2.7.7 Laboratory : Bioengineering

Member :	Professor	Adachi, Shuji, Dr. Agric. Sci.
	Assistant Professor	Kobayashi, Takashi, Dr. Agric. Sci.
	Doctor's program	1
	Master's Program	8
	Undergraduate	3
	Other	3
	Post-Doctoral fellow	1

A. Research Activities (2009.4-2010.3)

A-1. Main Subjects

a) Development of novel food processing technology by subcritical water treatment

Water is present in subcritical condition when being compressed to remain in the liquid state at temperatures above 100°C. Subcritical water has a dielectric constant close to that of organic solvents, which decreases with increasing temperature. Hence, it is better capable of dissolving hydrophobic substances. In addition, high ion product is also characteristic of subcritical water. Setting off with the aim of developing novel food processing technology by leveraging these unique features of subcritical water, we have been devoting our efforts to carrying out both basic and applied researches in subcritical water treatment, in regards to the conversion of little-used biomaterials to useful materials and the degradation (hydrolysis) kinetics of saccharides, amino acids, etc., respectively, from the reaction engineering point of view.

b) Characterization and application of nano- and microdispersed food ingredients

Nanoemulsions with oil droplet diameter of a few tens nanometer are expected of exhibiting some unique properties and functionalities, which are not found in the existing microemulsions. Nonetheless, the scientific knowledge pertaining to nanoemulsions is still insufficient at present. Taking into consideration the mass transfer phenomenon at the oil-water interface, we performed a systematic study on the effects of the decrease in oil droplet size of the disperse phase upon the oxidation of unsaturated fatty acids in the phase, wherein the oxidation reaction was found to have been impeded despite the high specific surface area of the nanoemulsions. We also suggested a model that explained the phenomena.

c) Bioreaction engineering research for construction of bioreactors

Study is carried out on the construction of bioreactor systems for efficient substance production based on the knowledge on the characteristics of biocatalysts such as enzymes. We aspire to establish a reasonable method for designing bioreactor systems for synthesis reactions, in particular the condensation reactions by hydrolytic enzymes for syntheses of functional food ingredients inclusive of surface-active substances, by elucidating the influence of various physico-chemical factors on the efficiency of the reactions.

d) Analyses and development in food processing

Processes such as cation-exchange resin-mediated separation of saccharides, powderization of lipid with food polymers which retards lipid oxidation, dehydration of pasta which produces rehydratable noodle are examples of existing food processes. However, the phenomena that occur during the processes are not yet to be fully understood. By applying both the existing and new approaches and new models to these processes, we endeavor to gain insight into the phenomena that happen through the processes and thereby contribute toward establishing a reasonable design method for substance production.

A-2.Publications and presentations

a) Publications

Original Papers

- Y. Murayama, T. L. Neoh, T. Kobayashi, and S. Adachi: Production of emulsifying and antioxidative substances from defatted rice bran by two-step subcritical water treatment. Japan J. Food Eng., 10(2), 107-114 (2009).

- Y. Watanabe, T. Okayasu, K. Idenoue, and S. Adachi: Degradation kinetics of catechin in aqueous solution in the presence of ascorbic acid or octanoyl ascorbate. Japan J. Food Eng., 10(2), 117-124 (2009).

- R. Wang, T. Kobayashi, and S. Adachi: Degradation kinetics of D-glacturonic aid and sdium D-glacturonate in sbcritical wter. J. Appl. Glycosci., 56(3), 181-184 (2009).

- P. Khuwijitjaru1, T. Yuenyong, R. Pongsawatmanit, and S. Adachi: Degradation kinetics of gamma-oryzanol in purified rice bran oil during thermal oxidation. J. Oleo Sci., 58(10), 491-497 (2009).

- N. Iwamoto, T. Kobayashi, and S. Adachi: Antioxidative capacities of durum wheat flour and its components on linoleic acid. J. Oleo Sci., 58(10), 537-541 (2009).

- Y. Watanabe, T. Yamashita, M. Yamasita, and S. Adachi: Suppressive effect of ?-tocopherol complexing with -cyclodextrin for the oxidation of methyl linoleate.

Food Sci. Technol. Res., 15(5), 479-482 (2009).

Reviews

- S. Adachi, S. Minten, and T. Kobayashi: Oxidation of lipid in bulk and dispersion systems. Japan J. Food Sci., 10(1), 9-15 (2009).

- S. Adachi: Extraction of functional food materials from unused bioresources by their subcritical water treatment. Shokuhin-Kakou-Gijutsu, 29(1), 24-32 (2009).

- S. Adachi: Properties and utilization of subcritical water. FFI J., 214, 131-138 (2009).

- S. Adachi: Properties and utilization of water in food processing. FFI ., 214, 103-105 (2009).

- S. Adachi: Properties and utilization of subcritical fluids. Kagaku To Seibutsu, 47(10), 697-702 (2009).

Reports

- T. Kobayashi, Biomidia, Jpapn Society for Bioscience and Biengineering 88(1), 22 (2010)

Patents

- Kobayashi, T., Ehara, T., Mizuoka, T., P2009-59428 (JP)

b) Conference and seminar papers presented

- The 8th meeting of Lipid Engineering Division of The Society for Biotechnology, Japan (1 papers)
- Annual Meeting of Japan Society for Bioscience, Biotechnology, and Agrochemistry, 2009 (2 paper)
- Annual Meeting of Japan Society for Food Engineering, 2009 (3 papers)
- The 463rd Kansai Branch Meeting of Japan Society for Bioscience, Biotechnology, and Agrochemistry (1 paper)
- The 41st Meeting of the Society of Chemical Engineers, Japan (1 paper)
- The 62nd Meeting of the Japan Society of Enzyme Engineering (1 paper)
- Super Green (2 papers)

A-3.Off-campus activities

Membership in academic societies

- Adachi, S. : The Japan Society for Food Engineering (director), Japan Oil Chemists' Society (secretary of Kansai branch), The Society of Chemical Engineers, Japan (Section-chief of Food and Food Processing Subcommittee).
- Kobayashi, T. : Japan Society of Bioscience and Bioengineering (biomidia committee)

Research grants

2.Other Research Grants

- Nanotechnology project, the Ministry of Agriculture, Forestry and Fisheries : Shuji Adachi : Assessment of anti-oxidation and stability of nano- and microparticles in food diversion system and their control
- Cooperation of Innovative Technology and Advanced Research in Evolutional Area (CITY AREA), Ministry of Education, Culture, Sports, Science and Technology, Japan : Shuji Adachi : Development of functional food materials

A-4.International cooperation and overseas activities

International meetings(country,roles)

- Adachi, S. : BioEco 2009, Tenjian, China (Invited lecture)., Asia-Pacific Biochemical Engineering Conference, (Kobe, poster presentation)
- Kobayashi, T. : Asia-Pacific Biochemical Engineering Conference, (Kobe, poster presentation)

B.Educational Activities(2009.4-2010.3)

B-1.On-campus teaching

a) Courses given

- Undergraduate level : Food Engineering (Adachi, S.), Physical Chemistry in Food Science I (Adachi, S.), Physical Chemistry in Food Science II (Adachi, S.), Laboratory Course in Chemical Engineering (Adachi, S., Kobayashi, T.).
- Graduate level : Food Production Technology (Adachi, S.), Bioengineering Seminar (Adachi, S.), Experimental Course in Bioengineering (Adachi, S.).

B-2.Off-campus teaching etc.

Part-time lecturer

- Adachi, S.: Graduate School of Engineering, Osaka City University (Special lecture)

Open lectures, etc.

- Adachi, S.: Annual Meeting of Japan Society of Food Hydrocolloids (lecturer).
- Adachi, S.: Basic Training Course of the Japan Society for Food Engineering (lecturer).
- Kobayashi, T.: The 31st Kinki Branch Meeting of Japan Society of Applied Glycoscience (lecturer)

B-3.Overseas teaching

International students

- International students : Doctral 1 (China) Research Students 3 (Netherland 1, Taiwan 1, Thailand 1)