## 2.1.7 Laboratory : Food Quality Design and Development

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| Member : | Associate Professor | Maruyama, Nobuyuki, |
| | Assistant Professor | Masuda, Taro |
| | KU Visiting Professor | Evelyn Mae Tecson-Mendoza |
| | Doctor's program | 2 |
| | Master's Program | 7 |
| | Undergraduate | 4 |
| | Post-Doctoral fellow | 1 |

**A. Research Activities (2009.4-2010.3)**

**A-1. Main Subjects**

a) Mechanism of protein sorting and accumulation in seeds

Storage proteins of legume seeds are synthesized during maturation. Seed storage proteins are transported from the ER to protein storage vacuoles. Intracellular transport to the protein storage vacuoles is defined by the sorting siganls of the storage proteins. We have found that several types of sorting signals exist in soybean seed storage proteins. In addition, identification of receptor for the signals and elucidation of molecular mechanism to the vacuolar sorting are in progress.

b) Development of crops producing food proteins with health-promoting 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.

c) Identification of structural factors determining allegenicity of peanuts seed storage proteins

Peanut induces a critical condition of an allergy patient. Many allergens are identified so far from peanut seeds. We are now preparing the recombinant proteins to identify allergen and its factor inducing a critical condition.

d) 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

- Nobuyuki Maruyama, Hisashi Hirano, Shigeru Utsumi; Biosynthesize and Biochemistry of seed compounds-Introduction, Science and Bioscience of Seeds, Japan Scientific Societies Press, 51 (2009)
- Nobuyuki Maruyama, Shigeru Utsumi; Biosynthesize and Biochemistry of seed compounds, Science and Bioscience of Seeds, Japan Scientific Societies Press, 52-56 (2009)
- Nobuyuki Maruyama; Section 1, 2.1 Organella（Protein Body), Soybean, Science Forum, 102-104 (2010)
- Nobuyuki Maruyama; Section 1, 2.3 Organella (Others), Soybean, Science Forum,102-104 (2010)
- Bunzo Mikami, Nobuyuki Maruyama, Shigeru Utsumi; Section 2, Globulin (primary, secondary, tertiary structures) Soybean, Science Forum, 115-121 (2010)

Original Papers

- Mori, T., Saruta, Y., Fukuda, T., Prak, K., Ishimoto, M., Maruyama, N., Utsumi, S. Vacuolar sorting behaviors of 11S globulins in plant cells Biosci. Biotechnol. Biochem., 73, 53-60 (2009)
- Motoyama, T., Maruyama, N., Amari, Y., Kobayashi, K., Washida, H., Higasa, T., Takaiwa, F., Utsumi, S. alpha' subunit of soybean b-conglycinin forms complex with rice glutelin via a disulfide bond in transgenic rice seeds J. Ext. Bot. 60, 4015-4027 (2009)
- Motoyama T, Okumoto Y, Tanisaka T, Utsumi S, Maruyama N.Co-expression of alpha' and beta subunits of beta-conglycinin in rice seeds and its effect on the accumulation behavior of the expressed proteins.Transgenic Res. Jan 19. online (2010)
- Kimura A, Tandang-Silvas MR, Fukuda T, Cabanos C, Takegawa Y, Amano M, Nishimura S, Matsumura Y, Utsumi S, Maruyama N.Carbohydrate moieties contribute significantly to the physicochemical properties of french bean 7s globulin phaseolin.J

Agric Food Chem. 58, 2923-30 (2010)

- 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

- 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

b) Conference and seminar papers presented

- Annual meeting of Japan Society for Bioscience, Biotechnology and Agrochemistry : 5 Presentations
- Annual meeting of Japanese Society of Breeding : 2 Presentations
- Annual meeting of the Protein Science Society of Japan : 1 Presentation
- NIBB MPIZ Joint Congress :1 Presentation

**A-3.Off-campus activities**

Membership in academic societies

- Nobuyuki, Maruyama, D. Agric. Sci. : Japan society for bioscience, biotechnology and agrochemistry , The Japanese Society of Plant Physiologists
- Taro, Masuda, D. Agric. Sci : The protein science society of Japan, Japan society for bioscience, biotechnology and agrochemistry

Research grants

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

- Young Scientists (B) : Maruyama Nobuyuki : Identification of novel receptor for protein storage vacuolar sorting
- Scientific Research (A) : Hirata Takashi : Development of selective inactivation of melanization related enzymes of crustacean by carbon dioxyde

2.Other Research Grants

- Sponsored Research Funds(The Ministry of Agriculture, Forestry, and Fisheries of Japan): Genomics and Agricultural Innovation : Maruyama Nobuyuki : Development of transgenic rice accumulating soyeabn beta-conglycinin
- Mishima Kaiun Memorial Foundation : Maruyama Nobuyuki : Analysis of heat response of seeds for a production of bioactive peptides
- Hokuto Biocience Foundation : Maruyama Nobuyuki : Analysis of the relationship between

structure and physicochemical function of seed storage proteins

- Takano Life Science Research Foundation：Maruyama Nobuyuki ：Analysis of factors of excellent emulsifying abity of phaseolin
- Foundation for Science and Technology：Masuda Taro ：Development of hyper metal accumulate molecule using plant ferritin as a scafold

**A-4.International cooperation and overseas activities**

International joint research, overseas research surveys

- Systematic proteomics of seed storage proteins, Wageningen University
- Functional properties of seed globulins, University of Philippines
- Molecular evolution of seed storage proteins, University of Moldova
- Functional diversity of soybean ferritin SFER1 and SFER2, China Agricultural University

Visiting Research Scholars

- JSPS Guest Schlor 1（Mexico）
- Kyoto University Visiting Professor 1（Philippines）

**B.Educational Activities(2009.4-2010.3)**

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

a) Courses given

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

**B-3.Overseas teaching**

International students

- International students : Master 1 (Malaysia) Doctral 1 (Philippine)