracts obtained using several extractants under subcritical conditions.
Chiou T-Y, Ogino A, Kobayashi T, Adachi S (2013)
J Oleo Sci 62: 1-8

Water sorption kinetics of spaghetti prepared under different drying conditions.
Aimoto U, Ogawa T, Adachi S (2013)
Food Sci Technol Res 19: 17-22

Properties of extract from okara by its subcritical water treatment.
Wiboonsirikul J, Mori M, Khuwijitjaru P, Adachi S (2013)
Intl J Food Prop 16: 974-982

Properties and water sorption characteristics of spaghetti prepared using various dies.
Yoshino M, Ogawa T, Adachi S (2013)
J Food Sci 78: E520-525

Shrinkage and tensile stress of sheet-like and cylindrical pastas with various moisture contents.
Mizuno N, Ogawa T, Adachi S (2013)
Food Biosci 2: 10-14

Properties of the rice stem extracts obtained by subcritical water/ethanol treatment.
Tangkhavanich B, Oishi Y, Kobayashi T, Adachi S (2013)
Food Sci Technol Res 19: 547-552

Dilatometric measurement of partial molar volume of water sorbed onto durum wheat flour.
Hasegawa A, Ogawa T, Adachi S (2013)
Biosci Biotechnol Biochem 77: 1565-1568

Properties of rice stem extracts obtained using subcritical fluids.
Tangkhavanich B, Kobayashi T, Adachi S (2013)
Biosci Biotechnol Biochem 77: 2112-2116

Hydrogel based oil encapsulation for controlled release of curcumin by using a ternary system of chitosan, kappa-carrageenan, and carboxymethylcellulose sodium salt.
Nakagawa K, Sowasod N, Tanthapanichakoon W, Charinpanitkul T (2013)
LWT J Food S Technol 54: 600-605

Spray-drying of casein aggregates loaded with β-carotene: Influences of acidic conditions and storage time on surface structure and encapsulation efficiencies.
Jarunglumlert T, Nakagawa K (2013)
Drying Technol 31: 1459-1465

Effect of droplet size on autoxidation rates of methyl linoleate and α-linolenate in an oil-in-water emulsion.

Ma T, Kobayashi T, Adachi S (2013)

J Oleo Sci. 62: 1003-1008