Chair Applied Biochemistry

2.3.4 Laboratory : Laboratory of Chemical Ecology

Member:	Professor	Nishida, Ritsuo, D. Agric. Sci.
	Associate Professor	Mori, Naoki, D. Agric. Sci.
	Assistant Professor	Ono Hajime, D. Agric. Sci.
	Assistant Professor	Yoshinaga Naoko, D. Agric. Sci.
	Doctor's program	1
	Master's Program	10
	Undergraduate	5

A. Research Activities (2010.4-2011.3)

A-1. Main Subjects

a) Contact pheromone perception mechanisms in cockroaches

Males of many tephritid fruit fly species of the genus Bactrocera show a very strong affinity to methyl eugenol (ME). Upon ME-feeding, males of the oriental fruit fly, B. dorsalis, selectively accumulated two metabolites, 2-allyl-4,5-dimethoxyphenol (DMP) and (E)-coniferyl alcohol (E-CF), in the rectal pheromone gland. While B. invadens accumulated DMP and E-CF as in B. dorsalis, B. zonata stored DMP and (Z)-coniferyl alcohol (Z-CF); B. correcta converted ME to (Z)-3,4-dimethoxycinnamyl alcohol and Z-CF. Such differences in phenylpropanoids may play a critical role in differentiating these species. The phylogenetic analyses of the four Bactrocera species by comparing nucleotide sequences in the mitochondrial genes were done in association with the rectal phenylpropanoid components, which suggested an usefulness of a chemotaxonomical approach based on the male rectal volatiles.

b) Phospholipid biosynthesis in the gut of Spodoptera litura larvae

We investigated the biosynthesis of lysoPC in Spodoptera litura larvae. S. litura larvae were fed artificial diets enriched with [U-13C]linolenic acid for 3 h, and then phospholipids in the gut contents were analyzed by LCMS-IT-TOF. Labeled linolenic acid was incorporated into lysoPC as well as diacylPC, diacylPE and diacylPI. Detailed investigation of the biosynthesis revealed that [U-13C]linolenic acid was incorporated into phospholipids in gut tissues, the biosynthesized phospholipids were released into the gut lumen, and then some diacylPC was hydrolyzed to lysoPC in the gut lumen. When S. litura larvae were fed artificial diets enriched with tannin, a significant increase in the activity to produce diacylPC in the gut tissues was observed. Activated diacylPC production leading to an increase of lysoPC in the larvae might be an adaptive mechanism against plant tannins.

c) Mechanisms of developmental fate determination regulated by levels of steroid hormones in insects

In insects, developmental transitions, molting and metamorphosis, are triggered by pulses of the steroid hormone, ecdysteroid(s). How the developmental fate, molting or metamorphosis, is determined is not clear in Drosophila. To elucidate mechanisms of determination of developmental fate and timing, I explored a system in which ecdysteroid level is reduced by ectopic expression of an inactivating enzyme that is induced by treatment of progesterone analogue. By using the system, I find that developmental fate of second instar larva is converted to pupariation instead of molting to third instar at a low level of ecdysteroid. The result demonstrates developmental fate, molting or metamorphosis, could be determined by levels of steroid hormones in Drosophila.

d) Nitrogen metabolism controling system in insects

FACs in caterpillar regurgitant originally known as key chemicals in the tritrophic interaction, chemically mediated relationships between plants-herbivorous-insect-their natural enemies, turned out to be important intermediates for caterpillars to archive effective nitrogen assimilation. Based on this finding, FACs synthase was purified from caterpillar midgut tissues to identify protein profile and genetic information. Broad range of insects were screened for its FAC synthase activity and studied their nitrogen assimilation system related to glutamine synthesis.

A-2.Publications and presentations

a) Publications

Original Papers(including book-reviews)

- Aboshi, T., N. Yoshinaga, R. Nishida and N. Mori: Phospholipid biosynthesis in the gut of Spodoptera litura larvae and effects of tannic acid ingestion. Insect Biochem. Mol. Biol. 40; 325-330, 2010

- Yoshinaga, N., H.T. Alborn, T. Nakanishi, D.M. Suckling, R. Nishida, J.H. Tumlinson and N. Mori: Fatty acid-amino acid conjugates diversification in lepidopteran caterpillars. J. Chem. Ecol. 36; 319-325, 2010

- Tokushima, I., W. Orankanok, K.H. Tan, H. Ono and R. Nishida: Accumulation of phenylpropanoid and sesquiterpenoid volatiles in male rectal pheromonal glands of the guava fruit fly, Bactrocera correcta. J. Chem. Ecol. 36; 1327-1334, 2010

- Tan, K.H., I. Tokushima, H. Ono and R. Nishida: Comparison of phenylpropanoid volatiles in male rectal pheromone gland after methyl eugenol consumption, and molecular phylogenetic relationship of four global pest fruit fly species: Bactrocera invadens, B. dorsalis, B. correcta and B. zonata. Chemoecology 21; 25-33, 2011

- Enomoto, H., T. Ishida, and R. Nishida: 3-Oxygenated a-ionone derivatives as potent male attractants for the solanaceous fruit fly, Bactrocera latifrons (Diptera: Tephritidae), and sequestered metabolites in the rectal gland. Appl. Entomol. Zool. 45; 551-556, 2010

Reports, others

- Mori, N., N. Yoshinaga and Y. Kuwahara: Arthropod Chemicals Activating Host Defense Reactions, Bioindustry 27; 28-34, 2010 (Japanese journal)

- Mori, N., T. Aboshi, N. Yoshinaga and Y. Kuwahara: Chemicals produced by insects in prey-predator interactions, Journal of Environmetnal Control Technique 28; 20-30, 2010 (Japanese journal)

- b) Conference and seminar papers presented
 - Annual meeting of Japan Society for Bioscience, Biotechnology, and Agrochemistry 2011
 - Japanese Society of Environmental Entomology and Zoology
 - The 91st Annual Meeting of the Chemical Society of Japan
 - Biomimetics research symposium
 - Union of Japanese Societies for Insect Sciences foundation symposium
 - The 18th International Ecdysone Workshop
 - 43rd Annual Meeting for the Japanese Society of Developmental Biologists

A-3.Off-campus activities 1

Membership in academic societies

- Nishida, Ritsuo, D. Agric. Sci. : Japanese Society of Applied Entomology and Zoology (Councilor)

- Mori, Naoki, D. Agric. Sci. : Union of Japanese Societies for Insect Sciences (Committee), Japanese Society of Applied Entomology and Zoology (Editor), Japanese Society of Environmental Entomology and Zoology (Councilor), The Acarological Society of Japan (Executive Committee, Editorial Board), JSBBA, Kansai branch (Committee)

A-3.Off-campus activities 2

Research grants

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

- Monbukagakusho Research Grant: Integrated Research (B) (2) : Nishida, Ritsuo, D. Agric.Sci. : Molecular chemical ecological approach for coevolutionary process between insects and plants

- Monbukagakusho Research Grant: Integrated Research (B) : Naoki Mori, D. Agric. Sci. : Insect herbivore-produced elicitors of plant defense reactions

- Monbukagakusho Research Grant: Young Scientists (B) : Ono, Hajime, D. Agric.Sci. : Analysis of signaling cascades of insect hormones by manipulation of hormonal secretion

2. Other Research Grants

- New applicational technology in Agriculture, Forest and Fisheries : Amano, H. (Mori, N.) : Applying biological interaction to control Acaridae pest in sustainable agricultural system

- The Asahi Glass Foundation : Ono, Hajime, D. Agric.Sci. : Elucidation of developmental mechanism regulated by levels of steroid hormone in insects

A-4.International cooperation and overseas activities 1

Membership in academic societies

- Nishida, Ritsuo, D. Agric.Sci.: Asia-Pacific Association of Chemical Ecologists (Executive), Biochemical Systematics and Ecology (Editorial advisory board), Chemoecology (Editorial advisory board)

International meetings(country,roles)

- Nishida, Ritsuo, D. Agric.Sci.: The 8th Chinese Society of Chemical Ecology Meeting, Shanghai (China, Plenary lecture)

B.Educational Activities(2010.4-2011.3)

B-1.On-campus teaching

a)	Courses	oiven
a)	Courses	given

- Undergraduate level :	Bioorganic Chemistry III (Nishida and Mori), Organic Reaction Mechanisms I (Mori), Structure Analyses of Organic Compounds (Nishida), Laboratory Course in Bioorganic Chemistry (Mori and Ono).
- Graduate level:	Laboratory Course in Chemical Ecology (Nishida, Mori and Ono), Chemical Ecology Seminar (Nishida, Mori and Ono)