# Chair Food Quality Science

## 2.1.7 Laboratory: Food Quality Design and Development

Member:	Professor	Urade, Reiko
	Associate Professor	Maruyama, Nobuyuki
	Assistant Professor	Masuda, Taro
	Doctor's program	2
	Master's Program	7
	Undergraduate	4
	Researcher	4

### A. Research Activities (2010.4-2011.3)

### A-1. Main Subjects

a) Mechanism of Seed Storage Protein Folding and Quality Control

Seed storage proteins synthesized in the rough endoplasmic reticulum in seed cells should be folded prior to transport to protein storage vacuoles. Identification and characterization of molecular chaperones and protein disulfide isomerase family members that assist in folding and quality control are ongoing.

b) Mechanism of Soybean Seed Protein Trafficking and Accumulation

Most soybean storage proteins are transported to storage vacuoles from the endoplasmic reticulum via the Golgi. Such targeted transport is made possible by a transport-signal recognition system as well as the molecular association of storage proteins. We are trying to elucidate these mechanisms at a molecular level.

c) Research on the Functions of Soybean and Wheat Proteins

Proteins have a significant effect on food function. We are investigating the relationship between food function, protein structure, and protein-protein interactions.

d) Development of novel crops for promoting food functions

An effort is being made to develop crops producing food proteins with health-promoting functions. Soybean proteins having heath-promoting functions have been successfully produced in transgenic rice seeds. Further, a development of transgenic soybean producing vaccine is now in progress. Recently we apply the heavy ion irradiation technique to develop hypo-allergenic peanut variety.

e) Identification of structural factors determining allegenicity of seed storage proteins

Many seed storage proteins are known as an allergen. We investigate a structural factor inducing a critical allergenic condition.

f) Analysis of the contribution of ferritin for crop iron contents

Human can absorb iron from food and recycle iron by sophisticated mechanism, so the amounts of iron which has to be absorbed from food is approximately 10 mg. However, many people suffer from anemia caused by iron deficiency not only in developing countries, but also advanced nations. Legume plants, especially soybean contains high amounts of iron in its dry seed. Therefore, soybean can be considered as a very good and low cost iron source. Most of iron in the dry soybean seeds are storaged in ferritin that is a ubiquitous iron storage protein. The objective of this project is investigate the relation ship among ferritin gene expression, existence of ferritin mature subunits and iron contents of soyeabn seeds.

g) Investigation of the metal accumulation mechanism of plant ferritin

The iron storage protein ferritin is widely distributed in the plant, bacteria and vertebrate. This protein forms a multimer composed of 24 subunits and has very tremendous property that thousands of iron atoms can be deposited in the protein as biologically available and non-toxic form. Recently, we have solved the three dimensional structure of plant ferritin from soybean and elucidate the metal sequestration pathway of ferritin. Further research in the mechanism of metal accumulation of ferritin is now in progress.

### **A-2.Publications and presentations**

a) Publications

Books

- Urade, R. Fortification of bread with soy proteins to normalize serum cholesterol and triacylglycerol levels. Flour and breads and their fortification in health and disease prevention (ISBN:9780123808868) (V. R. Preedy, R. R. Watson and V. Patel, ed.) pp.417-427 Academic Press

- Maruyama, N., Motoyama, T., Yoshikawa, M., Takaiwa, F., Utsumi, S. Seed storage proteins; Strategies for developing crops promoting human health, Soybean - Applications and Technology (ISBN 978-953-307-207-4) (Tzi-Bun Ng, ed)pp. 243-254, Intech

### Original Papers(including book-reviews)

- Akie Koh, Kimio Nishimura, and Reiko Urade. (2010) Relationship between Endogenous Protein Disulfide Isomerase Family Proteins and Glutenin Macropolymer. J. Agric. Food Chem. 58:12970-12975 査読有 - Tandang-Silvas, MR, Fukuda, T., Fukuda, C., Prak, K., Cabanos, C., Kimura, A., Itoh, T., Mikami, B., Utsumi, S., Maruyama, N. (2010) Conservation and divergence on plant seed 11S globulins based on crystal structures Biochim. Biophys. Acta-Proteins and Proteomics1804, 1432-1442. 査読有

- Cabanos, C., Tandang-Silvas, MRG., Van, O., Brostedt, P., Tanaka, A., Utsumi, S., Maruyama, N. (2010) Expression, purification, cross-reactivity and homology of peanut profilin Protein Expression and Purification 73:36-45. 査読有

- Motoyama, T., Amari, Y., Tandang-Silvas, MR., Cabanos, C., Kimura, A., Yoshikawa, M., Takaiwa, F., Utsumi, S., Maruyama, N. (2010) Developing transgenic rice with mutated □ subunit of soybean beta-conglycinin containing phagocytosis-stimulating peptide. Peptides. 31:1245-1250.査読

- Shutov, AD., Prak, K., Fukuda, T., Rudakov, S.V., Rudakova, A.S., Tandang-Silvas, MR., Fujiwara, K., Mikami, B., Utsumi, S., Maruyama, N. (2010) Soybean basic 7S globulin: Subunit heterogeneity and molecular evolution Biosci. Biotechnol. Biochem. 74:1631-1634.査読有

- Tandang-Silvas, M.R., Carrazco-Pena, L., Barba de la Rosa, A.P., Osuna-Castro, J.A., Utsumi, S., Mikami, B., Maruyama, N. (2010) Expression, purification and preliminary crystallization of proamaranth 11S globulin seed storage protein from Amaranthus hypochondriacus L. Acta Crystallo. Sect. F Struct Biol Cryst Commun 66: 919-922.査読有

- Cabanos C, Urabe H, Masuda T, Tandang-Silvas MR, Utsumi S, Mikami B, Maruyama N. (2010) Crystallization and preliminary X-ray analysis of the major peanut allergen Ara h 1 core region Acta Crystallo. Sect. F Struct Biol Cryst Commun 66:1071-1073.査読有

- Masuda, T., Goto, F., Yoshihara, T. & Mikami, B. (2010) The universal mechanism for iron translocation to the ferroxidase site in ferritin, which is mediated by the well conserved transit site. Biochem. Biophys. Res. Com. 400: 94-99 査読有

- Deng, J., Liao, X., Yang, H., Hua, Z., Masuda, T., Goto, F., Yoshihara, T., Zhao, G. (2010) Role of H-1 and H-2 subunits of soybean seed ferritin in oxidative deposition of iron in protein. J. Biol. Chem. 285: 32075-32086 査読有

- Masuda, T., Goto, F., Yoshihara, T. & Mikami, B. (2010) Crystal structure of plant ferritin reveals a novel metal binding site that functions as a transit site for metal transfer in ferritin. J. Biol. Chem. 285: 4049-4059 査読有

- Cabanos, C., Urabe, H., Masuda, T., Tandang-Silvas, M.R., Utsumi, S., Mikami, B., Maruyama, N. (2010) Crystallization and preliminary X-ray analysis of the major peanut allergen Ara h 1 core region. Acta Crystallogr. Sect. F 66(Pt 9) 1071-1073 査読有

- Fu, X., Deng, J., Yang, H., Masuda, T., Goto, F., Yoshihara, T. & Zhao, G. (2010) A novel EP-involved pathway for iron release from soybean seed ferritin. Biochem. J. 427: 313-321 査読有

### Reports, others

### - 裏出令子、河野光登、高純度大豆タンパク質の食品生理機能、不二製油株式会社フードサイエン ス研究所栄養健康室

- b) Conference and seminar papers presented
- Annual meeting of Japan Society for Bioscience, Biotechnology and Agrochemistry 7
- Annual meeting of the Japanese Biochemical Society 2
- APOCB Congress 1
- Annual meeting of Japanese Society of Breeding 1
- Annual meeting of the Japanese Society of Hematology 1
- Annual meeting of the Protein Science Society of Japan 1
- Annual meeting of Japanese Society for Ceramides 1

### A-3.Off-campus activities 1

#### Membership in academic societies

- Reiko Urade : Japan Society for Bioscience, Biotechnology, and Agrochemistry (General affairs)

### A-3.Off-campus activities 2

Research grants

1. Grants-in-aid for Scientific Research(KAKENHI)

- Scientific Research (B) : Reiko Urade : Gene targeting analysis of a folding enzyme ER-60 localized in the endoplasmic reticulum

- Grant-in-Aid for Young Scientists (B) : Nobuyuki Maruyama : Identification of novel receptor for protein storage vacuolar sorting

- Grant-in-Aid for Young Sceintists : Taro Masuda : Construction of hevy metal accumulation protein based on plant ferritin

- Grant-in-Aid for Scientific Research (A) : Takashi Hirata : Development of selective inactivation of melanization related enzymes of crustacean by carbon dioxyde

2. Other Research Grants

- Fiji Foundation for Protein Research: Reiko Urade: Physiological Function of Highly Purified Soy Proteins

- JAXA: Reiko Urade: Protein Crystallization Reaearch in Protein Crystallization Reaearch Facility

- The Ministry of Agriculture, Forestry, and Fisheries of Japan: Nobuyuki Maruyama: Development of transgenic rice accumulating soyeabn beta-conglycinin

- Asahi Breweries Foundation: Nobuyuki Maruyama: Epitope analysis of seed storage proteins based on their structures

#### **B.Educational Activities**(2010.4-2011.3)

#### **B-1.On-campus teaching**

a) Courses given

- Undergraduate level :	Outline of Bioresource Science I (Urade), Quality Design and Development (Urade), Quality Science (Urade, Maruyama), Seminar in Food Quality Science (Urade, Maruyama, Maguda), Fundamentals for Laboratory Course in
	Bioresource Science (Urade, Mauryama, Masuda), Fundamentals for Laboratory Course in Bioresource Science I/II (Urade, Mauryama, Masuda)
- Graduate level :	Food Quality Design and Development, Seminar (Urade, Maruyama, Masuda), Special Laboratpry Work in Food Quality Design and Development (Urada Maruyama Maguda)

### **B-3.Overseas teaching 1**

International students

- International students : Doctral 1 (Philippines)

Special notes :

15th Ando Foundation Award