Ag-ESD Symposium 2015

Food Loss & Food Waste

Ag-ESD Symposium for GLOBAL ACTION Program

11/16 (Mon.) ~ 20 (Fri.)

Program & Summaries

University of Tsukuba

Contents

Date: November 16 (Mon.) to 20 (Fri.), 2015

Venue: University Hall, University of Tsukuba

Tennodai 1-1-1, Tsukuba-shi, Ibaraki-ken, Japan

Main Working Language: English

Organizers: Agricultural and Forestry Research Center, University of Tsukuba

Background

The Agricultural and Forestry Research Center of the University of Tsukuba has been nominated by UNESCO as an Associated Center of the Asia-Pacific Program of Educational Innovation for Development (APEID) in the field of vocational and technical education, and has organized the Tsukuba Asian Seminar on Agricultural Education (TASAE) annually since 1979.

TASAE has gained a good reputation as an international agricultural program under APEID through the timely theme for each term. The themes of TASAE for each term were as follows:

- 1979-1981 【 The second term of APEID 】

  Agricultural Education at the Secondary Level in Asia
- 1982-1986 【 The third term of APEID 】

  Strategies for Innovation of Agricultural Education in Asian Countries
- 1987-1991 【 The forth term of APEID 】

  Education and Research for Higher Agricultural Productivity Conserving Nature Agro-ecosystem in Asian and Pacific Countries
- 1992-1996 【 The fifth term of APEID 】

  Education and Research for Sustainable Development of Agriculture and Conserving Nature and Agro-ecosystem in Asian and Pacific Countries
- 1997-2001 【 The sixth term of APEID 】

  Innovative strategies for linking agricultural and environmental education in Asian and Pacific Countries for the 21st century
- 2002-2007 【 The seventh term of APEID 】

  The utilization and conservation of the water resources for human survival, bioproduction and the environment considering sustainable development, and the role of agro-environmental education
- 2008-2013 【 The eighth term of APEID 】

  Promotion of Ag-ESD for the Development of a Sustainable Future

The 2008 International Symposium on Agricultural Education for Sustainable Development (Ag-ESD Symposium 2008) succeeded TASAE and the first annual symposium in the eighth term of APEID was held at the University of Tsukuba in November 2008. The eighth term of APEID is sponsored in collaboration with the Japan National Commission for UNESCO, JICA, Ibaraki University and the International Cooperative Education Program for Creation of Harmonious Asian Countries. The aim of Ag-ESD is to promote reform and improve agricultural higher education, especially considering environmental problems from an international viewpoint.

The Ag-ESD Symposium 2009 entitled “Food Safety and Food Security in Agricultural ESD” was held from November 9th to 12th at the university as the second annual symposium. Eighteen participants were invited from 7 countries: Philippines, Thailand, Indonesia, India, Malawi, Nigeria and Japan.

The Ag-ESD Symposium 2010 was held from November 8th to 11th at the University of Tsukuba and focused on “Secondary and Higher Education for Sustainable Development: Agriculture and the Environment ”. Fifteen participants from 8 countries: Philippines, Thailand,

Indonesia, Afghanistan, Bangladesh, Malawi, Ghana and Japan. A special session was organized for participation of high school teachers from Philippines, Thailand, Indonesia and Japan.

The Ag-ESD Symposium 2011 was held from November 7th to 11th and focused on "Appropriate Use of Biodiversity in Agricultural ESD". Twenty-one participants from 9 countries: Philippines, Thailand, Indonesia, Afghanistan, U.S.A, Ghana, Kenya, Malawi, and Japan.

The Ag-ESD Symposium 2012 was held from October 29th to November 2nd and focused on "Technological Innovations to Reduce Environmental Impacts in Agricultural Education for Sustainable Development". Nineteen participants from 9 countries: Philippines, Thailand, Indonesia, Afghanistan, U.S.A, Ghana, Kenya, Laos and Japan.

The Ag-ESD Symposium 2013 was held from November 25th to 29th and focused on "The Role of Universities in Promoting Agricultural Education for Sustainable Development". Seventeen participants from 7 countries: Philippines, Thailand, Indonesia, Afghanistan, U.S.A, Kenya and Japan.

The Ag-ESD Symposium 2014 was held from November 10th to 14th and focused on "Premium Agriculture and Food Project". Sixteen participants from 9 countries: Philippines, Thailand, Indonesia, Afghanistan, U.S.A, Malaysia, Ghana, Zambia and Japan.

Theme and Objective

1) Theme

Food Loss and Food Waste

2) Objective

To promote APEID program and Global Action Program, which is a post-ESD program of UNESCO, we will focus on issues related to the role of universities in promoting agricultural education for sustainable development.

Outline of Schedule

Nov. 15 (Sun.)	Arrival at Narita Airport, Japan
16 (Mon.)	Registration, Opening Ceremony, Keynote Addresses, Welcome Party
17 (Tue.)	Invited Lectures, Discussion with Students
18 (Wed.)	Invited Lectures, Poster Viewing, Excursion
19 (Thu.)	Poster Session, Invited Lecture, Awards Ceremony, Parallel session
20 (Fri.)	Young Researcher's Forum, Closing Ceremony, Farewell Party
21 (Sat.)	Departure from Japan

Accommodations

Nov. 15 (Sun.) Hotel Nikko Narita (Phone) 0476-32-0032

Nov. 16(Mon.) – 20 (Fri.) University Hall Annex, University of Tsukuba (Phone) 029-853-2386

Ag-ESD Symposium 2015 Program

Program of 2015 International Symposium on Agricultural Education for Sustainable Development

November 15 （Sun.） Arrival at Narita Airport [⇒ stay at Hotel Nikko Narita]

November 16 （Mon.）

10:30 Leave Hotel Nikko Narita for University of Tsukuba

12:00 Arrival at University Hall, UT

12:00-13:00 Lunch

13:15-13:30 Group Photograph (1)

13:30-14:00 **Opening Ceremony** [Special Conference Room, University Hall A]

Welcome Address

・Kyosuke NAGATA, President, University of Tsukuba

Opening Address

・Yooichi KAINOH, Director, Agricultural and Forestry Research Center (AFRC) (Associated Center of APEID), University of Tsukuba

【 * Chairperson: Ryozo NOGUCHI 】

14:00-14:15 Group Photograph (2)

14:15-15:15 **Keynote Address (1)**

・Hiroyuki KONUMA, Senior Advisor to the President, Asia Institute of technology (AIT), Visiting Professor, Faculty of Agriculture, Meiji University

◇ Topic: " Impacts of Food Losses and Waste in global Food Security and Environment "

【 * Chairperson: Atsushi TAJIMA 】

15:15-16:15 **Keynote Address (2)**

・Hiroko ISODA, Professor, University of Tsukuba

◇ Topic: " Roles of Anti- Oxidant Molecules as Functional Food Factor "

【 * Chairperson: Atsushi TAJIMA 】

16:15-17:15 **Registration and Orientation**

18:00-20:00 **Welcome Party** [The Soup Factory]

November 17 （Tue.）

09:20-09:40 **Address**

・Atsushi ASANO, Assistant Professor, Agricultural and Forestry Research Center (AFRC), University of Tsukuba

◇ Topic: " Education for Sustainable Development in Agriculture at the University of Tsukuba "

【 * Chairperson: Hideo YOSHIDA 】

09:40-10:20 **Invited Lecture (1)** [Special Conference Room, University Hall A]

・Shigeki YOSHIDA, Associate Professor, University of Tsukuba

◇ Topic: " Functional Phenolic Components in Teas "

【 * Chairperson: Hideo YOSHIDA 】

10:20-11:00 **Invited Lecture (2)** [Special Conference Room, University Hall A]

・Yuji MIYAGUCHI, Professor, Ibaraki University

◇ Topic: " Reuse of expired natto, fermented soybeans, as an animal feed "

【 * Chairperson: Hideo YOSHIDA 】

11:00-12:15 Break and Lunch (Free)

12:15-13:30 **Discussion with Students** [University Hall A]

・Lotis E. MOPERA, University of the Philippines, Los Baños

・Sujitta RAUNGRUSMEE, Kasetsart University

・Kudang Boro SEMINAR, Bogor Agricultural University

・Kynda CURTIS, Utah State University

13:30-14:00 Break

14:00-14:40 **Invited Lecture (3)** [Special Conference Room, University Hall A]

・Kudang Boro SEMINAR, Professor, Bogor Agricultural University

◇ Topic: " Food Chain Transparency for Food Loss and Waste Surveillance "

【 * Chairperson: Internship Student 】

14:40-15:20 **Invited Lecture (4)** [Special Conference Room, University Hall A]

・Sujitta RAUNGRUSMEE, Lecturer, Kasetsart University

◇ Topic: " Utilization of Food Loss and Waste "

【 * Chairperson: Internship Student 】

15:20-15:30 Break

15:30-16:10 **Invited Lecture (5)** [Special Conference Room, University Hall A]

・Lotis E. MOPERA, Director and Assistant Professor, University of the Philippines, Los Baños

◇ Topic: " Food Waste Scenario in Philippine Agriculture "

【 * Chairperson: Internship Student 】

16:10-16:50 **Invited Lecture (6)** [Special Conference Room, University Hall A]

・Abdullah YOUSUFI, Master's Student, University of Tsukuba

◇ Topic: " Horticulture Situation in Afghanistan Challenges and Opportunities "

【 * Chairperson: Internship Student 】

November 18 （Wed.）

09:00-09:40 **Invited Lecture (7)** [Special Conference Room, University Hall A]

・Hasfalina CHE MAN, Associate Professor, Universiti Putra Malaysia

◇ Topic: " Sustainable Approaches in Minimizing Grain Losses "

【 * Chairperson: Internship Student 】

09:40-10:20 **Invited Lecture (8)** [Special Conference Room, University Hall A]

・Kynda CURTIS, Professor and Extension Specialist, Utah State University

◇ Topic: " The Role of Sustainability Certification Programs in Reducing Food Waste in Tourism "

【 * Chairperson: Internship Student 】

10:20-10:30 Break

10:30-11:10 **Invited Lecture (9)** [Special Conference Room, University Hall A]

・Mahmoud BEN OTHMAN, Post-doctoral, Alliance for Research on North Africa

◇ Topic: " The anti-stress effects of Tunisian *Cymbopogon schoenanthus* L. ethanol extract and some of its active compounds "

【 * Chairperson: Internship Student 】

11:10-11:50 **Invited Lecture (10)** [Special Conference Room, University Hall A]

・Abass Karim NYO, Coordinator, Savannah Accelerated Development Authority (SADA)

◇ Topic: " Inadequate Infrastructure: the Bane behind Food Losses and Food Security in the Savannah Zone of Ghana "

【 * Chairperson: Internship Student 】

11:50-12:00 Break

12:00- Leave University Hall A for ASAKUSA

Lunch and **Excursion**

16:30-17:00 Leave ASAKUSA for University Hall (Annex)

18:30 Arrival at University Hall (Annex)

November 19 （Thu.）

09:00-13:30 **Poster Presentation** [Lounge at 30th Anniversary Hall]

・Selected persons: Graduate students, etc.

Lunch (Free)

13:30-15:00 **Senior High School at Sakado, University of Tsukuba Presentations**

15:00-15:30 **Invited Lecture (11)** [Special Conference Room, University Hall A]

・Petr Dejmek, Professor, Lund University

◇ Topic: " Solar Assisted Pervaporation (SAP): a Novel Technique for Small-scale Preservation of Juices and Juicy Fruits "

【 * Chairperson: Marcos NEVES 】

15:30-16:00 **Awards Ceremony for Best Poster Presentation**

16:00-18:00 Parallel session (Bioresouces Engineering) [Multimedia Room]

November 20 （Fri.） 《 Young Researcher's Forum 》

09:00-09:30 **Presentation (1)** [Special Conference Room, University Hall A]

・Yuta HOSHINO, Master's Student, Ibaraki University

◇ Topic: " Radiocesium and Potassium Dynamics in the Relation to Tillage and Cover Crop Managements after the FDNPP Accident "

【 * Chairperson: Toshiya MATSUKAWA 】

09:30-10:00 **Presentation (2)** [Special Conference Room, University Hall A]

・SUPRIYANTO, Lecture, Bogor Agricultural University

◇ Topic: " Hot Chili Information System to Forecast Supply Chili Production in Indonesia "

【 * Chairperson: Yuta HOSHINO 】

10:00-10:30 **Presentation (3)** [Special Conference Room, University Hall A]

・Dipti WANKHADE, Ph.D. Student, Kasetsart University

◇ Topic: " Development of Breeding Lines with Four Pyramided Resistance Genes that Confer Broad- Spectrum Blast Disease Resistance in Rice Using Marker Assisted Selection "

【 * Chairperson: Supriyanto 】

10:30-10:40 Break

10:40-11:10 **Presentation (4)** [Special Conference Room, University Hall A]

・Rona Camille M. LIZARDO, Assistant Professor 1, University of the Philippines, Los Baños

◇ Topic: " Development of High-Value Food Products from Selected Indigenous and Underutilized Crops for Increased Utilization and Reduction of Food Loss "

【 * Chairperson: Dipti WANKHADE 】

11:10-11:40 **Presentation (5)** [Special Conference Room, University Hall A]

・Toshiya MATSUKAWA, Ph.D. Student, University of Tsukuba

◇ Topic: " Type 2 diabetes prevention effect of Cyanidin-3-glucoside derived from black soybeans in adipocytes and skeletal muscle "

【 * Chairperson: Rona Camille M. LIZARDO 】

11:40-13:00 Lunch and Break (Free)

13:00-14:00 **Closing Ceremony** [Special Conference Room, University Hall A]

(Includes Awards Ceremony for the Best Presentation)

14:00-18:00 Free Time

18:00-20:00 **Farewell Party** [The Soup Factory]

November 21（Sat.）

07:00-09:00 Departure from Japan

List of Participants

【Welcome Address】

Kyosuke NAGATA
President
University of Tsukuba

【Opening Address】

Yooichi KAINOH
Director, Agricultural and Forestry Research Center, University of Tsukuba

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【Keynote Address】

Keynote Speaker **Hiroyuki KONUMA**
Senior Advisor to the President, Asia Institute of technology (AIT)
Visiting Professor, Faculty of Agriculture, Meiji University

Keynote Speaker **Hiroko ISODA**
Professor, University of Tsukuba

【Address】

Speaker **Atsushi ASANO**
Assistant Professor, Agricultural and Forestry Research Center, University of Tsukuba

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【Invited Lecture】

Invited Lecturer **Shigeki YOSHIDA**
Associate Professor, University of Tsukuba 【Japan】

Yuji MIYAGUCHI
Professor, Ibaraki University 【Japan】

Kudang Boro SEMINAR
Professor, Bogor Agricultural University 【Indonesia】

Sujitta RAUNGRUSMEE
Lecturer, Kasetsart University 【Thailand】

Lotis E. MOPERA
Director and Assistant Professor
University of the Philippines, Los Baños 【Philippines】

Abdullah YOUSUFI
Master's Student, University of Tsukuba 【Afghanistan】

Hasfalina CHE MAN
Associate Professor, Universiti Putra Malaysia 【Malaysia】

Kynda CURTIS
Professor and Extension Specialist, Utah State University 【USA】

Mahmoud BEN OTHMAN
Post-doctoral, Alliance for Research on North Africa (ARENA)

Petr DEJMEK
Professor Emeritus, Lund University 【Sweden】

Abass Karim NYO < Graduate of University of Tsukuba, SRD Course >
Coordinator, Agricultural Modernization and Food Security
Savannah Accelerated Development Authority (SADA) 【Ghana】

【Young Researcher's Forum】

Presenter

Yuta HOSHINO
Master's Student, Ibaraki University 【Japan】

SUPRIYANTO
Lecture, Bogor Agricultural University 【Indonesia】

Dipti WANKHADE
Ph.D. Student, Kasetsart University 【Thailand】

Rona Camille M. LIZARDO
Assistant Professor 1, University of the Philippines, Los Baños 【Philippines】

Toshiya MATSUKAWA
Ph.D. Student, University of Tsukuba 【Japan】

Summaries
for Keynote Address, Address and Invited Lectures

Contributors

Hiroyuki KONUMA
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Visiting Professor, Faculty of Agriculture, Meiji University, Japan
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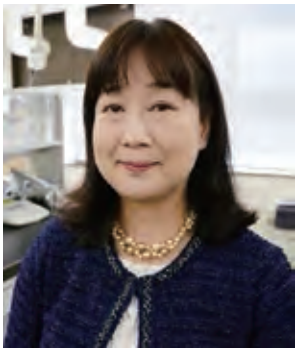
Specialty: Food Security, Agricultural Development

Impacts of Food Losses and Waste in global Food Security and Environment

The world is expected to add nearly 2 billion population by the year 2050 from present level of 7.3 billion. The average per capita calorie consumption would also exceed 3,000 kcal per day by 2050 from that of 2,780 kcal in 2005/07. The combination of these factors would necessitate the increase of global food production by 60 percent from the level in 2005/07 by the year 2050 to meet rapidly increasing food demands as per the projection made by FAO. On the other hand, the world has been experiencing various challenges in recent years such as stagnation of expansion of arable land, increasing scarcity of water resources, decline of the pace of annual crop productivity growth, high food losses and waste, increased use of food grains for non-food purposes, competition on the use of land and water between food crops and bio-energy crops, and negative impacts of natural disasters. While FAO predicts that it would be possible to increase food production by 60 percent by 2050 mainly from existing arable land with a benefit of agricultural research and yield increase, it remains very uncertain if it can be achievable due to unpredictable impact of climate change to agriculture which would largely be influenced by the level of greenhouse gas emissions in coming decades. Under these constraints, one of the most important and effective actions would be to minimize food losses and wastes which counted nearly 30 percent of global annual food production and ranked as the 3rd top emitter of greenhouse gas globally. Food losses and waste are not only the losses of food for consumers, but it would result in loss and waste of labors for which farmers devoted for many months, loss and waste of energy, water, seeds, fertilizer, etc. which are all needed to grow and produce. Reducing food losses and waste will not only avoid pressure on scarce natural resources, but also it will help in reducing environmental impacts while making more food available to consumers.



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Roles of Anti- Oxidant Molecules as Functional Food Factor

Caffeoylquinic acid (CQA) derivatives are polyphenolic compounds found in wide variety of plants. Previously, we have demonstrated that di- CQA and tri- CQA maybe neuroprotective through the ability to promote intracellular adenosine-5'- triphosphate (ATP) generation and by up-regulation of glycolytic enzyme expression. In the present study we have investigated the effect of di- CQA and tri- CQA on energy metabolism in SH-SY5Y cells using a metabolomics approach. Results indicate that di- CQA treatment of SH-SY5Ycells significantly increases the production of an array of glycolysis metabolites and tricarboxylic acid (TCA) cycle metabolites, including acetyl-CoA, succinic acid, fumaric acid, and malic acid. Tri-CQA treatment was also observed to increase the levels of all glycolysis and TCA cycle metabolites and evoked a stronger effect than that of di-CQA. In addition to their effects on glycolytic metabolites, di-CQA and tri-CQA exposure also induced a significant increase in the production of ATP, ADP, GTP, and GDP. Our results suggest that CQA-induction of intracellular ATP synthesis is mediated by the activation of central metabolic pathways including the activation of glycolysis and the TCA cycle (Patent No. 2008-298227).

The erythroid differentiation-inducing effect of apigenin and its derivatives on human chronic myeloid leukemia K562 has been reported but the functional group in its structure responsible for the effect has not yet been elucidated. Here, we determined the moiety responsible for the erythroid differentiation induction effect of apigenin by using different flavonoids to represent the functional groups in its structure. Results of the analysis of the relationship between the structure and function of the flavonoids suggest that the apigenin-induced K562 cell differentiation was due to the 2–3 double bond and hydroxyl groups in its structure. This is the first study that identified the specific functional group in apigenin that impact the erythroid differentiation effect in K562 cells.(Isoda H. et al., *Chem Biol Interact.* 2014, 220C, 269-277)

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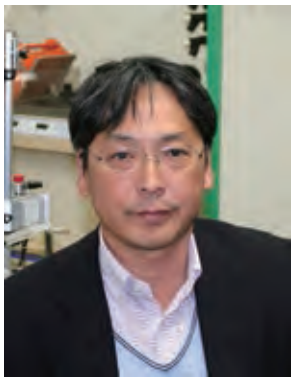
Education for Sustainable Development in Agriculture at the University of Tsukuba

The Agricultural and Forestry Research Center of the University of Tsukuba (AFRC-UT) has developed a number of international programs to improve agricultural education. As an Associated Center of the Asia-Pacific Program of Educational Innovative Development (APEID) nominated by the United Nations Educational, Scientific and Cultural Organization (UNESCO), AFRC-UT annually sponsored the Tsukuba Asian Seminar on Agricultural Education (TASAE) since 1979. TASAE has brought together more than 250 scientists and administrators from Asian countries for discussions on various agricultural, educational and environmental conservation issues facing the Asia-Pacific region. From 2008, the International Symposium on Agricultural Education for Sustainable Development (Ag-ESD Symposium 2008) succeeded TASAE. The aim of Ag-ESD is to promote reform and improve agricultural higher education, while considering environmental problems from an international viewpoint. In addition, a one credit Ag-ESD internship course is offered to graduate students so they can experience international programs. Another key factor to sustainable development of agriculture and education is effective dissemination of information between researchers and scientists. Therefore, AFRC-UT publishes the *Journal of Developments in Sustainable Agriculture* (JDSA). JDSA, a J-Stage based on-line journal, is an excellent medium for distribution of information on sustainable agriculture because it can be freely accessed from anywhere in the world.

The AFRC-UT has also participated in a new graduate program in Agricultural Education for Sustainable Rural Development (SRD) established in the Graduate School of Life and Environmental Sciences in collaboration with Japan International Cooperation Agency (JICA) since April 2006. This graduate program provides practical technical training relevant to sustainable food production and supply, and alleviation of poverty to regional agricultural extension agents and administrators in Asian and African countries. Graduates from this program can contribute to the alleviation of poverty in rural areas of their home countries. In addition, from September 2011, AFRC-UT began a new short stay “Farm Training Program” for undergraduate students from Kasetsart University (Thailand), Utah State University (USA), University of the Philippines Los Baños (Philippines) and Bogor Agricultural University (Indonesia) to receive training and technical experiences in Japanese field management and production systems for a period of several months.

Through the above and other programs, the AFRC-UT emphasizes internationalization of education for the development of sustainable agriculture as a major goal of the center.



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Functional Phenolic Components in Teas

Tea tree (*Camellia sinensis* L.) is cultivated in about 30 countries, and various types of teas are derived from tea leaves. Teas are generally classified into three major categories, green tea, oolong tea, and black tea depending on the degree of oxidation. In addition, post-fermented teas, which are fermented with specific microorganisms, are produced across China. Tea beverages made from processed tea leaves are widely consumed in the would because their attractive aroma, taste, and health promotion effect.

The main astringency phenolic constituents in green tea are catechins. The most abundant catechin is epigallocatechin-3-gallate (EGCG), and many scientists have reported the benefits of intake of EGCG. There are some cultives contained *O*-methylated EGCG, epigallocatechin-3-*O*-(3″-*O*-methyl)-gallate (EGCG3″Me). Japanese tea cultivar ‘Benifuuki’ is rich in EGCG3″Me, and EGCG3″Me stimulated the wound repair of vascular endothelial cells (VECs) more effectively than EGCG. These results suggest that EGCG3″Me has protective activity against oxidation stress.

During enzymatic oxidation process of tea leaves, catechins are oxidized, and produced teaflavins and thearubigin. Many reports on the possible health promoting effects of teaflavins have been published, but the contents of teaflavins in black tea are relatively low. To improve the productivity of teaflavins from catechins, homogenate of Japanese pear was added to green tea extract because Japanese pear contains high oxidase activity and is a local specialty of Ibaraki Prefecture. By the addition of pear homogenate, productivity of teaflavins were markedly increased. However, oxidase activity were varied depending on cultivar of pear.

Post-fermented teas have much attention because of their potential sources of novel compounds with biological activities. Teadenol A and teadenol B were isolated from post-fermented tea with *Aspergillus* sp. Teadenol A indicated the promotion effect of adiponectin secretion, and is expected to be a functional food additive for human health. Therefore, conditions of liquid culture with *Aspergillus* are optimized. Teadenol A was produced on a medium containing EGCG as a starting material, and the productivity of teadenol by liquid culture was higher than that by solid-fermentation of tea leaves.

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Reuse of expired natto, fermented soybeans, as an animal feed

Natto is a soybean product fermented with *Bacillus subtilis var. natto*, which has nutritional qualities and several functional ingredients. Many soybeans for raw materials are imported from abroad. The very low feed self-sufficiency is of concern to be the livestock industry in Japan, as is food self-sufficiency. However, food waste, equivalent to 20% of the food consumed foods in Japan is annually generated. The many natto-processing plants located in Ibaraki prefecture in North Kanto, Japan face the problem of disposal of expired and stock-surplus products. We have accordingly been studying the possibility of reuse of unused natto, as feed for swine and poultry. In this study, dried natto (DN) from commercial expired natto was prepared and the reusability of DN as feed for layer chicken was investigated.

Pre-experimentally, it was confirmed that feed supplemented with 3% DN could be fed to chickens with adequate palatability. Egg productivity and feed conversion ratio of DN-supplemented group were not significantly different from those of the control group. DN supplementation did not affect egg qualities such as shell strength and freshness. Supplementation also did not change the concentrations of isoflavones and vitamin E but reduced vitamin K levels in the yolk. Yolk cholesterol concentration also decreased with DN supplementation as a result of the water-insoluble fraction of DN. These results suggest that expired natto may be used as a feed supplement that can modify egg quality. Further study is needed to evaluate the reusability of various food wastes to build a food-recycling society on a global scale.

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Food Chain Transparency for Food Loss and Waste Surveillance

Food loss and waste is a considerable component of the world's food system challenges and has become a topic of growing interest worldwide. Many approaches and methods have been made to prevent or reduce food loss and waste. This paper describes an approach to monitor, prevent or reduce food loss and food waste using a food chain transparency framework. Food chain transparency requires a comprehensive and integrated ***farm-to-table*** approach in which the all actors in the chain (i.e. producer, processor, transporter, vendor, and consumer) play a vital role in ensuring food safety, food loss and quality. The vital and adequate information in a food supply chain needs to be recorded and provided to promote transparency along the chain, enabling the surveillance of food loss and food waste. The needs for food chain transparencies are aggressively increasing particularly due to the ***time-sensitive*** and ***high perishable food*** agro-products and agro-services in food industries to cope with food safety, food loss and waste. This paper addresses the motivation, *state-of-the-art*, application practices, future research needs in food chain transparencies for food loss and waste surveillance.

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Food Product Development

Utilization of Food Loss and Waste

Food loss and waste are the disposal of biodegradable solid wastes which create serious enviornment such as toxic gas solid emission and economical problems almost everywhere in the world. In generally, food loss mostly occurs at the front of the food chain during the production, postharvest, and processing. While, food waste occurs toward the back end of the food chain, at the retail and consumer level. Food and Agriculture Organization (FAO) of the United Nations is defined food wastes as the discarding or alternative (non-food) use of food that was fit for human consumption by choice or after the food has been left the spoil or expire as a result of negligence.

According to FAO's report, the global volume of food wastage is estimated at 1.6 billion tonnes of primary product equivalents. The direct economic consequences of food wastage excluding fish and seafood run to the tune of $750 billion annaully. In developing countries food loss and waste occur mainly at early stages of the food value chain in the farm. Thus, a strengthening of the supply chain through the support farmers could help to reduce the amount of food waste ; meanwhile, in medium- and high-income countries food is wasted and lost mainly at later stages in the supply chain. Differing from the situation in developing countries, the behaviour of consumers play a huge part in industrialized countries. In the United states 30% of all food, worth $48.3 billion, is thrown away each year. For United Kingdom household waste an estimate 6.7 million tonnes of food every year. While, in Bangkok,Thailand alone each year, food has thrown away about 0.935 million ton per year.

Due to, food is biological material subject to degradation and different food stuffs have different nutritional value ; basically, food loss and waste are diverted into feeding livestock, landfill. However more economics dimensions, researchers are focusing to the utilization of food loss and waste as raw material for the production of biofuel, biomaterial production or ethanol because these wastes have the potential to generate energy due to their higher organic composition and easily biodegradable nature. On the other hand, the utilization of food loss and waste can cause severe enviornmental issues for example emission of greenhouse gasses or generate undesirable by-products such as dioxin-related compounds**.** However, many projects have been developed food loss and food waste to be a novel biorefinery process that effectively convert food waste into valuable chemicals with carbon emission. The process will be utilized by enzymes and bacteria to convert food waste into acid such as succinic acid, lactic acid and etc . These chemicals widely applied to form the basis of many compounds for home and industrail use.

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Food Waste Scenario in Philippine Agriculture

In the Philippines, agriculture contributes about 8.6% of the country's Gross Domestic Product (GDP). Agricultural products are high volume, low value and highly perishable. These produce are generally wasted during the process of food distribution in the supply chain. Major contributors to huge losses are the inherent nature of these produce, the tropical setting of the country, lack of post-harvest infrastructure and facilities, the way of handling and the multi-layered distribution system. In the Philippines, substantial post-harvest losses of up to 50% was recorded from the initial harvesting, grading, packaging and transportation from field to storage and distribution to the consumers. To address these problems, agricultural development entails accelerating productivity and increasing linkages between farm production, agricultural services, industrial and technological inputs, and agro-processing. The context of agricultural development in the country involves a transition from farming to engagement in small and medium scale enterprises (SMEs) in the supply chain as processors. However, agricultural diversification and changing patterns in agricultural consumption poses both challenge and potential for change in reducing food waste in the Philippines.

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Horticulture Situation in Afghanistan Challenges and Opportunities

According to USDA foreign agriculture office, Afghanistan is the country where nearly 80% of people either directly or indirectly are involved or depended on agriculture (2011). The Afghanistan economy always depends on agricultural, despite the fact that only 12% of its total land is arable and about 6 percent is currently cultivated. During 1960`s Afghanistan was the world leader in raisin production .During 1960`s and 1970`s the export of high value horticultural products accounted for 48% of annual export revenue in Afghanistan. Prior to conflicts annual exports averaged around US$600 million of which 30% was dried and 7% was fresh fruits. It is estimated that income of horticulture products is three to seven time higher than that of wheat. Afghanistan`s climatic conditions are highly favorable for many tree crops, vegetables species and seed production.

Agriculture (crop production, Horticulture, Animal husbandry…) and forestry are the backbone of the economy in Afghanistan. Agriculture has always been of fundamental importance for Afghanistan economy and has played a central role in the past and is still very important for stable and thriving society. The history confirms that horticulture has been a vital part in agriculture and economy of Afghanistan, and last few decades of conflicts has caused destruction to agriculture infrastructure especially orchards.

Conflicts doesn't only result in destruction of resources such as seed, nurseries, water sources and knowledge but is also the most common cause of instability in most parts of the world. However Afghanistan with agriculture has the ability to rise once again and provide livelihood for up to 80% of its population. This will result in better economy and increasing food security.

The rebuilding of horticulture in Afghanistan can provide abundant employment opportunities. The establishment of horticulture should focus on good quality products with increased production. To develop a modern horticulture in Afghanistan, with all its components and elements, will be a significant challenge but has great potential to contribute to redevelopment of economy in Afghanistan.

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Sustainable Approaches in Minimizing Grain Losses

One of the leading global strategies for achieving sustainable food security is by minimizing food losses or post-harvest losses of grains. In this study, we are proposing sustainable approaches to reduce grain losses due to paddy plant disease by *in-situ* detection (immunosensor) and adopting an improved designed-bin for retaining better quality of grains.

In the South and Southeast Asia, one of the vital issue regarding food losses is due to Rice tungro disease (RTD) which affecting paddy fields. In Malaysia, the most serious tungro infestation was recorded in 1982, which more than 20,300 ha of rice field was infected and the estimated yield lost was about 34,000 tonne (USD10 million). The identification of RTD; except in advanced equipment and laboratories are generally carried out by visual observations of typical symptoms. These methods of identification are often complicated. Therefore, it is imperative to develop more specific detection method by application of immunosensor for *in-situ* detection for preventing the disease outbreak in planting area.

Another major issue of self-sufficiency in food grains requires adequate facilities for its storage. As an example in Pakistan, grain storage become major problems at large scale throughout the country due to insufficient methods of grain storage. The deterioration of wheat grains in terms of various quality parameters (moisture, insect-damage, fungi, aflatoxin, protein, fat, ash and starch) was observed during storage in traditional structures (earthen bin, bulk covered and room store) while better quality of wheat by designed bins (ferrocement, concrete block and straw-clay bins). The designed bins can be proposed as suitable storage for retaining better quality of wheat grains than traditional structures. Thus, the adoption of proper designed bins must be encouraged in the developing countries to reduce the grain losses.

We profile here a subset of approaches that are particularly practical and cost-effective, and that could improve yields or gains. It is important to note that many technical solutions can be effective only when other parts of the food supply chain are effective. Therefore, progress in reducing food loss and waste will require an integrated supply chain approach.

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The Role of Sustainability Certification Programs in Reducing Food Waste in Tourism

The USDA estimates food waste in the United States to be approximately 35% of the food supply. An estimated 133 billion pounds of food was wasted in 2010 (ERS, 2010) and the amount of uneaten food in 2008 was valued at $390 per US resident (Buzby and Hyman, 2012).

Excess food waste is a primary concern for both the sustainability movement and the hospitality industry, seeking to decrease costs in their low-margin business, and thus, industry and third-party organization have begun to address the issue. For example, the Food Waste Reduction Alliance, a cross-industry effort by restaurateurs, supermarkets, grocery stores and grocery manufacturers was stared to define opportunities to reduce food waste and lobby for policies aimed at reducing waste and rewarding waste reduction. Additionally, the Green Key Global organization provides a Green Key Eco-Rating certification program for the hospitality industry and Earth Check has a green resort certification program, both address food waste management and reduction.

While the hospitality industry feels these certification programs address the concerns of the environmentally concerned traveler (green hotelier, 2014), a study by Wink (2005) argues that certification programs will not be sufficient to distribute necessary information to consumers interested in eco-friendly tourism destinations. Further, a study by Blackman and Rivera (2010) found that in only six of 37 case studies did certification lead to actual environmental or socioeconomic benefits for certified hotels and resorts. However, these studies examined “environmental” or “sustainable” practices among tourism providers/hospitality industry prior to the inclusion of food waste reduction and management in the certification process.

This paper will discuss the potential for sustainability certification programs to reduce food waste among tourism providers through a review of the literature and case studies citing actual environmental and economic impacts resulting from certification program participation.

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The anti-stress effects of Tunisian *Cymbopogon schoenanthus* L. ethanol extract and some of its active compounds

Stress is known to induce alterations in various physiological responses even leading to pathological states. It was demonstrated that different stress paradigm significantly affected learning and memory function, and intensified fear memory in mice. The effects are supposed to be an outcome of a complex interaction of stress and altered activity of different mechanisms such as decrease in central neurotransmitters, neurohormonal factors, and neurotrophic factors, and increase in free radical generation and oxidative damage in the central nerve system.

In view of the potential use of natural products and botanicals as stress adoptogens, anti-oxidant rich phytochemical extracts are gaining a lot of interest. In this respect, several plants are traditionally and clinically used for the management of neurological disorders.

The present study was designed to investigate the anti-stress properties of the ethanol extract of Tunisian medicinal plants: *Cymbopogon schoenanthus* (CSEE), growing wild in the Southern part of Tunisia. In addition, we investigate the neuroprotective effects of some active compounds on H_2O_2-induced cytotoxicity, overproduction of ROS, and ATP depletion in human neuroblastoma SH-SY5Y cells. Our results demonstrated that pretreatment of SH-SY5Y cells with CSEE and their active compounds significantly inversed H_2O_2-induced neurotoxicity. In addition, the fluorescence intensity of DCFH-DA in cells treated with H_2O_2 was increased after 60 min of incubation, compared to untreated control cells. Pretreatment of the cells with mixture of pure compounds prevented the accumulation of ROS relative to H_2O_2-treated cells. Moreover, our results showed that H_2O_2 at 150 µM significantly decreased intracellular ATP levels in SH-SY5Y cells. Therefore, to deeply understand the anti-stress effect of these compounds, still to demonstrate their effects on anti-oxidant enzyme and against stress disorders at *in vivo* levels.

Therefore, and to the best of our knowledge this study is the first to demonstrate the preventive potential of CSEE against stress disorders at *in vitro* levels.

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Solar Assisted Pervaporation (SAP): a Novel Technique for Small-scale Preservation of Juices and Juicy Fruits

In some developing countries, there is an abundance of fruit in season, but the fruit cannot be stored for later use or transported to markets due to inadequacies of basic infrastructure - poor roads, nonexistent electricity and expensive fire fuel. There may be lots of sunshine, but drying of liquid fruit in trays presents a handling problem, and an opportunity for pests and microorganisms to infest the food.

The (patent pending) solution we have developed is to use pouches made of liquid water impermeable but "breathable" food grade textiles. The materials are typically produced as a thin layer or coating of nonporous hydrophilic polyurethane, often with textile or nonwoven backing. Water molecules are transported from the juice through the polymer layer by diffusion and evaporate at its, or the support layer´s, outer surface. Pouches made from such materials can be deployed with no infrastructure available, just laid on a roof or hung from a string, and being nonporous, protect against all external organisms.

As any drying process they function as long as the water activity inside exceeds the external water activity immediately outside, and the drying rate is dependent on the water transport resistance of the material composite and the driving force. In Sweden, not renowned for a hot, dry climate, we can reach storage stable concentrations of juices in less than a week and even concentrate the very dilute birch sap. The drying rates are of course faster in places such as Mozambique, and can be further increased using simple glazing above the pouches, not to mention a true solar dryer. The pouches can also be reused.

We have successfully produced a range of products of different dryness, from juice concentrates to fruit leathers - and at the opposite end of the world, in Canada, we have demonstrated the concentration of maple sap to maple syrup.

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Inadequate Infrastructure: the Bane behind Food Losses and Food Security in the Savannah Zone of Ghana

The world losses approximately 1.3 billion tons or one third of the food produced annually for human consumption globally through waste or food losses almost as much as the entire net food production of sub-Saharan Africa.

The issue of food losses discourse is highly important in efforts towards impacting on hunger and food security especially in the world's poorest countries. The exact causes of food losses are varied and very much dependent on the socio-economic conditions in a given country.

Food losses in sub-Saharan Africa are basically influenced by crop production technologies and infrastructure. In Ghana agriculture used to be the highest contributor to GDP and employment until recently that it was over taken by the services sector. Notwithstanding this the sector still remains the highest employer in the Northern Savannah Ecological Zone (NSEZ) of Ghana. This zone is about 54% of the entire land mass of Ghana and is considered the bread basket of the country. With all these agricultural potentials, it is still considered the poorest part of the country.

The zone is poor because very little has been done to tap the potential of the NSEZ in terms of agricultural infrastructural investments. This deficiency of infrastructure in the agricultural sector, has contributed to lots of food losses from seed bed preparation to the final consumer. In fact there are huge losses along the whole value chain rendering smallholder farmers poorer and poorer and making them food in secured.

There should be some serious re thinking of infrastructural investments including roads, warehousing, improved technologies among other things to help increase productivity and reduce the percentage of food losses in the SADA zone to insure food security in the zone and Ghana.

Summaries
for the Young Researcher’s Forum

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【**Young Researcher's Forum**】

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Radiocesium and Potassium Dynamics in the Relation to Tillage and Cover Crop Managements after the FDNPP Accident

The nuclear accident at the Fukushima Dai-ichi Nuclear Power Plant (FDNPP) occurred as a magnitude 9.0 earthquake and associated tsunami that struck the Tohoku and northern Kanto regions of Japan on March 11, 2011. The released radioactive nuclides were deposited over a wide area of the Tohoku and Kanto regions.

In this study, we investigated radiocesium soybean fields in Ibaraki, approximately 170 km from the FDNPP. The different tillage systems were moldboard plow/rotary harrow (MP), rotary cultivation (RC), and no tillage (NT); the three types of winter cover crops were fallow weeds, rye, and hairy vetch; and two rates of manure (0 and 1 Mg ha^{-1}) were compared the radiocesium contamination and potassium contents in the soil.

MP and RC reduced the radiocesium contamination (^{134}Cs + ^{137}Cs) in the 0–2.5 cm soil layer, although NT left a large amount of radiocesium on the soil surface. The radiocesium concentration of the rye cover crop was significantly lower than hairy vetch and fallow during 4 years. In 2014. The radiocesium concentration in soybean grains was significantly lower in MP and RC than in NT from 2011 to 2014. In 2014, 4 years after the FDNPP accident. The transfer factor for soybean grain was significantly lower in MP and RC than in NT, although the transfer factor in NT also decreased each sampling year after the FDNPP accident. The 0–2.5 cm soil layer was the lowest deposit density of potassium. Negative correlation was seen in deposit density of the radiocesium of the soybean and that of potassium in the soil.

We conclude that despite numerous benefits of the NT system for environmental conservation, soil inversion by tillage significantly decreased the radiocesium contamination of crops. Thus, tillage inversion would be appropriate to counter measures after the nuclear accident.

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Hot Chili Information System to Forecast Supply Chili Production in Indonesia

The price fluctuation of hot chili (*Capsicum annuum.* L) in Indonesia is caused by unstable monthly supply of hot chili from farmers. In fact the total amount of annual production of Hot Chili is higher than needed. The increase in the price of hot chili causes inflation and increase of import quotas. One of the solutions for coping with these problems is to develop an information system to forecast chily supply periodically (monthly or annually) to allow farmers and decision makers to manage the production of chili in the best possible scenario. The information system that has been developed can also be used as reference to balance supply and demand, the determination of nationally unified planting schedule, and reduction of hot chili import quotas to support national food security and sovereignty. Started in year 2013 the information system has been implemented in several regencies as central production of hot chili, including Blitar, Kediri, Brebes and Garut. In this year, the informatin system will be disseminated to 20 regencies in Indonesia.

Keyword : Chili, Information System, food supply, chili production

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Development of Breeding Lines with Four Pyramided Resistance Genes that Confer Broad- Spectrum Blast Disease Resistance in Rice Using Marker Assisted Selection

Rice blast disease caused by the fungal pathogen Pyricularia oryzae is one of the major rice diseases for rice growing areas all over the world. A genomic investigation unveiled that rice varieties IR64 and Jao Hom Nin (JHN), having resistant genes in four genomic regions, demonstrated a broad spectrum resistance against rice blast pathogens in Thailand. A cross between Qignizhan (CH1) and IR64 varieties was made to improve blast resistance containing the two mentioned resistant quantitative trait loci (QTLs), as CH1 was susceptible to blast. Further the F1 was crossed with JHN. This three- way crossing was made to develop highly blast resistant progenies into a single genotype. Marker Assisted Selection (MAS) was used to identify four QTLs in homozygous fusion in F2 and F3 plants. MAS screening with six markers RM212, RM319, RM139, RM144, RM208, and RM179 was used to provide the desired progenies to have resistance against Thai isolates of blast. MAS identified F3 homozygous plants carrying a combination of four resistance QTLs. Genes have been fixed with the help of SSR markers for chr.1, chr.11, chr.2 and chr.12. The lines of F4 generation containing QTLs show broader spectrum resistance towards blast isolates. MAS has become an important tool for screening durable resistance, minimizing the time and cost to make progress in breeding programs.

Rice breeders can use conventional breeding programs with MAS to develop resistance in susceptible varieties. The field experiment was conducted to assess the agronomic features, yield, and yield component. By similar kind of breeding programs, we can improve varieties for durable resistance from diseases.

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Development of High-Value Food Products from Selected Indigenous and Underutilized Crops for Increased Utilization and Reduction of Food Loss

In many developing countries with humid and warm climate like the Philippines, more than 40% of food loss occurs during the production, postharvest, and processing stages of the food supply chain. This is due to deterioration of perishable crops, lack of storage and processing facilities, and inadequate market systems (FAO, 2011). As a result of food loss and food waste, essential nutrients that could contribute to the energy supply are also lost. Food wastage and the corresponding nutrient losses, when projected with the entire population, reveal a considerable negative economic implication (FNRI-DOST, 2014).

Food processing and preservation has played a major role in reducing food loss and wastage. In this study, selected indigenous and underutilized crops in the project sites (Tayabas, Candelaria and Dolores, Quezon province, Philippines) namely ‘Saba’ banana, white corn, and sweet potato were identified for possible product development. These crops were processed into flour, which was consequently, used in various food products such as native delicacies. Studies on the process optimization and characterization of the flour were also conducted. Physico-chemical, proximate, functional, and sensory properties were determined alongside the product development experiments.

These indigenous and underutilized crops could be given attention in terms of processing possibilities. Processing of these raw materials makes them shelf-stable, increases their market value and prevents them from being loss or wasted.

Development of new food products and optimization of the processing technology are effective channels to promote underutilized crops as alternative food sources. This will also encourage our local farmers from the study areas to expand their production of these crops not only as additional source of income but for their own subsistence.

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Type 2 diabetes prevention effect of Cyanidin-3-glucoside derived from black soybeans in adipocytes and skeletal muscle

Type 2 diabetes mellitus (T2DM) is a serious metabolic disorder, comprising 75~80% of all diabetes cases, and the number of patients is increasing every year around the world. The main cause of the onset of T2DM is obesity. In obese individuals, the glucose uptake level and cellular metabolic activity are decreased when the level of inflammatory cytokines and circulating free fatty acids (FFA) and decrease in adiponectin in the blood. It has been reported that some polyphenolic compounds are effective for treatment of T2DM and recently, cyanidin-3-glucoside (Cy3G), an anthocyanin contained in black soybean and blueberry, has been reported to reduce the blood glucose level, and is effective for the prevention of T2DM. However, the mechanism of Cy3G's effect has not yet been elucidated. In this study, we investigated the molecular mechanism underlying the T2DM preventive effect of Cy3G, using adipocytes and skeletal muscles as cellular model.

Black soybean seed coat extract (BSSCE) rich in Cy3G were fed to db/db mice (diabetic model mice) for 30 days to evaluate the prevention effect of T2DM. Furthermore, to evaluate the effect of Cy3G on adipocytes and skeletal muscles *in vitro*, 3T3-L1 adipocytes and C2C12 myotubes (skeletal muscle model) were used and the effect of Cy3G on differentiation of adipocytes, metabolic activity, and glucose uptake ability of adipocytes and skeletal muscle were evaluated.

BSSCE-administration inhibited the gain in body weight and white adipose tissue weight of db/db mice. Furthermore, Cy3G-treated 3T3-L1 adipocytes had increased insulin sensitivity, glucose uptake level and mitochondrial metabolic activity by promoting adipocyte differentiation. Cy3G-treated C2C12 myotubes had increased glucose uptake and mitochondrial metabolic activity. These results indicated that Cy3G can prevent the onset of T2DM by improving glucose uptake and metabolic activity of adipocytes and skeletal muscles.

Abstracts
for Poster Presentations

Contributors

◊ **Doctor course**

GIS-based Weighted Linear Combination for Suitability Assessment of Solid Waste Management Sites in Dhaka City

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For developing countries like Bangladesh, urban solid waste management (USWM) is a complex issue. Rapid urbanization increases pressure on urban infrastructure and services, thus, resulting to poor urban service delivery including uncollected solid waste in most urban locations of Bangladesh. The waste in Dhaka City (Capital of Bangladesh) varies from 6000 to 7000 metric tons per day. Most part of the city areas faces an urgent solution to manage large amount of waste in a limited space and logistics. The composition of municipal waste of Dhaka city is food waste–66%, paper–7%, wood & glass–7%, plastics–6%, and others–11%. Further, a large fraction of household wastes accumulate and no segregation is being practiced. Reducing this 66% food waste or organic content by means of composting and energy production by biogas digester installation could be an alternate solution for Dhaka City. GIS could help in dealing with several factors of waste disposal and treatment simultaneously which needs to be considered while planning waste management in urban areas. The anaerobic and aerobic waste treatment technologies would have a strong impact for the reduction of organic waste. Research was completed for ward 2 from zone 2. A GIS model was proposed for featuring the waste management of ward 2 of Dhaka North City Corporation (DNCC). A suitability map was produced to identify the most suitable points for composting and some suitable local waste generating points also identified for city corporation waste collection. Study attempted to evaluate the route for collection and transportation of municipal solid waste for ward 2. Among 81 waste points of ward 2, 31% were located where the road network found very poor, 30% waste points located in a fair road network and 39% were located in a very good road network. ArcGIS analysis was carried over for sensitive location of waste bins. It was found that 21% of existing waste collection points were located besides of very high sensitive locations, like some of them were located just beside of educational institutes, hospitals, road intersection and market places. The analysis identified the immediate and most vulnerable relocating waste points and suggested for the suitable waste points. Study also proposed two best suitable vacant points as suitable composting sites. Further research will be conducted to cover all words of this zone under the DNCC.

Economic Evaluation of Agricultural Production Risk towards Cyclone in Bangladesh

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Cyclone is regarded as one of the greatest challenge for the southern people of Bangladesh. The coastal zone of Bangladesh is particularly prone to the risks of cyclone with storm surges and face more than one cyclone of various velocities every year. They generally occur in early summer during April-May or late rainy season during October-November. Due to tropical cyclones agricultural crops especially *boro* and *aman* rice are always in danger on harvesting time. In 2009 such kind of tropical cyclone Aila hit to south west coastal region in Bangladesh leading to a long term crisis situation and causing unprecedented sufferings in particular areas. Agricultural lands were inundated with saline water from cyclone-induced storm surges and the major crops (*boro* rice) were devastated. Farmers who were transplanted their *boro* rice earlier they were harvested before cyclone hit. There is might be lack of empirical evidences that analyzes if a relationship between early cropping and production factors exists. This study evaluated randomly selected 84 farm households from 7 unions of Koyra upazila in Khulna district to examine the relationship between early cropping and production factors that focus on escape of cyclone risk. Alongside descriptive statistics and binary logistic regression analyses were carried out to identify the factors which influence farmers for early cropping. In descriptive statistics, farms are categorized by early cropped and late cropped and this study unveiled that the mean of planted farm size is 0.57 ha (small farm), average number of labor force from family is 1.32, most of the farmers have secondary level of education with more than 23 years of farming experience, early cropped farmers were not-damaged and average cost of high yield variety of rice production is about 73,415 Tk/ha whereas the average income is 12,629 Tk/ha from high yield variety of rice production but the average off farm income is 120,448Tk/year. Binary logistic regression analysis signifies that the main contributing production factors for early cropping are labor force from family, education, planted size of farms 0.6-1.0 ha and farms 0.4-0.6 ha, location of farms in south and north-west side of Koyra upazila. It is also observed that farming experience, marginal farms (0.02-0.2 ha) and location of farms in relatively east and north-east side of Koyra upazila have a negative relationship towards the early cropping. The *R* square is 0.562. This research findings is very important for micro level study in the disaster-prone coastal zone of Khulna district that more working labor from family, better education, planted small farms size and specific location of farms have a positive influence to take decision by farmers for early rice production and it will escape tropical cyclones and ultimately reduces the cyclone risk of crop production. Thereby, this research has an implication for mainstreaming environmental planning policies in government planning accordingly escape cyclone risk from a local level perspective.

Economic Evaluation of Oil-Water Separation and Suspended Solid Recovery for Wastewater Treatment

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The technologies to recover oil from wastewater including animal and vegetable oil were developed during the postharvest food processing. They contribute to reduce the load of blocking the drainage derived from mass of oil, reduce the initial cost and running cost of the facilities for wastewater treatment, and reuse the recovered oil and the oil-removed water as valuable resources. By introducing oil-water separation technologies, especially in food processing factories under proper sanitary condition, the recovered oil could be used as food and the oil-removed water could be used as water resource. On the other hand, actual wastewater from food processing factories includes not only oil but also suspended solid (SS) such as protein and starch, and it acts as a constraint of wastewater treatment. Although SS recovery equipment was developed, its economic performance was not clear. This study aims to propose economic evaluation of introducing oil-water separation and SS recovery into wastewater treatment system of a food processing factory.

The evaluation method consists of two components, Value Function (VF) and Separative Work Unit (SWU). SWU was the scale of value produced by separation, widely used in the field of separation engineering and VF was the function used to calculate SWU and convert concentration to the economic value. Object wastewater was assumed to have water quality; 4,500 L/day of drainage volume, 19,000 mg/L of n-hexane extracts and 1,100 mg/L of SS, which was determined by the field investigation at a food processing factory, Naoetsu-Yushi Co. Ltd., which produces boiled chicken from culled chicken. Recovered oil was used as fuel and oil-removed water was treated at wastewater treatment facility in the factory. Recovered SS was assumed as floss and waste sludge that were treated as fuel for an incinerator. The evaluation was conducted to two cases, introducing only oil-water separation equipment and introducing oil-water separation equipment and SS recovery equipment into wastewater treatment.

Results shows the higher SWU of the latter case than the former and maximum difference of SWU between the cases were about 8,000 JPY/day under certain ability of oil-water separation equipment. It means that introducing SS recovery equipment with oil-water separation equipment has the possibility to develop and establish more economic wastewater treatment system. This method enables to evaluate the economic performance of wastewater from food processing factories that includes some kind of valuable resource.

Root Endophytic Fungus, *Chaetomium cupreum* Promotes in Al-tolerance Mechanism of *Miscanthus sinensis* via Producing Siderophores

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Generally, soil in Japan is recognized to be acidic soil, and aluminum (Al) is dissolved into soil solution under low pH condition. Al^{3+} is known to be a toxic element to plants due to inhibition of root elongation. Some plants are known to have mechanisms to detoxify Al, and it is important to clarify these mechanisms in Japan. *Miscanthus sinensis* is a native grass to Japan. It is well-known that *M. sinensis* grows well under acidic soil without growth inhibition showing Al tolerance. *Miscanthus sinensis* accumulated and detoxified high concentration of Al in the roots via producing citric and malic acids. While, root endophytes are known to promote plant growth and nutrient absorption into plant tissues, and to produce siderophores including organic and phenolic acids, which detoxify Al by chelating. The objective of this study was to clarify the mechanism of Al tolerance in *M. sinensis*, considering the interaction with root endophytes.

We collected *M. sinensis* growing in old mine site, showing high acidity and containing high concentrations of Al and heavy metals. From the roots of *M. sinensis*, we isolated *Chaetomium cupreum* which are reported as a root endophyte, and *C. cupreum* showed high siderophore production. In the inoculation test of *C. cupreum*, we examined the growth, and concentration of Al in *M. sinensis* seedlings growing in sterile study-site soil with or without *C. cupreum*. *Chaetomium cupreum* increased the roots and above-ground parts growth compared with control via producing indole-3-acetic acid. It was reported that some microbes could decrease harmful elements effects on plants via detoxifying harmful elemnts in their mycelia. Thus we suggested that *C. cupreum* alleviates Al toxicity via producing compounds as siderophores, which detoxify Al. Now, we are trying to identify the siderophores produced by *C. cupreum*.

Preparation, Characterization and Application of a Novel TiO_2 Based Photosensitizer for Photodynamic Therapy

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In recent years, TiO_2 is noted as a potential photosensitizer in the field of photodynamic therapy (PDT) due to its low toxicity, high stability, excellent biocompatibility, and photoreactivity. However, pure TiO_2 can only be excited by UV light which is harmful and hinders its practical applications. Fortunately, doping nonmetal, metal and semiconductors with TiO_2 could enhance its photocatalytic ability and facilitate the application of TiO_2 as a photosensitizer for PDT. In this work, we firstly developed a visible-light driven $P/Ag/Ag_2O/Ag_3PO_4/TiO_2$ composite with high photocatalytic ability, and use $P/Ag/Ag_2O/Ag_3PO_4/TiO_2$ composite to investigate photocatalytic apoptosis of cancer cells under LED light. So, we developed a novel $P/Ag/Ag_2O/Ag_3PO_4/TiO_2$ photosensitizer with high photocatalytic ability. It is the first time to use this novel material to investigate its photocatalytic cytotoxicity under LED light, which is an alternative light source with relatively narrow spectral bandwidths and high fluence rates.

Pure TiO_2 and $P/Ag/Ag_2O/Ag_3PO_4/TiO_2$ composite were prepared by sol-gel method, followed by characterizations of XRD, SEM, TEM, EDS, UV-vis and PL methods. Photocatalytic cytotoxicity were investigated by WST, Trypan-blue and Dead/live staining methods. $P/Ag/Ag_2O/Ag_3PO_4/TiO_2$ exhibited stronger absorption band in visible light region and higher separation efficiency of photo-exited electron-hole pairs compared with pure TiO_2. The apoptosis of cancer cells increased with the increase in concentration of particle and irradiation time. Besides, photocatalytic cytotoxicity of $P/Ag/Ag_2O/Ag_3PO_4/TiO_2$ was much higher than pure TiO_2 under LED light. Therefore, results indicated that $P/Ag/Ag_2O/Ag_3PO_4/TiO_2$ photosensitizer exhibited high photocatalytic ability for photodynamic therapy, and shows promising potential for practical applications.

Effects of Resveratrol and ε-Viniferin on Adipocyte Differentiation and Adiponectin Protein Expression in 3T3-L1 Preadipocytes

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Obesity, the main clinical manifestation of the disturbance of energy intake and consumption, is associated with the development of various diseases including coronary heart disease, hypertension, type 2 diabetes and cancer. Adipose tissue is composed of adipocytes and plays an important role in lipid homeostasis and energy balance. The primary roles of adipose tissue are to store energy in the form of triglycerides when energy intake exceeds energy expenditure, and to release it in the form of free fatty acids in starvation. The adipocyte synthesizes and secretes various biologically active molecules called adipocytokines such as adiponectin.

Resveratrol and its dimer ε-viniferin are natural polyphenolic compounds in red wine. Numerous studies have demonstrated that resveratrol exhibits a variety of beneficial functions including anti-oxidant and anti-obesity activities, and the activation of Sirt 1, known as mammalian sirtuin. In contrast, there are very few reports describing the functions of ε-viniferin. The objective of this study is to investigate and compare the effects of ε-viniferin with those of resveratrol on the adipocyte differentiation and adiponectin protein expression in 3T3-L1 preadipocytes.

3T3-L1 preadipocytes were cultured with 3-isobutyl-1-methylxanthine, dexamethasone, and insulin for cell differentiation to mature adipocytes in the presence and absence of resveratrol or ε-viniferin. Adipocytokine protein expression and other parameters of adipocyte differentiation were evaluated on day 10 after adipogenic initiation.

The accumulation of intracellular lipid was partially suppressed by the treatment of the cells with 15 μM resveratrol and 5-15 μM ε-viniferin, respectively. The protein expression of the transcriptional factor PPARγ, which mediates lipid accumulation, was also inhibited. In contrast, the protein expression of SIRT 1 and adiponectin, a typical beneficial adipocytokine secreted from mature adipocytes, was increased. These data suggest that both resveratrol and ε-viniferin induce the differentiation of adipocytes with decreased lipid accumulation and increased adiponectin expression. Therefore, both compounds in red wine have a potential for preventing obesity followed by several diseases such as diabetes.

Physicochemical Properties, Water Sorption and Glass Transition Temperature of Vacuum Spray Dried (VSD) Orange Juice Powder

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The most widely grown citrus fruit in Japan is orange (*Citrus sinensis*). Orange is the great sources of phytochemicals, vitamins C and bioactive compounds. The present study shows interest in the processing of orange juice (*Citrus sinensis*) powder by the application of a new technique of Vacuum Spray Drying (VSD) process to make heat sensitive stable powder. The dryer was developed to turn liquefied food into a powder at a low temperature (40-50°C) drying using superheated steam (200°C) as a heating medium, which will suppress the damage or loss of thermosensitive functional ingredients.

The physicochemical properties of orange juice powder with three different combinations of concentrated juice solids (COJ): maltodextrin (MD) solids at 50:50, 40:60, and 30:70 by weight were determined. The moisture content, hygroscopicity, water activity, particle size, rehydration and ascorbic acid retention were significantly affected by the maltodextrin concentration and drying conditions. All of the powder samples had water activity (a_w) values in the ranges of 0.15±0.01-0.25±0.00 and moisture contents of 2.29 to 3.35%. Powders with 50:50 COJ/MD had significantly (at $p \leq 0.05$) higher particle sizes as 7.75±0.25 µm and particle distributions than 40:60 and 30:70 powders of 6.36±0.45; 6.02±0.16 µm respectively. VSD orange juice 50:50 powder retained a maximum amount of 71.01% ascorbic acid. The sorption isotherms were determined by the gravimetric method, while the glass transition temperature or Tg of powders conditioned at various water activities were determined by differential scanning calorimetry. Cyclone recovery increased to 63.3% with increasing as Tg and MD. As results, experimental data of water adsorption were well fitted to both BET and GAB models. Overall, the sorption behavior of the orange juice powder exhibited a type III sigmoid curve, and the highest and lowest water adsorption occurred at a_w values above and below 0.53, respectively. With respect to the Tg, Gordon–Taylor model was able to predict the strong plasticizing effect of water on this property. In order to calculate the critical conditions of storage, at which orange juice powders are not susceptible to deteriorative changes such as collapse, stickiness and caking, for this sorption isotherms and Tg data were plotted as a function of a_w and the critical values of water activity and moisture content were obtained considering a room temperature of 25°C. Powder with 30:70 was more stable and it showed the highest critical water activity of 0.68 and moisture content of 11.0% (d.b.). Based on the stability and product recovery the present study concluded that COJ/MD 30:70 by weight can be used in industrially to produce orange juice powder.

Keywords: orange juice, vacuum spray drying, water sorption, glass transition temperature, stability

The Key Processing Technology for Bioactive Phospholipids Products of Japanese Mustard Spinach (*Brassica Rapa Var. Perviridis*)

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Lysophosphatidic acid (LPA) is a growth-factor-like phospholipid that has been confirmed the role of preventing or restoring gastrointestinal (GI) disorders in many recent studies. Its formation in our human bodies is through phospholipase A_2 (PLA_2) digestion of phosphatidic acid (PA). Therefore，it may be possible to consider that PA-rich foods exert a beneficial effect on certain kinds of GI disorders through the supplementation of LPA. However, PA does not accumulate too much in plants at normal condition. It needs some processing methods like grinding and mastication to trigger the activation of phospholipase D (PLD) in plants and thus lead to the production of substantial PA from endogenous phospholipids.

Japanese Mustard Spinach (*Brassica Rapa Var. Perviridis*), also known as Komatsuna in Japanese, is a common vegetable in the Japanese diet, and contains relatively high PA at normal condition. Here, to manufacture Mustard Spinach PA-rich foods, a new processing method of micro wet milling (MWM) is proposed. Our results already showed that the smaller particle, the higher PA content for cabbage. So that MWM is considered to mash the materials for getting liquid with smaller particle size materials, and we will study the effects of different processing parameters on PA content in Komatsuna and the optimized processing technology will be developed. In this work, TLC and Blight & Dyer method were adopted to extract phospholipids and PA, the contents of phospholipids and PA were detected by spectrophotometer at 660nm, the particle size was measured by SALD-2200, and PLD activity was determined by BIO-RAD Microplate Reader.

Rapid Meat Spoilage Analysis Based on the Fluorophores Content

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Conventional method for bacterial load analysis is conducted by directly counting the colonies that growth from the single cell. An effort to seek the relation between bacterial loads with the changes of the metabolites on the sample still an open field. Some metabolites that change or are secreted during bacterial growth are known to be fluorophores.

Fluorescence spectroscopy has high sensitivity and selectivity to detect the trace of fluorophores components on food matrix. The fluorescence fingerprint (FF) is a set of fluorescence spectra acquired at consecutive excitation wavelengths. FF has been used as a non-destructive technique for both qualitative and quantitative measurement (Fujita et al., 2010; Kokawa et al., 2012; Shibata et al., 2011).

Our previous research shows an appropriate Aerobic Plate Count (APC) estimation (R^2=0.975; RMSECV = 0.849 log CFU/ cm^2) was achieved by FF coupled with fiber optics for beef samples. Partial Least Square Regression (PLSR) validation model for the system shows high prediction with R^2 validation and RMSEP of 0.813 and 0.881 log CFU/cm^2, respectively. High regression coefficient comes from several wavelength regions related to three kind of intrinsic fluorophores (NAD(P)H , Porphyrins, and Flavin).

Thus, FF coupled with fiber optics is a promising tool for bacterial loads prediction. However, the previous procedure could not distinguish whether the fluorescence signals are emitted from the bacterial cell or the surface of the beef. Moreover, wide variety of beef surface such as rough contour or an adipose tissue part affect the FF signals significantly. Thus, an exact fluorophores change on the beef surfaces is still unclear. Therefore, our objective is to develop a bacterial load prediction based on FF of remnants collected by swabbing the beef surface. In addition, it is also our aim to elaborate wether this swab-dilute procedure provides better prediction or not.

Beef samples were stored for 72 hours in a 15 ^oC incubator with aerobic condition. The surface of the beef were wiped every 12h with a sterile swab. After swabbing, the cotton swab was dilute with a nine milliliter (9 ml) buffer solution. Conventional bacterial counting was conducted using two milliliter (2 ml) from the dilution. The rest of the diluted solution was centrifuged at 3500 x g for 5 minutes in order to separate the bacterial cell from the solution. The supernatant was used for obtaining of the FF data.

FF as explanatory variables were obtained by fluorescence spectrophotometer F7000 (Hitachi-High-Technologies, Japan). The PLS regression model was developed to estimate an aerobic plate count (APC) from FF.

GIS-based MCA Modeling to Assess Agricultural Land Use Changes in Bangladesh

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Land use changes have significant impacts on sustainability of food security, ecological balance and environmental protections in the developing countries. Bangladesh is one of that and facing the challenges with limited arable land resources. Another concerning points are the agricultural lands transformation into industrialization and urban developments during a last decade. According to the World Bank, Bangladesh has lost 11% of the agricultural land in last 20 years. The industrial growths on agricultural lands in the suburb areas are being increased without any suitability assessments. Improper expansions of industry in the agricultural lands could be a threat of sustainability of food production. Therefore, the aim of this study is to find out the land use changes over a time period in a suburb area that have the potentials of industrial growth over a time period. To emphases on both agriculture and industries for a sustainable growth, the study also assessed potential locations and further growth of industries by land suitability analysis with protecting agricultural lands.

To meet the research objectives, Multi-criteria Analysis (MCA) was done with the help of Geographical Information System (GIS) and Analytical Hierarchy Process (AHP). Initially, a base line survey was conducted to know the recent land use change and collected 420 geographical positions of factories. With the help of preliminary study, seven criteria along with fifteen factors and five constraints were selected to perform MCA for land suitability assessment. Expert's opinions were collected to use AHP for weighting the criteria. ArcGIS 10® was used to analyze the agricultural land use changes and mapped the factories in Savar administrative areas. Raster layers of factors and constraints were generated in ArcGIS 10® to perform reclassification. Furthermore, weighted overlay was done to find out the suitable locations of industrial sites. The study area was then classified into four categories: "Not suitable", "Less suitable", "Moderately suitable" and "Most suitable".

Due to rapid growth of factories, averagely, 6% of agricultural lands were decreased in each of the unit of the study area. Moreover, in some places, the percentages of agricultural land degradation were more than 10%. The geographic positions of 420 factories in Savar showed that the factories were located in the places where agricultural land decreased the most. According to the land suitability assessment, only 5% land was found "Most suitable" for industrial purposes. The outcomes of this research reflected the growth of factories that had influence on the agricultural lands transformation over a time period. The area was occupied with built-up industries and any more expansion of factories without suitability assessment could imbalance the sustainability of agricultural land use including ecological and environmental protection.

Keywords: LSA (Land suitability Analysis), GIS (Geographic Information System), MCA (Multi-criteria Analysis), AHP (Analytical Hierarchy Process).

Effects of Compost Addition on the Number and Quality of Tubers in a Potato Production System in an Andosol Soil

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Creating planting systems that reduce environmental load and maintain or increase productivity are currently some of the main objectives of crop production systems. It is environmentally sound to reduce chemical fertilizer (CF) input and supplement it with composts in potato production but the effects on yield are not yet understood. Increasing CF costs cause farmers to apply less than the recommended amounts. Compost has not only been used as a soil amendment, but also as a nitrogen source for potatoes, and for constructing a sustainable production system with low chemical fertilizer input. Such integrated fertilizations using swine manure (SM, 1.8% N) and poultry manure (PM, 2.5% N) composts with CF (21% N) were evaluated against the sole application of compost or CF.

The experiment was carried out at the Agriculture and Forestry Research Center, University of Tsukuba from March 2012 to July 2015. Continuous cropping and compost application was carried out in this period with 6 croppings of potato. Spring cropping was conducted every year using “Danshaku” during the experimental period and autumn cropping was conducted in 2012 and 2013 using “Nishiyutaka” and “Dejima”, respectively. The gross experimental area was 48 m x 17.5 m. Ten experimental plots including zero nitrogen application (Zero) were arranged with three replications on a randomized block design. Each plot was 4.8 m x 3.9 m. Row and plant distances were 0.8 m and 0.3 m, respectively. Nitrogen application was set at 12 kgN/10a for spring planting and reduced by 25% for autumn planting. Treatments were conducted in the same area and potatoes were cultivated continuously. All cultivars matured at 90-100 days after sowing every year and 5 plants per plot were harvested for tuber yield measurement.

Unlike grain crops, tuber crops have high variations in yield even within the same plot. Poultry manure 100% (PM100) showed consistently higher total yield in all spring croppings from 2012 to 2015, while SM100 showed the opposite i.e. low yields in spring. Integrated fertilization plots including SM25, SM50. SM75, PM25 and PM50 also showed significant high yields during spring croppings. CF100 had the highest marketable yield but some compost plots achieved the same yields as CF100 in spring. In both autumn seasons, CF100 had remarkably low marketable yields compared to compost plots. In the 4 spring seasons, 2014 had a remarkable reduction in yield due to adverse weather and a high incidence of potato scabs. A notably high non-marketable tuber yield was observed in 2014 in all plots. The yield and quality of potatoes in 2015 crops recovered after the fallow period in 2014. The percentage of marketable tuber yield for CF100 was highest in summer croppings, but that of autumn plantings were higher in all compost plots except PM50 than CF100. Compared to CF100, compost plots had the same percentage of marketable tubers or significantly higher percentages in autumn croppings. Compost type and integration management should be considered carefully if there is to be an improvement in yield quality and reduction in tuber loss which would help reduce food loss.

Oviposition Preference for Leaf Age in the Smaller Tea Tortrix, *Adoxophyes honmai* (Lepidoptera: Tortricidae) as Related to Performance of Neonates and Parasitoid Searching

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Tea, *Camellia sinensis*, is a major plantation crop of many countries. The smaller tea tortrix *Adoxophyes honmai* is a common pest of tea plants in Japan. Damage caused by larvae of this species is widely distributed throughout tea plantations, but the mode of oviposition is still unclear. Insect species prefer to oviposit on suitable host plants for offspring survival and development. Not only preferred plant species, but the age of leaves also affects the oviposition decision of maternal insects and performance of their offspring. In this study, we focused on the effect of leaf age in oviposition preference of *A. honmai* moths and the performance of their offspring. Moreover, the behavioral response of *Ascogaster reticulata,* an egg-larval parasitoid of *A. honmai,* to volatiles from young and old leaves was observed.

Two-choice experiments between young and old leaves, showed that *A. honmai* moths preferred to oviposit on wax paper placed close to old leaves than young ones. Thus, volatiles from old tea leaves appear to act as attractants and stimulate oviposition. In contrast, neonates preferred feeding on young leaves. More than 70% of neonates fed on young leaves 24 h after starting the experiments, but the reasons for neonate feeding preference are not yet clear. Development of larvae that continuously fed on young leaves was better and the survival rate higher. The oviposition decision of females to choose old tea leaves may increase the survival of offspring by reducing the risk of encountering natural enemies in the upper site of the plants and reducing competition with other tea pest insects that prefer young leaves. Neonates of this species preferred feeding on young leaves that may be easy to consume and good for development. After hatching, neonates may move to the young leaves and start feeding there.

Subsequently, host searching behavior of the parasitoid *A. reticulata* was observed by using a 4-arm olfactometer. Two-choice experiments between the tea branch that contained infested tea leaves with 24-h-old *A. honmai* egg masses versus intact tea branches showed no significant differences between the total time that female wasps spent searching in the arena of the infested branch volatiles and the intact branch volatiles. In the case of two-choice experiments between young and old tea leaves from intact tea plants, wasps preferred the volatiles from old leaves. Total time that wasps spent on an arena with old leaf volatiles was significantly longer. These wasps may not use the infested plant volatiles as a cue to find their host, but may discriminate young and old leaf volatiles to decide the landing site on the suitable host habitat of the tea plants to increase the possibility to encountering host eggs. Finally, we conclude that plant volatiles are not only essential for host insects to find suitable habitats for producing viable offspring, but also important for parasitoids to locate their host.

Logistics Modeling for Sustainability Assessment of Local Food Systems Using GIS

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Sustainability stands for maximizing benefits and maintains the quality of natural resources over the time. This concept integrates with environment, ecology, economy and social aspects, and extends from natural resources to local food production to ensure food security in the changing climates. Local food has the high potentials to grow, cultivate, and distribute to the local communities with adopting climates at the micro level. The potentials of local food could be strengthen the food security in the developing countries. Indonesia is one that and ranked fifth in higher population in the world. The increase of population is follow with the increased dependence of rice as a staple food. This dependence on the rice consumption has risk in production in the climatic changes. To reduce the dependency, diversification is required in consumption of local foods, such as cassava, which becomes a good alternative and less risk as a root crop to support the sustainability of food production in Indonesia. Cassava has played an important role in Indonesian, although the crop is not native to Asia. To increase the production and sustainability of this root crop, suitability assessment for land selection besides the major crops is required. Therefore, the objective of this research is to develop a logistics model to measure sustainability and suitability of local food production.

To measure sustainability in cassava production among different geographical contexts, the model was combined with Geographical Information System (GIS) and Analytical Hierarchy Process (AHP) extended into three dimensions: Ecology, social, and economic. The model was built into three stages: first, the priority indicators were identified by Analytic Hierarchy Process (AHP), second sustainability analysis was conducted using reflective practice, and third, suitability analysis was performed using ArcGIS® for vector features and raster images. A survey to the local farmer was conducted during the summer of 2014 at the Serang city, Banten Province of Indonesia. The criteria for suitability assessment of cassava were land cover, slope, rainfall, stream and road. GIS-based proximity and raster reclassification into 4 categories according to the land suitability referred by the United Nations of Food and Agriculture Organization (FAO).

This primary focus was to find out the suitable areas to increase cassava production based on the criteria and factors. These criteria and factors were selected in context of food security and sustainability agriculture according the professional expert's opinions and community survey. The result was performed that 2,407 ha (8.41%) was found as highly suitable while 8008 ha (27.9%) was moderately suitable and 88 ha (0.30%) was marginally suitable for cassava production. On the other hand, 18,117 (63%) ha of land was occupied with residence and settlements. The logistic model could serve as a significant role to government and entrepreneur to identify the most suitable location to increase local food capacity against the changing climates. In further research, the logistic model can be extended with satellite remote sensing systems to assess the cassava production regionally and site-specific management of cassava.

Keywords: AHP (Analytical Hierarchy Process), Cassava, GIS (Geographic Information System), Local Food.

Economic Effect of Climate Variation on Supply and Demand of Rice in Bangladesh

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This study was designed to find out the impact of climate change on rice yield and market clearing price under 5th assessment report (AR5) of IPCC considering the supply and demand model in Bangladesh. The result showed that the scale of fluctuation of yield was substantially higher under high temperature and erratic rainfall. The simulation proposed to give priority in developing temperature resilient rice variety (*Aman* genotype) and efficient water utilization in dry season for sustainable food supply against feeding the hungers. Furthermore, price showed more volatility in de-globalized and low GDP scenarios than medium GDP and population growth. However, the fluctuations of rice price oppositely caused the instability of rice demand under the scenarios.

Key words: Yield, Supply and demand elasticity, Market price and forecasting

Environmental Assessment of Biodiesel Production from Palm Oil and Microalgae

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Some terrestrial crops dominate the production of bioenergy. Each crop has environmental footprint that need to be considered (water, nutrients, energy requirement, CO_2 equivalent emissions). Massive utilization of biofuel crops will boost fertilizer and water consumption. In this research, two promising crops, palm oil and microalgae; have been selected to compare the critical environmental footprint. Environmental loading is a key factor to decide sustainability of biofuel production from crops.

Field investigation and measurement has been conducted at 2 oil palm plantations and mills located in Riau and Lampung province, Sumatra, Indonesia during 2013. This data was compared with laboratory experiments of *Chlorella sp.* with 25 $g/m^2/d$ of biomass and 30% lipid production.

The Life Cycle Assessment (LCA) technique has been applied, presenting preliminary results for environmental assessment of biodiesel production. For inventory database and simulation, SIMAPRO 8.04 version with Ecoinvent 3.1 LCI database and Align biofuel GHG emission calculations in Europe (BioGrace) v.4d 2015 were used.

The critical environmental footprint of oil palm and microalgae-based biodiesel has been successfully evaluated. The outcomes confirm the potential of microalgae as a sink of greenhouses gases, but highlighted the crucial necessity of decreasing energy consumption and some technical improvements in cultivation and oil extraction stages. Results related with greenhouse gas (GHG) emissions were compared with European sustainability criteria, in order to identify the reduction of environmental footprint of both biodiesel crops. The evaluation also showed that integrated energy plantation is an important solution to increase and maintain environmental sustainability of biofuel production.

Water Temperature Changes in Water Dynamics of Small Paddy Area

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Water temperature in river basin is an important factor in agricultural production and habitat environment of aquatic organisms. The global average of air temperature is expected to rise between 2.6 to 4.8 degrees by 2100. Increased temperature has an impact on river water temperature (IPCC, 2013). River water temperature depends not only on air temperature and radiation but also heat exchange between air and ground. Especially, in Japan where a lot of water is used for paddy irrigation, changes in the water temperature may be caused in the processes of canal flow, water distribution, submerging in paddy plots and drainage reuse in the paddy area. Uchijima (1962) showed that water temperature rise in paddy plots is suppressed because solar radiation is blocked by the leaf lush foliage in August. Shimmura and Taniguchi (2013) showed that water temperature changes in farm drain are similar to that in paddy plots. They individually discussed water temperature changes in each place such as paddy plots and canals. In this study, we observed water temperatures in beneficiary area of one branch irrigation to clarify the changes in a series of water dynamics.

Kawamata area (about 30 ha) located in upstream of the Fukuoka-zeki beneficiary area was selected as the target site. The observation was conducted by installing water level and temperature sensors at the following points: a) upstream and downstream of a main irrigation canal near a division work of Kawamata area, b) inlet and outlet of paddy plots, and c) tail-end of an farm drain including the above paddy plots in the catchment area. The observation was carried out while the irrigation period in 2015. In this study, we used observed data on August 3rd and 4th. In addition, the intensive observation was also conducted in some paddy plots and the tail-end and its 200 meters upstream point of the farm drain.

The difference of water temperature between daytime and nighttime in the main irrigation canal was 0.9℃. On the other hand, water temperature at the paddy inlet was 2.8℃ higher in daytime and 2.4℃ lower in nighttime in comparison with the downstream of main irrigation canal. The discharge in main irrigation canal is smaller than in farm ditch. Therefore, the former variation range of water temperature is smaller than the later one by the difference of heat capacity.

Comparing continuous data of water temperatures at paddy outlets and the tail-end of farm drain, the later was lower than the former. Also in the intensive observation, the water temperature was low in order of the upstream of farm drain, the tail-end of farm drain and the paddy outlet. Water temperature in farm drain is raised by drainage inflow through the paddy outlets. Meanwhile, it is considered that water temperature of the upstream of farm drain was lowest because temperature of seepage water from paddy is lower than drainage water through paddy outlets.

Study of the Effects of Photocatalytic Pretreatment on Various Macromolecular Components and *Chlorella vulgaris* to Enhance Biohydrogen Production

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Rising global warming and depletion of fossil fuels are the major social and economic crisis we are facing today. One of the solutions to these problems could be a clean and renewable energy. Biohydrogen being a clean energy has drawn worldwide attention and researches have been carried out to make it a sustainable energy for the future. Biohydrogen from biomass has drawn particular interest due to its eco-friendly and cost effective nature. However, pretreatment and availability of biomass are still a few limitations. Therefore, in this research we used *Chlorella vulgaris* as the biomass, as it can be easily cultivated and does not interfere with food security. However, its cell walls are difficult to degrade and in order to overcome this problem we employed the photocatalytic pretreatment.

Thermal, acid, alkali and ultrasonic pretreatment methods have been investigated as pretreatment methods of biomass, but since their energy intensive they limit their practical application. In this research we propose to use a newly developed photocatalyst material ($P/Ag/Ag_2O/Ag_3PO_4/TiO_2$) for photocatalytic pretreatment of the biomass, *Chlorella vulgaris* for enhanced hydrogen production. But before studying the effects of photocatalytic pretreatment on the algal biomass we used Rhodamine B as a dye model and BSA (bovine serum albumin) as a protein model to study the effects of photocatalytic pretreatment.

Photocatalytic pretreatment of Rhodamine B (2.5ppm, 100ml) using $P/Ag/Ag_2O/Ag_3PO_4/TiO_2$ photocatalyst under simulated solar light showed an average degradation effeiciency of 38.1% in 2 hr. The BSA (0.5g/L, 100ml) demonstrated a degradation efficiency of 43.2%. Conclusively, on treating *Chlorella vulgaris* (150 ml) biomass the protein concentration increased to 4.5 times in 60 hr. This showed that the photocatalytic pretreatment was effective in breaking down the algal cell walls and releasing the proteins into the solution. Further, the pretreated algal biomass will be used for biohydrogen production. Therefore, photocatalytic pretreatment can be a promising pretreatment for algal biomass in the future and by using solar light it can be applied for practical use.

Processing of Hydrogel Beads Loaded with Functional Compounds of Radish By-products by Reverse Phase Spherification

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Hydrogel bead (HB) processing is one of the encapsulation which has been wildly used in the food industry, and used to reduce the reactivity between core and environmental factors to protect the adjustment for the controlled-release ability of the core material. In this study, we used alginate as wall material, calcium lactate as the gelling agent, and radish by-products juice as core material. Especially radish leaves disposed as waste during harvesting and processing create significant food waste for producers and contain abundant nutrition. Reusing of the by-products of radish as new natural and functional ingredients, is not only cutting the waste production but also upgrading radish to higher value.

A difference from basic spherification is utilizing alginate adding into calcium solution. Reverse phase spherification (RPS) is a method which suspends calcium source in alginate solution. Furthermore, comparing to the basic spherification, the versatility of the ingredients may be manipulated using the RPS. Calcium chloride having a fast throughput has been used as gelling agent in this field mostly however the hydrogel beads which are made by calcium chloride have a bitter taste. The phenomenon makes the development of hydrogel beads be limited in the food industry.

The objective of this work was to process hydrogel beads by RPS with calcium lactate in order to determine its potential as gelling agent. For the effects ofconcentration of calcium lactate (X_1) and gelling time (X_2) on swelling capacity (Y), the results were optimized by response surface methodology with central composite design. Optimized beads were prepared using 0.3M calcium lactate and gelling for 34.7 min. The optimized formulation demonstrated 44.39 % of swelling capacity, r^2 of formulation was 0.997 and lack of fitting had no significant difference. There was no interaction between 2 variables, and X_1 had a higher influence on swelling capacity than X_2.

These findings suggest that calcium lactate could be a good source of gelling agent. Furthermore, reusing of the radish by-products as new natural and functional ingredients is not only reducing the waste but also upgrading radish.

Optimization of P/Ag/Ag_2O/Ag_3PO_4/TiO_2 Thin Film Coated Photocatalytic Reactor for High Efficiency Water Purification under Solar Light

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Due to the rapid development of society, increasing demand and shortage of clean water sources have become a worldwide issue. Recently, TiO_2 photocatalyst has attracted considerable interest for water purification. However, some drawbacks still hinder the practical application of TiO_2 for wastewater treatment: the fast recombination of photogenerated electron–hole pairs, low utilization of visible light and tedious post-separation of TiO_2 nanoparticles. Therefore, it is necessary for us to develop a metal salt modified photocatalytic thin film coated reaction system for solving these problems.

In this study, P/Ag/Ag_2O/Ag_3PO_4/TiO_2 thin film system was synthesized by sol-gel method to avoid the separation process, and P, Ag, Ag_2O and Ag_3PO_4 were used as dopants for increasing its visible light photosensitivity and inhibiting the recombination of electron–hole pairs. The synthesis of P/Ag/Ag_2O/Ag_3PO_4/TiO_2 thin film was optimized by investigating the effects of different amounts of Ag dopant, calcination temperature along with time and number of coating layers. The characteristics of the material were analyzed by X-ray Diffraction (XRD), UV-vis spectrophotometer and Scanning Electron Microscope (SEM). The photocatalytic activity of synthesized P/Ag/Ag_2O/Ag_3PO_4/TiO_2 thin film was evaluated by degradation of Rhodamine B, a model recalcitrant of organic waste, under simulated solar light.

From the results, the P/Ag/Ag_2O/Ag_3PO_4/TiO_2 photocatalyst possesses showed the remarkable stability, smaller band gap and higher visible light harvest ability, resulting in better photocatalytic activity under simulated solar light irradiation than traditional TiO_2 catalyst. Besides, this material could reduce the requirement of irradiation source and the cost for the practical application of photocatalyst. Therefore, the P/Ag/Ag_2O/Ag_3PO_4/TiO_2 thin film coated glass substrate system could operate at low cost with high efficiency, reusablity and promising potential for water purification by using solar light.

Effect of PEG Modified $P/Ag/Ag_2O/Ag_3PO_4/TiO_2$ on Degradation of RhB

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Photocatalyst, especially TiO_2 has drawn worldwide attention in these several years due to its low toxicity. But because of its large band gap (3.2 eV) and high recombination rate, it limits practical application of TiO_2. In the previous study, an efficient $P/Ag/Ag_2O/Ag_3PO_4/TiO_2$ photocatalyst synthesized by sol-gel method has been investigated. In this study, in order to enhance the ability of the novel material, Polyethylene glycol (PEG) was used as a binder, dispersant and structure-directing reagent for creating smaller particle size and improving photocatalytic activity of various simple photocatalyst under visible light. PEG, which is identified as an efficient template regent to prepare nano-crystalline particles was used to modify $P/Ag/Ag_2O/Ag_3PO_4/TiO_2$, which would also expand its specific surface area and improve photocatalytic activity. In this study, PEG is utilized to increase specific surface area and improve photocatalytic activity of $P/Ag/Ag_2O/Ag_3PO_4/TiO_2$.

Different average molecular weight and different dosage of PEG was utilized to modify $P/Ag/Ag_2O/Ag_3PO_4/TiO_2$. Then the material was calcined at different temperatures under different time to confirm the optimum condition for synthesis. After testing different dosage (0.1g, 0.2g, 0.4g, 1g) of PEG, the results showed that when the dosage of PEG-2000 was 0.2g, the degradation rate of RhB reached 95%, which was better than other dosages. It proved that optimum dosage of PEG is efficient for improving the photocatalytic activity of $P/Ag/Ag_2O/Ag_3PO_4/TiO_2$.

Feasibility Study for Utilization of Fuel Cell Tractor based on Energy Self-Sufficient in Rural Area

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Though nowadays people tried lots of methods to improve the fuel efficiency of conventional inner combusting engine, the highest efficiency is about 35% and only under a specific range of engine rotation. Add up with the mechanical loss, the fuel efficiency of a diesel tractor is only about 19%. To reduce the mechanical loss, people invented hybrid vehicle, but due to the limitation of inner combustion engine, the efficiency still can not exceed 30%. Thus, the concept of fuel cell tractor was proposed. Theoretically, the fuel efficiency of a fuel cell tractor can reach up to 47%, and the only one fuel cell tractor NH^2 has an efficiency of 34.54-46.05%, which proved the reliability of this concept. Three types of power plan FC-T, RMFC-T and biodiesel driving Hybrid-T were discussed, and four common types of food crops wheat, rice, soybean, corn were selected to prove the possibility of fuel self-sufficient in this paper.

The energy flow chart designed in this paper are:

1. For FC engine type, we use fermentation to get methane then use steam reformation to get hydrogen.
2. For RMFC engine type, we use fermentation to get methane then use oxidizing reaction to get methanol.
3. For Hybrid engine type, we use oil expeller to get the plant oil then use Transesterification to get biofuel.

The final energy efficiencies from biomass or waste of different engine types and self-sufficient abilities are:

1. FC: efficiency 14.86%; SS ability 4.60-10.50
2. RMFC: efficiency 11.57-14.87%; SS ability 4.60-10.50
3. Hybrid: efficiency <8.7%; SS ability 0.78

Though the efficiencies from biomass is lower than the conventional engine's 19%, the energy resource is biomass, it is totally harmless and continuable. For Hybrid, because the oil which we need to convert to biofuel is from the grain, so the yield is limited to a very low standard and cannot achieve our self-sufficient goal, while if we can get enough waste oil from other approaches, the efficiency can reach up to 20.9%.

Study on Cross-sex Migratory Ability of GGCs from 7- and 9-days-old Chick Embryos

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Development of the method to conserve genetic resource is important to secure endangered animals species. In this respect, recent development of germline chimeras technology, produced by collecting and transferring gonadal germ cells (GGCs), opened a new horizon to secure and propagate endangered avian species. Apparently, efficient recovery of GGCs from developing embryonic gonad is the first step of producing germline chimeras.

Recently, a novel method of recovering GGCs has been reported by simply incubating embryonic gonad in phosphate buffered saline without containing Ca^{2+} and Mg^{2+} (Nakajima *et al*. 2011). In their study, a bimodal discharge of GGCs from the gonad into PBS(-) has been observed which indicates the presence readily discharged GGCs (d-GGCs) and un-discharged GGCs (u-GGCs). The objective of the present study, therefore, was to evaluate the migratory ability of d-GGCs and u-GGCs in chick embryos.

In Experiment 1, temporal pattern of GGCs discharge was observed by incubating 7-, and 9-days-old chick embryonic gonad at 37.8 ^{o}C between 0 to 90 minutes. No difference in the pattern of GGCs discharge between male and female was observed when 7-days-old embryonic gonad was incubated in PBS(-), whereas significantly higher GGCs was discharged from female gonad compared with male gonad when 9-days-old embryonic gonad was incubated in PBS(-).

In Experiment 2, fluorescent-labeled d-GGCs and u-GGCs were both detected in the gonad of recipient embryos under all four possible cross-sex germ GGC transfer conditions. However, the number of GGCs observed in the recipient's gonad was significantly higher in GGCs recovered from 7-days-old embryos when compared with GGCs collected from 9-days-old embryo.

From the results obtained from the present study, it was revealed that GGCs discharge into PBS(-) and migratory ability into recipient's gonad change in between 7-days and 9- days of embryonic development.

Dynamic Stability Analysis of Agricultural Tractor Steering on Slope based on Joint Simulation with CarSim and Simulink

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Agriculture remains a hazardous industry, and farmers worldwide remain at high risk of work-related injuries, especially, on industrialized farms, injuries frequently involve the use of agricultural machinery, and a common cause of fatal agricultural injuries is tractor rollovers (NIOSH Workplace Safety & Health Topic: Agricultural Injuries, 2013). Japanese MAFF (Ministry of Agriculture, Forestry and Fisheries) statistics show that 65.1% of fatal farming accidents caused by agriculture machinery during the year of 2013. Among them 75 people was killed by tractors' sideways rollovers or overturns, accounts for 67.6% of 111 wheel tractor accidents. In order to decrease rollovers and improve tractor stability and safety actively, dynamic stability performance should be analyzed. The key parameters affecting dynamic stability are factors from the environment, such as slopes, a rough terrain, potholes, washboards, stones etc. as well as subjective factors, particularly speed and driving style (Spencer and Gilfillan, 1976).

Some researchers have studied dynamical behaviors of tractors passing over an obstacle on flat surface and slopes, but its behaviors of steering on a slope were underemphasized. As we all know, sideways rollovers usually caused by improper steering operation. In this study, a 3-DOF dynamical model combining the three major factors (sloping grounds, speed and turns) responsible for tractor overturns is built up for describing tractor's motions. Compared with experimental methods, computer simulation would be quick, cheap and easily control. In some cases, experimental methods could be hazardous to both life and equipment. For these reasons joint simulation system were designed by combining CarSim with Simulink. CarSim is used for building up tractor's dynamical model, executing commands and exporting parameters of motion states to Simulink. Simulink is control unit to analysis dynamical situation and send commands in real-time.

The results show that tractor's rolling angle is made up with two parts, one comes from the angle between tractor's lateral side and ground, the other comes from different deformation of tires that caused by the effect of centrifugal force and weight transfer. The rolling angle increases with the increasing of velocity or the increasing of slope's angle. The rolling angle is changing as approximate cosine curve. Tractor will behave more unsteadily with the increasing of velocity or the increasing of slope's angle.

Keywords: Dynamic Stability, Agricultural Tractor, Joint Simulation, Rollover

Design and Development of an Automatic Vertical Garden System for Urban Agriculture Initiative in Malaysia

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The increase in population of lifestyle in urban area in Malaysia led to the decrease of agricultural lands. With increase in urbanities, food insecurity especially the accessibility of food becomes a major concern, specially vegetable production. Hence, the urgent initiative needs to be considered in order to avoid the shortage of vegetables and arable lands. The controlled agricultural structure such as vertical garden has potentials to increase vegetables production in the urban area. Vertical garden uses an assortment of support structures to help plants grow up vertically instead horizontally which takes up a lot of spaces. However, in Malaysia the idea of growing vegetables in the vertical garden is still in its infancy stage. There is still lack of relevant and site-specific design and database to support and invest in vertical gardening system. These data include the appropriate design, suitable types of plant growth, conditions needed for healthy growth, construction and maintenance of farming facilities and also the implementing and production budget.

Therefore, the main purpose of this study was to develop a smart vertical garden complete with an automatic control system. The vertical garden system was mainly targeted to be used in the urban or housing area that has limited spaces for agriculture purposes. In this study, a vertical garden structure was designed by using the Autodesk Inventor 3D® and fabricated. Numbers of relevant factors were considered to design this vertical garden, such as suitability of the design, materials selection, size and measurements of the structure, type of plants, target consumers and cost of production. Besides, the factors of plants growth environment include drip irrigation system, plant water requirement and photosynthetically active radiation for the biomass conversion of this vertical garden. The plant evapotranspiration rate was calculated based on the FAO Penman- Monteith equation. The 3D designed of the vertical garden structure was proposed and prototype of the vertical garden was fabricated. The main parts of the structure consisted with water tank, extendable pole as the support, irrigation line and five stacks of planting pots while each pot had eight planting pockets. At the same time, it was also designed with the drip to the gravity flow irrigation system. The water was pumped onto the top stack of plants, then continued to flow down to the next down stacks through the effect of gravity, until the entire garden was watered. To ensure the quality and optimum usage of water and nutrient for the healthy plant growth, a controller with EC and pH sensors can be implemented in this vertical garden. The parameters such as Electrical Conductivity (EC), pH and volumes of nutrient and water solution in the tank can be continuously monitored and adjusted by the controller until required range is achieved. It is expected that this vertical garden could be able to grow 40 leafy vegetables within the size of only 0.25 square meter.

Keywords: Food Insecurity, Urban agriculture, Vertical Garden System, Vegetable Production

Nondestructive Freshness Evaluation of Export Fruits Using NIR Spectroscopy

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Japanese government promotes export of Japanese agricultural products, and fruits are important items in this promotion. Because exporting takes a longer time than domestic transportation, it is concerned that fruits are spoiled during export. To assure freshness of Japanese fruits, freshness evaluation method for export fruits is required. In addition, film packaging and container are used at exporting, but fruits continue respiration after harvesting. When the fruits are packed in an inappropriate way, there is risk of anaerobic respiration. Under anaerobic condition, sugars in fruits are metabolized to ethyl acetate, acetaldehyde, and ethanol. These metabolites make fruit taste worse. In the present study, anaerobic metabolites are set as a freshness index of fruits, and nondestructive freshness evaluation of high-grade strawberry using NIR spectroscopy investigated.

High-grade fresh strawberries were sealed in airtight plastic bags with deoxidants, and stored for up to 72 hour at 35°C. NIR spectra of intact strawberry fruit in the 500–1000 nm region were acquired every 24 hours. After spectral measurement of intact fruits, these strawberries were mashed and filtered through a plastic mesh, and Brix value and NIR spectra in the 1000–2500 nm region of the strawberry juice were measured. Obtained spectra were analyzed with SNV treatment and principal component analysis (PCA).

In the SNV-treated spectra, intensity of band in the 850–920 nm region changed during the storage. This band is assignable to the third overtone of C-H stretching vibration, and the intensity change of this band reflects change of sugar to anaerobic metabolites. Result of PCA in this band revealed that the strawberry fruits were separated based on storage day (Fig. 1).

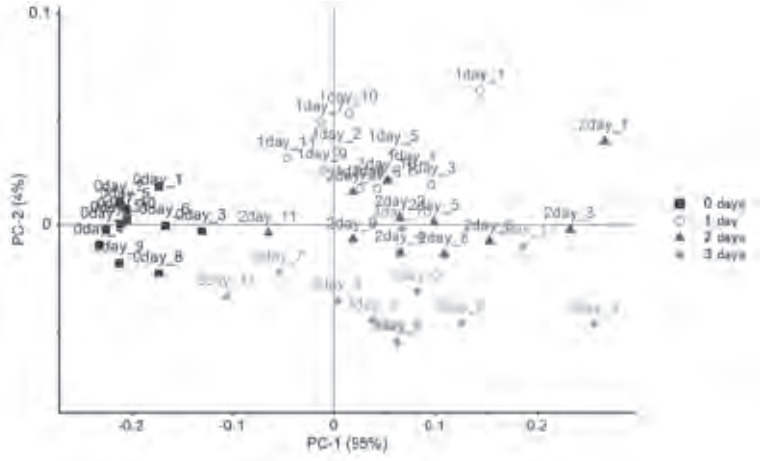

Figure 1 PC score plots of NIR spectra of intact strawberries during storage

Potentials of Ashitaba *(Angelica Keiskei Koidzumi)* Supplementation on Alleviation of Heat Stress in Milking Holstein-Friesian

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Due to the recent rapid improvement of the milk production ability, milking cow is becoming susceptible to heat stress. One of the typical indicators of heat stress in milking cow is a decrease of dry matter intake (DMI), which result in the decrease of milk production. Therefore, alleviation of heat stress is becoming one of the important issues in dairy industry.

Lingering of heat stress effect on amount of free radicals as end products of oxidation which it is a natural by-product of cellular metabolism. Under normal conditions, oxidation reduction reaction occurs in cattle's body and animal's body keeps the balance between free radicals and antioxidants at acceptable levels but when the free radical production arises out of body's ability, it damages membranes and even can be cause of destruction of the cell.

Ashitaba *(Angelica Keiskei Koidzumi)* contains two main chalcone, 4-hydroxyderricin(4HD) and Xanthoangelol (XA) which considered as a potent anti-oxidant. There is a conducted experiment to examined the effect of anti-oxidants from Ashitaba on the activity of anti-oxidant enzymes (superoxide dismutase and glutathione (γ-L glutamyl-L-cysteinylglycine)) in blood plasma and blood cells. Four lactating Holstein cattle were assigned to a double reciprocal design for 6 weeks from late July to early September 2015 within three cycles. This experiment had conducted to evaluate the physiological and behavioral responses of the heat-stressed milking cow after feeding by ashitaba supplement at Agricultural and Forestry Research Center, University of Tsukuba and also to alleviation of heat stress in dairy cattle.

Along with the evaluation of antioxidant enzyme activity in dairy cattle, the change in milk production quality and quantity, heart rate and respiration rate had examined in heat stressed dairy cow.

Difference of Phosphate Absorptive Coefficient in Siziwang and Xilingol in Inner Mongolia

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Although overgrazing is believed as a main cause of grassland degradation in Inner Mongolia, destruction of material cycle among soil, plant and livestock is suggested as the other significant factor. It was suggested that total phosphorus in soil largely decreased whereas total nitrogen in soil remained almost same level from the 1960s through 2012 and proposed that lack of phosphorus by taking out from grassland could be the cause of degradation (Kasuga *et al.* 2015). Actually, productivities and total phosphorus contents of plants increased by phosphate and nitrogen fertilization (Kasuga, 2015). On the other hand, these increasing rates were different between areas possibly because of precipitations, plant species and soil properties. However, available data of soil properties of these areas were not enough. Therefore, phosphate absorptive coefficient (PAC), an indicator of phosphorus fixation potential of soil, was measured in reported areas in this study. We expected that high PAC soil has low increasing rate of productivity and total phosphorus content of plant.

Control soil samples obtained in the experiment performed in Siziwang and Xilingol in 2014 (Inaba *et al.* 2015) were used. The experiment blocks were set 3 repetitions in each areas and 3 soil samples were taken in each blocks. Soil samples were sealed up and preserved in dark area at room temperature. PAC was measured by ammonium phosphorus solution method. Mean PAC values of Siziwang and Xilingol were compared by t-test ($p<0.05$)

PAC of Siziwang soil was significantly lower than that of Xilingol soil (5.55 g $P_2O_5\,kg^{-1}$ vs. 6.51 P_2O_5 kg^{-1} respectively; $p<0.05$). Nevertheless, increasing rate of productivity and total phosphorus content of plant was lower in Siziwang (Kasuga, 2015). Furthermore, these values were lower than general Japanese soil PAC (8 – 26 g $P_2O_5\,kg^{-1}$). Thus, difference of increasing rate of productivities and total phosphorus contents of plants should not be explained by difference of PAC, however, more research is needed because number of data is not enough.

Effects of an Immature Leaf Pruning Treatment just above Each Floral Truss on the Photosynthate Translocation and Fruits Yield in Tomato

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Tomato fruits yield is dependent on a carbon assimilation by photosynthesis in plant body and its partitioning into fruits. Those factors are influenced by a canopy structure, a photosynthetic capacity and a sink strength in each plant organ. In recent, an immature leaf pruning treatment just above each truss has been applied to increase up fruits yield in tomato production, because it could depress a competition on assimilation translocation between immature leaves and fruits. In this study, we evaluated the effect of the leaf pruning on the carbon assimilate translocation and fruits yield in tomato.

In this study, we used two tomato cultivars 'Reiyou' (Japanese type cultivar) and 'Levanzo' (Dutch type cultivar). Those tomato cultivars were grown hydroponically in G5 greenhouse of Agricultural and Forestry Research Center of University of Tsukuba. We pruned an immature leaves with 15~20cm length just above each truss. In the 1st experiment from autumn to winter in 2013, after pruning of those immature leaves, $^{13}CO_2$ as an isotope tracer was applied to plant to evaluate the carbon assimilation translocation. In the 2nd experiment from spring to summer and the 3rd experiment from autumn to winter in 2014, effects of an immature leaf pruning on the dry matter partitioning and fruits yield were evaluated.

In the 1st experiment, it was indicated that the treatment could be effective for the increase of fruits yield. Fruits yield per plant increased 55% in 'Reiyou' and 30% in 'Levanzo' than control without any leaf pruning, respectively. In addition, the isotope abundance ratio in fruit under the leaf pruning treatment was higher than control. In the 2nd experiment, we revaluated a dry-matter partitioning to fruits to examine whether dry matter partitioning ratio to fruit was increased by the leaf pruning treatment. Especially in 'Reiyou', dry matter partitioning ratio to fruit increased by the leaf pruning treatment and it was 10% higher than control.

A previous report said that the number of flowers increased by immature leaves pruning (Saito, 1970). In our experiments, the number of fruits per each truss increased by the leaf pruning. For example, in the 2nd experiment, 'Reiyou' had a 50% higher in the fruits number of the 3rd truss than control, remarkably. Those tendency has been same in the 3rd experiment. From those results, the increased fruits yield by the leaf pruning could be explained as the increase of flower. However, the increased number of flowers by the leaf pruning could change the source-sink balance. For an increase of fruits yield by the immature leaf pruning, total management for plant canopy should be required to keep enough number of leaves.

Membrane Microdomains Regulate Signaling Pathway in Chicken Sperm

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Understanding of physiological changes in sperm during fertilization is important to build assisted reproductive technologies useful to rescue endangered avian species. Accumulated literatures showed that fertilization-associated changes in sperm are regulated by diverse signaling pathways via protein phosphorylation events. However, little is known about what is an initial trigger to excite these signaling pathways. Membrane rafts are functional membrane microdomains enriched in sterol, ganglioside G_{M1} and membrane proteins such as caveolin-1. Recent studies demonstrated that membrane rafts exist in mammalian sperm and play an important role during fertilization by regulating protein tyrosine phosphorylation via activation of protein kinase A (PKA), a serine/threonine-protein kinase. More recently, we found that membrane rafts are also present in chicken sperm. However, functional roles of the assembly are not determined yet. Therefore, we investigated a possible function of membrane rafts by assessing phosphorylation profile of proteins including caveolin-1 in chicken sperm using cyclodextrins, membrane raft activators.

Sperm were collected from Rhode Island Red. Presence of caveolin-1 in chicken sperm was determined by western blotting and immuno-localization experiments. Membrane rafts in sperm were activated by treatment with methyl-β-cyclodextrin (MBCD) or 2-hydroxypropyl-β-cyclodextrin (2OHCD) for 1 hour in TES-NaCl medium containing 0.2% BSA. Samples were subjected to western blotting using appropriate antibodies for detection of phosphorylated caveolin-1, and proteins with phosphorylated tyrosine and serine/threonine residues.

Caveolin-1 immunoreactivity in chicken sperm was detected at predicted molecular weight, and was microscopically observed over the flagellum. Serine/threonine phosphorylated caveolin-1 was abundant in chicken sperm, but disappeared after MBCD treatment. Phosphorylation of tyrosine residue was stimulated in some proteins by 2OHCD treatment in concentration-dependent manner while MBCD treatment did not. In contrast, both MBCD and 2OHCD treatment inhibited PKA-dependent protein phosphorylation. This study demonstrated localization and possible function of caveolin-1 in chicken sperm and showed involvement of membrane rafts in regulation of signaling pathways. Our results provide new insight into functional roles of membrane rafts in chicken sperm.

Enzymatic Production of Compound-K from *Gynostemma pentaphyllum*

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Gynostemma pentaphyllum is a perennial herbal plant which is expected to have a high availability as a new domestic medicinal crop from the point of its cultivation superiority and functionality. It has high stress tolerance and grows faster to be harvested 4–5 times a year, and has a healthy functionalities such as anti-tumor activities, anti-gastric ulcer effect, immunomodulatory effect, and treatment of hyperlipidemia. Phytochemical studies of this plant have identified that these functionalities are due to the involved saponins called Gypenosides, which exerts their health effect when they are decomposed into Compound-K (C-K) by the microbial fermentation or intestinal bacteria digestion. This makes the plant difficult to be used as the medicinal crop because the microbial fermentation is difficult to control, and there are individual differences in the intestinal floras. To solve this problem, enzymatic treatment was proposed because it is easy to be controlled and has an ability to produce a uniform product. In this research, the hot water extract of *G. pentaphyllum* is treated with industrial enzyme aiming to produce C-K from Gypenosides to get some basic data to develop a new health food effectives to all people.

Previous studies reported that crude enzyme extracted from microbes decompose Gypenosides into C-K, however, degradability of Gypenosides using industrial enzymes has not been elucidated. In order to investigate this subject, Tokushima type *G. pentaphyllum* was used in this experiment. There are 14 saponins in the plant and four of them, Gypenoside I, II, V, and VII are to have the possibility to be decomposed into C-K. Rhamnopyranose and glucose are connected to C-K with α-glycoside and β-glycoside bond so that two kinds of enzymes, α- glucosidase and β- glucosidase are required to cleave the bonds respectively. Degradation of Gypenosides with the enzymes is determined by refractometer, spectrophotometer and HPLC after the treatment with the industrial glucosidase. Refractometer is proposed as a simple indicators of Gypenosides extraction to express them as Brix. Phenol-sulfuric acid method is used for determining them by using spectrophotometer after pretreatment with a Sep-Pak C18 cartridge to separate Gypenosides from other interfering sugars which were liberated by the enzymes. HPLC is also used to evaluate the degradation. Although this method cannot measure all Gypenosides according to low availability of their standards, it is a good way to measure Gypenosides in the highest accuracy. From these experiments, the possibility of industrial enzymatic reaction to enhance the functionality of *G. pentaphyllum* was explored to have the plant improvement for the commercial value as a medicinal crop.

Development of a High Efficient Tomato Production System based on the Analysis of a Plant Canopy Structure and Light Condition

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The productivity of tomato in a greenhouse production system is a crucial aspect for the worldwide competition on a food trade. For an improvement of the productivity in tomato greenhouse production, a promotion of photosynthesis in plant canopy should be required because the tomato fruits yield is based on the dry matter quantities in plant body. To increase the photosynthesis in tomato, we can improve the light condition inside the plant canopy by the training of leaves based on data of plant canopy structure. In this study, we tried to develop a new light sensor system to estimate the leaf area index (LAI), and evaluate the practical estimation of plant canopy LAI in a greenhouse for tomato production.

Monsi-saeki (Monsi and Saeki, 1953) suggested that LAI could be estimated based on the light intensity data on the top and inside the plant canopy by Lambert-Beer law. To estimate LAI of plant canopy, we should define the extinction coefficient K depend on the planting density and plant shape. At first, the extinction coefficient K was evaluated during summer and winter season. Not only the extinction coefficient was varied among 6 different tomato cultivars, but it could be changed by the season and planting density. Especially in winter season, the low light intensity level induced the extension of internode, and it could depress the extinction coefficient K. Furthermore, under the higher planting density treatment, the extinction coefficient K became lower than low planting density treatment because of the extended plant shape in the high planting density. By using those different extinction coefficient K defined by 1st experiment, we tried to estimate the plant canopy LAI in the practical tomato production greenhouse and train a tomato plant canopy. As based on the estimated LAI data, we could train the plant canopy and keep a constant level of LAI in each treatment. However, in some cases, we found some unstable light condition data that showed the light intensity data inside plant canopy overcame the data on the top of plant canopy. In early morning, the east side of treatment may perceive the direct light from sun to the side of plant canopy, and this situation could induce the abnormal light intensity data. For the accurate estimation on plant canopy LAI, it seems that we should consider the sensor position and direction to prevent the direct light perception.

Strategies for Enhancing the Storage Stability of Lotus Root (*Nelumbo nucifera*)

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The demand nowadays for safe and quality food, as consumers become more aware and conscious about the quality of food they purchase and consume is increasing.Generally, a factor that affect the quality of a food product is its appearance. It is because apperance can affect a product's perception and general acceptance towards consumers. Currently, various processing methods were applied to food products to enhance quality and at the same time, extend its shelf-life. Lotus root (*Nelumbo nucifera*) is a popular ingredient in different dishes around the world. In Japan, more than 60,000 ton of lotus roots are produced per year and majority of the production comes from the Ibaraki region. The said plant is a good source of dietary fiber, vitamin C, B-complex group of vitamins such as pyridoxine, folates, niacin, riboflavin, pantothenic acid and thiamin. Lotus root also contains significant amounts of polyphenols such as gallic acid, catechins, chlorogenic acid and caffeic acid. However, the lotus root has been challenged in post-harvest storage as the plant is prone to oxidation and browning due to the presence of polyphenols which serve as a substrate for enzymatic browning. Aiming to solve these problems, several studies have been made to improve its post-harvest quality, such as the use of various chemicals and anti-browning agents. We have focused on the development of edible dipping solutions consisting of oil-in-water emulsions loaded with antimicrobial compounds and ascorbic acid as anti-browning agents, to improve the storage stability of lotus root. The application of emulsions is important in incorporating hydrophobic and hydrophilic compounds which may not be appropriate for aqueous solutions alone. In this study, the effect of the incorporation of antimicrobials such as carvacrol and nisin as well as the use of different concentrations of ascorbic acid and the effect of vacuum packaging against the browning of lotus root were evaluated. In addition, we were also interested in comparing the efficacy of aqueous acid and salt solutions with varying cocentration to evaluate the effect of pH in the browning of lotus root. For the quality of the lotus root samples, the color changes were observed and were assessed based on the color values (L*, a* and b*). Results have shown that the incorporation of antimicrobials (nisin and carvacrol), anti-browning agent (ascorbic acid) and the application of vacuum packaging is an effective method to delay browning in lotus root based on the gathered color values and calculated indices (browning and whiteness). The L* value is a measure of the luminosity (brightness or lightness) of the sample, thus a lower level of luminosity means higher browning. The samples applied with emulsions containing both antimicrobial, anti-browning agents and vacuum packaging had the lowest change in color indicating reduced browning activity and achieved the highest whiteness index (WI) and lowest browning index (BI). BI and WI are quality indicator parameters calculated based on brown and white colors,respectively.

Developing a Novel Zeolite Absorbent Modified by Natural Materials to Enhance Methane Production in Ammonia-rich Condition

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Nowadays, large amounts of livestock wastes are generated each year which causes serious contamination problems. Anaerobic digestion of organic waste has been widely used to solve the problems. In the process of anaerobic digestion, ammonia is a main inhibitor, which is produced as a common metabolic end product. Adding absorbent to adsorb ammonia is a method to mitigate ammonia inhibition, which is highly efficient and low-cost. In addition, the absorbent could also be a carrier for the growth of microorganisms in the anaerobic reactor. In this study, natural materials like lignite and egg shell were used to modify zeolite to develop a novel zeolite absorbent. The ammonia adsorption capacity of absorbents was determined. The result showed that the ammonia adsorption capacity of natural material modified novel zeolite absorbent reached up to 55.1 mg/L higher than other samples. Through the kinetic and isotherm analyses, it was indicated that the ammonia adsorption type was ion-exchange on a heterogeneous surface. The SEM-EDS analysis showed that the contents of a variety of cations of novel zeolite absorbent were also higher than other absorbents, which was in accordance with the adsorption type analysis results. The results of BET surface area analysis showed that the eggshell could effectively modify zeolite to enhance its surface area. After the development of novel absorbent, different kinds of modified absorbents were set in ammonia-rich anaerobic digestion reactor. The novel zeolite bioreactor showed the best performance, including methane concentration, cumulative methane production, and methane yield. The SEM photos showed the morphology of the microorganisms immobilized on the surface of absorbents. The quantity and diversity of microorganisms immobilized on the novel zeolite absorbent was highest. This result showed a better growth condition of microorganisms on the novel zeolite absorbent. The ATP values of the microorganisms in the bioreactors were determined and the novel zeolite bioreactor showed the highest value which indicated the better activity of microorganisms. These results corresponded to the results of SEM photos. In summary, the novel zeolite absorbent is not only an effective absorbent for ammonia adsorption but also a good carrier for the growth of microorganisms. The novel zeolite absorbent can successfully be applied in ammonia-rich anaerobic digestion.

Effects of Different Homogenizers on the Oxidative Stability of Oil-in-Water Emulsions based on Refined Vegetable Oil

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An emulsion consists of two immiscible liquids such as oil and water, one dispersed in the other as small spherical droplets. Oil-in-water emulsions including milk, mayonnaise, and cream are one of the most common forms of lipids in foods. These products are deteriorated through lipids oxidation affected by individual components and their composition, microstructure, emulsification process, and storage environment. There are many previous studies on oxidative stability of oil-in-water emulsions, whereas it is not clear the effects of process itself. Therefore, our studies focus on the effects of mechanical emulsification process where shear stress, impact force or cavitation occur.

Refined soybean oil or refined rapeseed oil was used as oil phase, Milli-Q water was used as water phase. Oil phase (50 g) and water phase (450 g) were emulsified through rotor-stator homogenization (RSH) at 8,000 rpm for 5 min alone, or RSH followed by high pressure homogenization (HPH) at 100 MPa for 3 times. Droplet size distribution of the emulsions was measured using laser diffraction technique. The remaining emulsions were centrifuged at 10,000 rpm for 5 min, and the supernatant oil phases were sampled and labeled as RSH-treated oil or HPH-treated oil. Oxidation induction time (OIT) of untreated oil, RSH-treated oil and HPH-treated oil were measured as oxidative stability index at 120 °C with air flow rate at 20 L/h. Water content of the oils were also measured using Karl-Fisher method.

From the results of droplet size distribution, the interfacial area between oil phase and water phase of the emulsion prepared by RSH was 10^4 times larger than that of before processing. The interfacial area of emulsion prepared by RSH and HPH was 10^5 times larger than that of before processing. OIT of treated oils were shorter than that of untreated oil, especially HPH-treated oil was remarkable. Water content of treated oils were higher than untreated-oil and nearly reached the saturation solubility of water in oil. Increasing water content could promote oxygen supply. Moreover, large energy was applied to the samples for increasing the interfacial area, which might affect the chemical structure of the components. It is assumed that certain lipids could change into lipid radicals, which accelerates the initiation phase of lipid oxidation. Further experiments are needed in order to elucidate the mechanism of decline in the oxidative stability of the emulsions.

Degradation Characteristics of Microalgae by Micro Wet Milling

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Currently, renewable energy such as solar power, wind power, geothermal power, and biomass has been developed actively due to global warming and fossil fuel depletion problem. Biodiesel is one of the renewable energy which is carbon neutral. This is an alternative fuel of the light oil, and is obtained by transesterification of the lipids from the biomass along with alcohol and catalyst. While variety of terrestrial plants such as rapeseed, sunflower, and jatropha are used in the biodiesel feedstock, in recent years, microalgae has been considered as a promising biodiesel feedstock due to high lipid content, high growth rate, no compete for food production. The general process of microalgae biodiesel production is performed in the order of the cultivation of the microalgae, harvesting, dewatering, oil extraction, and conversion to fuels from the lipid extract. Lipid extraction from microalgae cells is performed using an organic solvent such as hexane, however it extraction rate is low. To improve the lipid extraction rate, it has been studied to add a cell disruption of algal cells before lipid extraction. Already cell disruption by ultrasonic treatment, high pressure homogenization, brad beating, and microwave radiation has been studied, and also it is reported these cell disruption method improve the extraction rate of lipid. However, these methods require large energy, energy saving in the cell disruption method is desired for the cost reduction of microalgae biodiesel production. This study is to examine the wet milling of microalgae by the Micro Wet Milling (MWM) as a new way of cell disruption. MWM is a method of wet milling with a modified electric stone mill wet material. Because MWM is excellent in miniaturization of wet material, grinding work index is smaller than the other grinders. Also MWM is considered to reduce the energy of a cell disruption than traditional methods as it is operated at normal temperature and pressure. However there is no knowledge that a wet milling by MWM applied to cell disruption of microalgae biomass. Then this study aims to clarify the characteristics of the wet milling of microalgae by Micro Wet Milling.

The microalgae strain used in this study is *chlorella* sp. which is commercially available (water content : 86%). Samples variously adjust the water content (86%, 90%, 95%, 99%) is ground by MWM. After the milling, we measure the particle size (median diameter) by a laser diffraction particle size distribution meter (SALD-2200) to see the shape change of the algal cells , further confirm the shape of the algal cells in the image by an optical microscope. Furthermore, ground algae lipids were extracted by n- hexane, to calculate the extraction rate. Clarifying the milling conditions where the lipid extraction rate is the best, we get basic data to establish microalgae biodiesel production that utilizes a Micro Wet Milling process.

Evaluation of Energy Efficiency of Low Pressure Hydrothermal Decomposition for Microalgae Oil

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Microalgae are attractive biomass because of high growing speed and not competing with food production. Many technologies have been developed in microalgae biofuel processing. Especially, hydrothermal decomposition for oil without drying process can be applied to wet condition of microalgae. This study focuses energy efficiency evaluation in microalgae oil extraction process by low pressure hydrothermal decomposition, and proposes optimization method for oil productivity by controlling temperature, pressure, moisture content, and processing time as physical parameters.

Native microalgae (*Desmodesmus sp.*) in Minamisoma City, Fukushima Pref. were used in this research. 50 g microalgae (Water content: 92.5%, Solid weight: 3.75g, potential energy of solid: 60 kJ, oil quantity: 0.094 g, calorific value: 3.9 kJ) was used for low pressure hydrothermal decomposition after primary dewatering as pretreatment. Lipid quality and quantity were measured in before and after treatment by the methanol extraction.

0.55 g of total oil weight and 23 kJ of its calorific value were measured after low pressure hydrothermal decomposition. Thus, 37.8% of oil calorific ratio was calculated by 60 kJ of solid calorific value for experiment material. 0.10 of energy profit ratio (EPR) was calculated by 2,203 kJ of input energy in this experiment from the viewpoint of oil production, and 0.59 of EPR was calculated by 385 kJ of theoretical energy consumption. Based on these results and 49.4% of oil calorific ratio by 375℃ of temperature condition has been reported by Garcia Alba *et al.* (2011), 210-240℃ of temperature condition can be predicted to bring 0.66-2.7% increasing of the EPR compared with 200℃ of temperature condition.

Development on Production for New Type of Sake Using Micro Wet Milling

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Sake is made from rice. The processes are mainly composed of rice polishing, steaming, saccharification, fermentation, and refining Moromi or fermented broths. Rice bran and sake lees are removed and discarded in these processes however those are rich in nutrient and functional ingredient such as protein, dietary fiber and GABA. As rice bran and sake lees can be included in Sake, it becomes unrefined Sake which is new and nutritious and where the rice bran and sake lees can be intaken effectively. However there are two problems to make this unrefined Sake. First, brawn rice is hard to ferment because rice bran includes a lot of protein. Second, texture of unrefined sake is bad due to the included big particle in Moromi. A Miniaturization process, "Micro Wet Milling(MWM)" was proposed for brawn rice and Moromi to solve these problems. MWM is a method to mill materials with liquid. It is expected that reactive and texture of Sake is improved by the use of MWM.

"Rice slurry" is liquid food material when the wet milling is applied to brown rice. The brown rice slurry is suspended liquid, so that protein, lipid and glucose contents are different from polished rice ones.

Condition of good texture of unrefined Sake is to have maximum particle size with 100 μm and more ratio than 50%- by 10 μmparticle.

Accordingly the purpose of this research is to make clear the brewing properties of the rice slurry and achieve good texture of unrefined Sake.

Brewing properties of the brown rice slurry were investigated. Polished rice slurry was used for control. EtOH and glucose concentration were monitored over 2 weeks. Fermentation curves were different. However maximum EtOH concentration reached to the same level at the end of both fermentations. Fermentation was considered to be not inhibited by rice bran.

Milling properties were examined. Fermented brown rice slurry was milled one time by MWM and the particle distribution and median size were measured. Particle sizes were smaller than the sample before milling. Good texture conditions were not achieved, so that it is necessary to investigate MWM condition and milling time.

In the future, component in making Sake will be analyzed and the function will be revealed. At last making new type of Sake will be evaluated by sensory test.

Highly Value-added Agricultural Processing for the Effective Utilization of Food Resources

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In Japan, about 40% of agricultural products prior to shipment have been discarded because of the prevention of lower pricing and the unsatisfactory of food standard (Tamura, 2014). This present situation has caused an environmental pollution so that an improvement of the disposal problem is necessary. As one of the solutions, adding value to agricultural products by a novel processing is proposed, and which isthought to lead an effective utilization of food resources. As it is said that many agricultural products have phospholipids and phospholipase D (PLD) which can produce phosphatidic acid (PA) by the organics degradationion by processing such as grinding and chewing. The PA incorporated into the body is hydrolyzed by digestive enzymes and it becomes component to protect the gastrointestinal (GI) mucosa. It is found that this component is effective in the prevention and treatment of GI mucosal damage. In brief, agricultural products containing a large amount of PA can be a functional food that works in the cure of GI mucosal damage (Urikura et al, 2012). The PA production has been found to be affected by the temperature and particle size after the degradation of plant cells or tissues, however their detailed discussions have not been observed yet. In this study, the effect of temperature and particle size at micro-wet milling (MWM) processing on PA yield was elucidated by use of cabbage being be rich in phospholipids. .

In the experiment for the temperature effect, PA production of cabbage was carried out for 15 minutes in a warm bath at 25~75 ℃ after the mixer grinding. The PA production between at 25 and 35℃ have no significant difference, and they are the largest in the this experimental conditions.. At more than 45℃, PA production was decreased with increasing in the temperature. It was found that PLD of cabbage has a high activity at 25~35℃. In the experiment for particle size effect, cabbage was ground in 0.5~3 min with a mixer and PA production was carried out for 1 hour in a warm bath at 25℃. When the particle size was about 210~690μm, PA content was increased linearly with the reduction in particle size. In the experiment of MWM system, PA was produced at 25℃ after the MWM processing. When the particle size was less than 100μm, PA content was increased linearly. However, when the particle size was from 15~100μm, PA content was constant at 600μg-PA/g-d.b.. The 3min degradation by mixer produced particle size of 200μm and temperature of 40℃ so that the MWM processing was found to be more suitable for PA production than mixer.

The Educational Effects of Food Education Activities Using Millet

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Japanese eating habits have changed quickly and dramatically in recent years, and various problems in food and nutrition have arisen. To solve these problems, the Japanese government enacted the Shokuiku Basic Law in 2005 and the Second Basic Program for Shokuiku Promotion in 2011. These laws were created to promote 'Shokuiku,' which was defined as a base of intellectual, moral and physical educations for all people. Opportunities for taking various Shokuiku activities have been increasing in a variety of venues. Many schools have also begun to include Shokuiku activities in extra school activities. Although many reports about the effect of food education activities on dietary habits and health have been performed, there are few reports about the effect of agricultural activities on the thinking or mindset of elementary school students. The cultivation of crops is the most essential activity for producing food. We think that agricultural experience will prove to be a very important aspect of 'Shokuiku,' especially for the younger generation. In this study, we made and carried out a curriculum for food education concerning millets in an elementary school, and decided to evaluate its educational effect.

We conducted a series of 'Shokuiku' activities for 1st and 6th grade children at Toride Elementary School in Tsuchiura City in 2014. The children started to cultivate common millet (*Panicum miliaceum*) and foxtail millet (*Setaria italica*) for cooking materials after harvesting. Students also cultivated other millets including barnyard millet (*Echinochloa utilis*), finger millet (*Eleusine coracana*), sorghum (*Sorghum bicolor*), pearl millet (*Pennisetum americanum*), Job's-tear (*Coix lacryma-jobi* var. *ma-yuen*), buckwheat (*Fagopyrum esculentum*), grain amaranth (*Amaranthus caudatus*) and quinoa (*Chenopodium quinoa*), to study the characteristics of millets and learn about crop diversity. A series of farm works related to millets cultivation – for example, broadcasting fertilizer, making ridges, sowing seeds, weeding, thinning, harvesting, threshing and milling – were performed by children themselves. After they harvested some millets, they cooked dishes using millets they had produced themselves. A questionnaire-based investigation was conducted several times in the subsequent year to evaluate the effect of these activities.

The survey showed that children's feelings and thoughts on food and agriculture were changed. Especially for 1st grade children, their understanding of agriculture, interest in foods and gratitude for food became deeper and stronger as they experienced cultivation practices. From a quantitative questionnaire for 6th grade children, we understood that 'Shokuiku' activities were able to make an impression even if they were hard and tiring activities. Moreover, the degree of physical difficulty of the activity might be related to the degree of understanding of agriculture, interest in foods and gratitude for food inspired in the children. From the answers to questionnaires by children's parents, half of them noticed good changes in their children: e.g. an increased interest in food, appreciation of the value of food, and so on. Elementary school teachers commented on the curriculum of the 'Shokuiku' activities, saying that it was difficult for children to learn gratitude for food by these activities alone. We concluded that 'Shokuiku' activities by millets cultivation had a positive effect on children's minds. But it will be necessary for us to improve the millets cultivation 'Shokuiku' curriculum by making a series lessons and activities.

Ni Accumulation and the Tolerance of *Thujopsis dolabrata* var. *Hondai* Seedlings Growing in Serpentine Soil, Mt. Hayachine

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Mt. Hayachine in Iwate prefecture, Japan is characterized by serpentine site, which is known to have high concentrations of Ni. In general, few plants that can tolerate high concentrations of Ni can grow in serpentine soil. *Thujopsis dolabrata* Sieb. et Zucc. var. *hondai* Makino occurs naturally on Mt. Hayachine. In this study, we hypothesized that *T. dolabrata* var. *hondai* shows Ni tolerance due to detoxification by phenolics.

In June 2013, we collected five *T. dolabrata* var. *hondai* seedlings and root-zone soil from the Kadoma National Forest on Mt. Hayachine to analyze the concentrations of Ni, other heavy metals, and macronutrients. The seedling roots had high concentrations of Ni (43.4 ± 27.3 mg kg^{-1} DM). Further, we conducted a pot experiment by using 1-month-old sterile seedlings grown in three types of sterilized soils—Kadoma soil (obtained from the Kadoma National Forest), Tsugaru forest soil, and nursery soil—and compared the concentrations of Ni, nutrients, and catechin, as well as the growth of seedlings in the different soils. The pot experiment indicated that the roots of seedlings grown in Kadoma forest soil contained high concentrations of Ni and catechin, which could act as an antioxidant and a possible Ni-chelating compound that detoxified Ni in the plant cells.

We concluded that *T. dolabrata* var. *hondai* seedlings growing in the serpentine site of Mt. Hayachine accumulated Ni and could detoxify it by producing high concentrations of catechin.

Effects of Maize-Cowpea Intercropping on Yield and Forage Quality

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Effective land use in crop production is needed because of the rapid increase of population in developing countries. Intercropping is one of the effective ways to increase the yield of crops in limited arable land. Meanwhile, utilizing residue of crops as forage is an economic and efficient land use. Therefore the objective of this study is to investigate the advantage of maize-cowpea intercropping on yield and the forage quality of unedible parts.

Maize (*Zea mays* L. var. *saccharata*) and cowpea (*Vigna unguiculata* L.) were sown in May 2014. This experiment included 3 treatments; mono-cultured maize, mono-cultured cowpea and intercropping(maize: cowpea=1:1) with 3 replications. The size of each plot was 5 m x 5 m. The row distance was 50 cm for mono-cultured plots, 25 cm for intercropping plots. The hill distance was 30 cm for all treatments. The plant length/height was measured once a week. Photosynthetic rates were calculated with a portable photosynthesis system on 55~59 DAS (days after sowing). SPAD values were measured at vegetative and reproductive stage. The water content of soil was measured once a month. Fresh ear yield of maize and dry grain yield of cowpea were investigated after harvesting 90 DAS and 111 DAS, respectively. The chemical analysis using leaf and stem of each crops at the stage of harvesting time (1^{st} sampling) and one month after harvesting time(2^{nd} sampling) was conducted.

As a result, plant heights of intercropped cowpeas were larger than mono-cultured, because maize plant shutting sunlight made them grow spindly. SPAD values were higher in mono-cultured plots than intercropping plots. There were little differences on photosynthetic rates between the treatments. The water contents of soil in intercropping plots were higher than mono-culture maize plots during cultivation period, because cowpea plants had been covering the soil surface between maize plants. This phenomenon could be useful in dry area where people need to use limited source of irrigation water. The yield of maize were not different between the treatments, but that of intercropped cowpea were 66 % of mono-cultured cowpea. In total, land equivalent ratio(LER) was 1.55, which indicated advantage of intercropping. Although the protein and fat content of maize were decreased from 1^{st} to 2^{nd} sampling, these contents of cowpea were not decreased. In addition, since the protein and fat content of cowpea were higher than maize, it was indicated that intercropping with cowpea improved the forage quality of residue compared to mono-cultured maize plots.

Growth and Biomass Production of Egyptian and Japanese Lowland Rice Cultivars under Different Irrigation Intervals

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Water and food demands are increasing due to both the population growth and reclamation of farmland in Egypt. The amount of irrigation water in rice cultivation is twice as much as that of upland crops. The efficient use of water resource is required in agriculture, particularly rice cultivation. Previous research has shown that prolonged irrigation intervals save water. The objective of this study was to compare the growth and yield of Egyptian and Japanese lowland rice cultivars under different irrigation intervals.

The experiment was conducted using two Egyptian cultivars (Sakha 104 (japonica) and Giza 178 (japonica x indica)), and a Japanese cultivar (Koshihikari) in plastic house in 2014. Three cultivars were grown in 1/5000 a pots filled with soil. The pots were irrigated every four days (S, conventional interval in Egypt), every eight days (M), or every twelve days (L) up to 3 cm above soil surface. The treatments started 7 days after transplanting. Plant age in leaf number, plant length, and the number of tillers were recorded every 7 days from the transplanting to heading. Plants were harvested on October 16, and yield and yield components were measured.

The amount of irrigation water in S, M, and L was 3507, 2150, 1720 mm, respectively. The longer the irrigation interval, the shorter the plant length. Similar tendency was found in the number of tillers. There was no clear difference in plant age in leaf number among the treatments in all cultivars. Plant length of Sakha 104 was less affected, but the number of tillers was more reduced than other cultivers by prolonged irrigation. Dry matter weights in M and L were significantly lower than those of S, and the reduction of dry matter weight of panicle was larger than that of stem and leaf. The total dry matter weights in M and L were reduced by 39 % or more. There was no clear cultivar difference in response to prolonged irrigation intervals. Water use efficiency (Total dry matter weight/the amount of irrigation water) was not improved in M and L due to the large reduction of total dry matter weight.

Prolonged irrigation intervals saved water by 39% as compared with conventional irrigation. However, water deficit reduced plant length and tiller numbers, and seriously reduced grain yield. Plants could get water from lower soil under the field conditions, on the other hand water in the pots was quite reduced in the present experiment. Future studies are needed to reexamine the effect of prolonged irrigation intervals on plant growth and yield of rice under the similar conditions to paddy field.

Oxygen Generation from Rhodamine B Solution Catalyzed by $P/Ag/Ag_2O/Ag_3PO_4/TiO_2$ under Simulated Solar Light Irradiation

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Overall water splitting to produce H_2 and O_2 over a semiconductor photocatalyst using solar energy is a promising process for the large-scale production of clean, recyclable H_2. For the reactions of water splitting, the oxygen evolution reaction is more kinetically demanding which is very important for overall water splitting. Numerous attempts have been made to develop photocatalysts that function under visible-light irradiation to efficiently utilize solar energy. TiO_2 as a promising semiconductor has been found to be easily excited under UV light causing water splitting, but the wide band-gap restrain the large-scale use, as it cannot be excited under solar light. Therefore, it is important to develop active photocatalytic materials for water splitting under solar light. According to our previous study, a new $P/Ag/Ag_2O/Ag_3PO_4/TiO_2$ composite has been successfully synthesized by sol-gel method, and in this work photocatalytic oxygen generation from $P/Ag/Ag_2O/Ag_3PO_4/TiO_2$ composite was investigated. The reaction temperature, pH and concentration of photocatalyst were considered at the same time. Finally, the photocatalytic mechanism was proposed to explain the photocatalytic process.

The results demonstrated that $P/Ag/Ag_2O/Ag_3PO_4/TiO_2$ showed substantial and high efficiency under solar light. Significant amount of O_2 was observed over $P/Ag/Ag_2O/Ag_3PO_4/TiO_2$, and the evolution rate reached 2125 μmol/g/h, which showed high efficiency for oxygen production. In order to explore the mechanism that influences oxygen evolution, pH, temperature and illumination intensity was investigated. Understanding these characters could help clarify the mechanism of oxygen evolution by $P/Ag/Ag_2O/Ag_3PO_4/TiO_2$ material. Therefore, $P/Ag/Ag_2O/Ag_3PO_4/TiO_2$ should be a promising material for oxygen evolution reaction.

Histological Study on Spontaneous Gonadal Germ Cells (GGCs) Discharge from the Gonad of Developing Chick Embryos

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Due to the rapid loss of the genetic diversity in nature, necessity to develop a system to conserve animal genetic resources is acute. In this respect, recent technical development of the germline chimera, produced by collecting and transferring GGCs, provides a practical means of conserving endangered avian species.

It has been reported that GGCs can be collected by simply incubating gonads recovered from 7-day-old embryos in PBS(-) up to 1.5 hours (Nakajima *et al.*, 2011). However, it was revealed that the spontaneous GGCs discharge form 7-day-old chick embryos is inhibited with the increase of the Ca^{2+} concentration in PBS(-). Accordingly, a presence of Ca^{2+} mediated cell-to-cell adhesion between gonadal somatic cells and GGCs has been suggested (Nakajima *et al*. , 2014). Present study, therefore, histological sample were prepared to examine the pre- and post- gonadal changes of 7-day-old chick embryos in PBS(-).

In Experiment 1-1, in order to examine the pre- and post- gonadal changes of 7-day-old chick embryos in PBS(-), a preliminary study was carried out find out a method of prefixation. Experiment revealed that the gonadal tissue pre-fixed using Bouin was more stable compared with tissue pre-fixed using 4% paraformaldehyde. Histological changes will be examined to disclose the nature of the spontaneous GGCs discharge from the embryonic gonads into PBS(-).

In Experiment 2, the cadherin 1 to 4, 6, and 12, and desmoglein 2 and 4 primers were used to detect Ca binding protein which are possible candidates responsible to connect GGCs with gonadal somatic tissue. At present, N-cadherin, was detected from the gonad of 7-days-old embryos.

Future study should be directed toward examining the histochemical identification of N-cadherin in the gonad-mesonephros complex in relation to GGCs dissociation from the embryonic gonad.

Mesophilic Methane Fermentation with Wood Drying Wastewater by Fixed-bed Reactor

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Nowadays, recycling wastes and decreasing environment loads are required in terms of establishment of the recycling-based society around the world. Creating energy such as bio-ethanol or bio-gas from biomass is especially focused in Japan, because there is a few fossil resources such as natural gas or petroleum oil and so on. Now much waste is recycled. For example, in some sewage center or food factories, the generated organic wastes are transformed biochemically to biogas or methane by anaerobic digestion and burned to generate electricity. However in the huge lumber mill for example, the wood drying wastewater (WDW) is not utilized as biomass energy resource now.WDW is discharged in the wood drying process and the amount of WDW is about 1000 t/month in a lumber mill. WDW is now treated with activated sludge process or coagulation method and then discharged into sewers. Therefore, a new recycling method of WDW is desirable to be used as organic resource. WDW is liquid and contains many organic matters so that anaerobic digestion is considered to be suitable for WDW, because the composition is similar to sewage or some food wastewater. Semi-continuous stirred tank reactor (SCSTR) experiment with WDW by draw-and-fill method was conducted in former study. It was found that the concentration of microbe is needed to keep high because of the wash out failure. In this study, a fixed bed reactor which can keep high concentration of microbe is used at the same condition as SCSTR experiment.

The characteristic of WDW was that the pH was 3.66, TC(Total Carbon) was 1271 mg/L, TN(Total Nitrogen) was 7.904 mg/L, TS(Total Solid) was 0.32 wt % and CODMn was 3102 mg/L. A plastic cylinder (2.6 L vol) was used as a reactor. Pall rings were used as a support medium Operating temperature is set around 37 ℃ for mesophilic fermentation. The seeding sludge was inoculated with synthetic wastewater by adding it twice a week for a month in order to fix microbes. HRT is ranged from 6, 8, 10, 12 day after inoculation. pH, VFA(Volatile Fatty Acid), TC, TN,VS in the fermented broth and the amount and methane concentration of the produced gas were measured. This experiment by fixed-bed reactor is conducted now. If WDW can be transformed to methane as energy in present experiment, the environmental loads will decrease. The result will be reported in the poster presentation.

Effect of Quantitative Differences in Volatiles from Host- or Nonhost-infested Maize on the Attraction of the Larval Parasitoid *Cotesia kariyai*

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Maize (*Zea may*s) is a major economic crop and the most important staple food for several countries. Farmers must control various species of herbivorous pest insects when producing maize crops. Biological control is one integrated pest management (IPM) method that can decrease pest populations in an environmentally friendly way using natural enemies. Parasitoid insects use herbivore-induced plant volatiles (HIPVs) to locate hosts. However, the natural environment is a complex habitat of many herbivorous species with both suitable and unsuitable host species. That is, the complex habitat is full of volatile cues (e.g. volatile qualities and volatile quantities) released by both host- and nonhost-infested plants. Parasitoids encounter these signals as distorted information on host presence while foraging. Therefore, the presence of nonhost species in the complex habitat may affect the parasitoid decision for locating their hosts. In this study, we focused on multitrophic interactions of *Cotesia kariyai*, a specialist larval parasitoid of the common army worm (*Mythimna separata*), as a major pest causing severe damage to maize crops. Moreover, the Asian corn borer (*Ostrinia furnacalis*), one of the most important maize pests in Japan, was selected for this study as a nonhost species. We investigated the effects of quantitative differences involatiles from host- and nonhost-infested maize plants on the olfactory responses of the parasitoid during searching behavior with a 4-arm olfactometer. Total duration and total number of visits in the treated and control arenas were recorded and calculated using the software, The Observer® XT (ver. 9.0).

First, we found that *C. Kariyai* females preferred both host- and nonhost-infested plants to healthy plants. Second, parasitoid attraction increased with the addition of the number of infested plant units or number of larvae on infested plants as volatile quantities or damaged areas were increased. Parasitoids showed a greater preference to 3 units > 2 units > 1 unit of host-infested plants. Also, they preferred infested plants that were fed on by 5 larvae > 3 larvae > 1 larva of host species. Third, we showed the volatile quantities affect the searching efficiency of *C. kariyai* to locate hosts in the presence of nonhosts by comparing responses to host-infested plants with various units of nonhost-infested plants. Finally, we conclude that *C. kariyai* females can discriminate between healthy plants and host/nonhost-infested plants using the profiles of volatiles released. Moreover, this parasitoid can perceive differences in the quantitative quality of volatiles from infested plant units, because they preferred higher volatile units to lower ones. The quantity of HIPVs emitted affects the olfactory responses of *C. kariyai* in their searching behavior. Therefore, in complex habitat, parasitoid responses may be affected by the quantity of HIPVs from host- and nonhost-infested plants. These correlations may be used to predict a parasitoid's capability to locate hosts in the field.

Incorporation of Cholesterol to Sperm Membranes Improves Cryosurvivability of Chicken Sperm

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Cryopreservation of sperm has been a useful technique for preservation of genetic resource in endangered animals. However, it has been a persisted problem that freeze-thaw process causes membrane alteration resulting in deterioration of viability and functionality of sperm. Previously, we demonstrated in chicken sperm that freeze-thaw process induces cholesterol efflux leading to programmed cell death so called apoptosis. This led us to hypothesis that increase in cholesterol content of membrane might improve cryosurvivability of chicken sperm. In this study, we tested this possibility by incorporating cholesterol into membranes of chicken sperm following by cryopreservation.

Semen were collected from matured Rhode Island Red. Cryopreservation was performed as described previously (Tajima *et al.,* 1989). For incorporation of cholesterol to membranes, sperm (1.2×10^8 cells) were treated with 0, 0.5, 1.5, 3, and 6 mg cholesterol-loaded cyclodextrin (CLC) for 15 min at 22˚C. Experiment 1: quantification of cholesterol amount in membranes was performed in CLC-treated sperm after freeze-thaw process. Experiment 2: post-thaw viability and acrosome integrity were examined using propidium iodide and FITC-peanut agglutinin in CLC-treated sperm. Experiment 3: apoptotsis assay was performed with 0 and 1.5 mg CLC-treated sperm following by freeze-thaw process. Experiment 4: distribution of exogenous cholesterol in sperm was visualized after incorporation of fluorescent cholesterol into membranes.

Experiment 1: cholesterol content in sperm membranes increased in CLC-concentration dependent manner. Experiment 2: following by freeze-thaw process, 1.5 mg CLC-treated sperm showed higher viability (71.8%) than others (4.3~48.5%) ($P<0.05$) and no significant differences in acrosome integrity compared to sperm treated with 0 mg CLC (75.0%). Experiment 3: occurrence of apoptosis significantly decreased in 1.5 mg CLC-treated sperm (14.2%) compared with sperm treated with 0 mg CLC (32.4%) ($P<0.05$). Experiment 4: exogenous cholesterol was distributed into entire sperm membranes with more intensified in sperm head region relative to other compartments.

In present study, we demonstrated that 1.5 mg CLC-treatment of chicken sperm improved cryosurvivability by inhibiting occurrence of apoptosis. Currently, post-thaw fertilizing ability of CLC-treated sperm is under investigation using artificial insemination. Our results would provide a foundation to establish a novel method for avian sperm cryopreservation.

Optimum Selection for Para Rubber Wood Energy Plant in Thailand using AHP

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The Ministry of Energy was assigned from Thai government to set up the 10 Year Alternative Energy and Development Plan-(AEDP 2011-2021) aiming to create the framework and direction for increasing alternative energy consumption by 25% in 2021. From AEDP target attempt to increase biomass electricity generation from 2012 that was 1,960 MW to 3,630 MW in 2021 until recently The Ministry of Energy made a new AEDP plan which is AEDP 2015 (2015-2036) that set up a higher target of biomass which is 5,570 MW. Thailand has a high potential of biomass energy sources. Para rubber wood (*Hevea brasiliensis Muell*) is an interesting option for biomass energy resource in Thailand especially in Southern of Thailand, tokihere are many parts of para rubber wood residues (root, slab, saw dust) that can use as a biomass. During 2006-2011 para rubber trees were cutting down around 34,000 hectares per year (approximately 430 para rubber trees per one hectare). Now the conventional technology for para rubber power plant is direct combustion but there is an interesting technologies else that is gasification.

Analytic Hierarchy Process (AHP) model is an approach method for a complex decision-making that was used in this research to identify suitable option of technology for para rubber wood power plant in Thailand. So, this research attempts to survey different types of para rubber wood power plant in Southern of Thailand and compare two technologies between direct combustion and gasification by using AHP by considering in criteria, sub-criteria and alternative. Criteria and sub-criteria are considered in many topic such as energy potential economics, environment effect. There are four initial criteria, including benefits, opportunities, risks and costs (BORC).

From expected outcome of this research the direct combustion technology should be suitable more than gasification, it is expected that study will help to promote Thai government policy and also supports the investors in Thailand. This will lead to increase economic growth and will solve the problem of low price of rubber, which is directly related with farmers.

Processing of Whole Mulberry Wine with Micro Wet Milling System

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Mulberry or Kuwano-mi belongs to the Moraceae family. It is widely distributed in Asia and well-known on its significantly nutritional qualities. Due to its fragile structure and low stability in the storage, it is usually processed as freezing food. Another possibility is to commercialize its fermented product. However the nutrition in mulberry's pomace and seeds is lost in the traditional wine processing because it only uses squeezing juice to ferment, on the other hand, the root and seeds of mulberry are difficult to remove.

Micro Wet Milling System (MWM) which can degrade raw material into smaller particles by stone milling is used to produce whole mulberry wine in order to keep full nutrition with good sensory or taste. The milling and fermentation characteristics of mulberry are investigated for the new wine processing with MWM system.

The harvested mulberries (Shimane-ken,2014) are stored in a freezer and thawed in the use. Saccharomyces Cerevisiaes (Spain,2013) is chosen as wine fermentation yeast.

1. Milling characteristics: The effects of mixing time for the mixer and the feeding rate for MWM system on the particle size of degraded mulberry are demonstrated.

2. Fermentation characteristics: By use of milled mulberry with MWM system as raw materials, the effect of dilution ratios on alcoholic (GC14B、Shimadz), Brix% and particle size (SALD2200, Shimadz) are observed. Sterilization at 60ºC for 10 min before fermentation was conducted. Due to the high viscosity of mulberry, the dilution is given at 2, 3 and 4 fold by distilled water.

Milling experiment result shows that the smallest particle size by use of mixer is 107μm and the following MWM system reduces to 31μm when feeding rate is 14g/min by use of stone mill. The other result shows that MWM system can make higher polyphenol content (170.8mg/100g) in the mulberry juice compared with mixing only (153.4mg/100g).

Fermentation experiment result shows that the alcohol is increasing with the decreasing of Brix. the alcohol between 2, 3 and 4 fold dilutions are 12.2%, 11.6% and 11.1%, respectively. The Brix% values between these dilutions are 9.3%, 8.5% and 8.1%. There is no significant difference in the alcohol and Brix% between 2, 3 and 4 dilution ratios of wine. However the particle size as 31μm in the mulberry juice reduced to 27.3μm in the final wine.

Toward the Production of an Edible Vaccine Against Influenza : Spray-Dry Characteristics of Tomato Fruit

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Vaccination is the most effective way for preventing infectious diseases such as Influenza. Traditional injectable vaccines are less effective against infection at mucosal surfaces because of poor inducers of mucosal immunity. Moreover, it costs very expensive in production and has some risk of infection because of using syringes and needles. Plant-derived edible vaccine is expected to get rid of those problems by using virus-like particles (VLPs), which survive through the severe conditions in the digestive tract, as a carrier molecule for foreign antigenic epitopes and stimulate both mucosal and systemic immunity by inducing antibodies in the intestinal fluid. We are attempting to produce edible vaccine bearing the extracellular domain of influenza A virus matrix protein 2 (M2e) on human Hepatitis E virus-like particle by transformation of tomato, *Solanum lycopersicum* cv. Micro-Tom. Nevertheless, the cold chain process is still required to preserve quality and quantity of recombinant protein particles, therefore undesirable for storage. Spray drying, involves in evaporating moisture component from slurry or liquid solution and making powder by rapidly drying with a hot air, is one of the most well-known technology commonly used in the pharmaceutical and food industries.

The purpose of this work was to develop a stable dry powder formulation containing VLPs expressed in tomato fruit. However, a protocol of spray drying in this tomato cultivar is still unexplored. Thus, we firstly use non-transformant tomato as the material in our study. Tomato is milled by Micro Wet Milling (MWM) to reduce particle size not to clog in the nozzle pore. Tomato slurry derived from MWM will be added with several kinds of diluent before pilot-scale spray drying. Glass transition temperature (T_g) measurement is helpful to determine the ratio of the slurry to the diluent. Spray-dried tomato powder will be also determined by various parameters such as yield, particle size, and moisture content in order to select the appropriate drying profile to obtain a robust formula of a dry product. If succeed, we will try to apply those formula in spray drying of VLPs expressed tomato. Then, measure the antigenicity by ELISA to confirm the potential of using spray drying process in the production of edible vaccine.

Evaluation of Microorganism Inactivation in Water Environments by using $P/Ag/Ag_2O/Ag_3PO_4/TiO_2$ Thin Film Reactor Circle System under LED Irradiation

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Escherichia coli (E.coli) are a kind of faecal coliform whose presence in water is a sign of contamination by sewage or animal waste. Water contaminated by *E. coli* can cause many diseases, such as stomach ache, vomiting and fever. Usually, the most commonly used techniques for water disinfection, such as chlorination and ozonation have shown disadvantages related to the formation of potentially hazardous byproducts. In recent years the advanced oxidation processes (AOPs) have been a promising waste water treatment for its efficient oxidation ability, such as photocatalysis which has attracted considerable interests for its remarkable disinfection performance.

According to our pervious study, a novel $P/Ag/Ag_2O/Ag_3PO_4/TiO_2$ photocatalyst powder which is a promising material with remarkable photocatalytic efficiency for organic degradation was developed. In this study, because the powders have some drawbacks such as tedious post-separation, the $P/Ag/Ag_2O/Ag_3PO_4/TiO_2$ film will be coated on glass tubes to overcome this problem. The aim of this research is to evaluation of microorganism inactivation by using new photocatalytic materials under LED irradiation. In this study, the *E.coli* and *Enterococcus* will act as the model of microorganism and a model of virus, respectively. It is the first time to use LED lamp as light source to inactivate microorganism by using photocatalyst.

In this work, some factors that affect the microorganism inactivation were taken into considerations, such as light intensity, initial concentration and irradiation time. In conclusion, after photocatalytic inactivation of *E. coli* with initial concentration of 10^6 CFU/mL, the sterilization rate reaches around 90% under LED irradiation, and further the additional disinfection experiments are repeated three times showing the high stability of the photocatalyst. Further, the mechanism of bacteria disinfection by $P/Ag/Ag_2O/Ag_3PO_4/TiO_2$ will be proposed. Therefore, the novel $P/Ag/Ag_2O/Ag_3PO_4/TiO_2$ photocatalyst could be a promising material for microorganism photo-inactivation.

Life Cycle Assessment of Microalgae Oil Extracted by Hydrothermal Treatment and its Utilization for Diesel Engine

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Availability of land and food security are the major problems to produce biofuels from agricultural crops. Currently, many countries are dealing with critical issue related to food supply. In this case, diverting food crops towards production of biofuels will be a detrimental step towards food security. High cost of microalgae based biodiesel is a major problem to its commercialization.

Hydrothermal Treatment (HTT) have been studied by various researcher at different operating condition including pressure, temperature, reaction time, catalyst, species, influence of solvent etc. Net Energy Ratio (NER) and Green House Gas (GHG) emission are the two main factors that can decide the sustainability and feasibility of this technology. Biodiesel from HTT is not economically feasible because of high energy investment associated with high temperature and pressure.

Therefore, this study focuses on downstream process (HTT) as well as on credits of microalgae oil by evaluating its performance in diesel engine. Study also assist to minimize energy investment and environmental loading in oil extraction process by using low pressure (1.5-3.5 MPa) and temperature (150 –250 ^{0}C). Life cycle assessment (LCA) is a fundamental tool that will help to achieve the goal of this study by using SimaPro.

It is expected that, energy investment and environmental loading will be minimized by using low pressure and temperature because temperature plays a significant role in electricity consumption. NER of HTT process and performance (Power, Torque) of algae oil in diesel engine including GHGs emissions (CO_2, NO_x, PM, CO, H_2S, and HC); will provide an overall idea about feasibility of algae oil using HTT technology.

Expression Analysis of R2R3-MYB Transcription Factor in Corolla of *Primula sieboldii* cultivars 'Kyoganoko' and 'Uchu'

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Primula sieboldii is native to the eastern Asia and it is produced many cultivars in Japan. These cultivars have abundant flower color variations. The colored flower cultivars accumulate anthocyanin pigments. It is reported that accumulation of anthocyanin is influenced by the transcription factor such as R2R3-MYB. In previous research, we obtained 20 homologs of R2R3-MYB from the next-generation sequencing data and revealed the expression tendency of each R2R3-MYB gene in eight developmental stages of 'Nankin-kozakura' corollas. And it was thought that *PsMYB1~2*, *PsMYB9*, *PsMYB11~12* and *PsMYB18* might affect anthocyanin synthesis because the expression increase of these R2R3-MYB genes was concomitant with floral pigmentation. In this study, to obtain further information about R2R3-MYB, we performed expression analysis of R2R3-MYB genes in corolla of red-flower cultivar 'Kyoganoko' and white-flower cultivar 'Uchu'.

'Kyoganoko' and 'Uchu' corollas of eight developmental stages were used as plant materials. The stages are as follows ; Stage1(St.1): buds before pigmentation ; St.2: buds began pigmentation ; St.3: the middle of St.2 and St.4 ; St.4: fully colored buds ; St.5: buds protruded from sepals ; St.6: corollas just before flowering ; St.7: corollas just after flowering ; St.8: corollas after a few days flowering. We performed real-time PCR expression analysis designed gene specific primers.

By real-time PCR expression analysis, it was categorized into three groups by the expression tendency of each gene. R2R3-MYB genes in first group were high expression levels in 'Kyoganoko', compared with 'Uchu'. *PsMYB1*～*3*, *PsMYB11* and *PsMYB17* belong to this group. Especially, explession level of *PsMYB1*, *PsMYB2* and *PsMYB11* are significant diffierence with 'Kyoganoko' and 'Uchu' at St.2 and 3. In the second group, expression levels of the genes in petal of 'Uchu' were higher than those of 'Kyoganoko'. R2R3-MYB genes of the second group are *PsMYB10*, *PsMYB12* and *PsMYB18*. The transcript level of third group genes were hardly differences with 'Kyoganoko' and 'Uchu'. *PsMYB4*～*9*, *PsMYB13*～*16* and *PsMYB19*～*20* are categorized into this group.

From the results of our previous and this study, it was considered that the genes of the *PsMYB1*, *PsMYB2* and *PsMYB11* might be more correlated with floral pigmentation.

Study on Anaerobic Digestion with Ammonia-rich Substrate under Intermittent Illumination Condition

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Along with the development of world population, the demand for meat products has risen drastically. As a consequence, accumulation of livestock waste constitutes a growing problem. Anaerobic digestion is considered to be a promising process to deal with the livestock waste, since both pollution control and energy recovery can be achieved by the process. However, even though ammonia is an essential nutrient for bacterial growth, at higher concentrations it acts as a strong inhibitor of methane production during anaerobic process. Although most conventional anaerobic digestors are operated under dark conditions, the use of fixed-bed anaerobic digestors operated under thermophilic light conditions has been studied. It has been reported that optimal illumination time on a thermophilic anaerobic reactor plays an important role in activating methanogens. There has been few reports on methane production through anaerobic digestion under illumination, especially regarding high ammonium concentration conditions. Therefore, this study focuses on intermittent illumination method to mitigate ammonia inhibition.

In this experiment, a series of batch experiments were carried out under thermophilic condition (55 °C) by using ammonium-rich synthetic medium as substrate at varying nitrogen concentrations: 2211 mg/L (N2211), 3378mg/L (N3378), 4402 mg/L (N4402). After 15 days of fermentation The bioreactors were illuminated for 60 minutes per day followed by treatment under dark conditions. After 15 days of fermentation the bioreactors that were regularly illuminated 60 minutes per day achieved higher methane production than that under dark condition. The ATP value of the corresponding bioreactors indicated that intermittent illumination improved the activity of the methanogens even with high ammonium concentration. Moreover, to improve the efficiency of the illuminated anaerobic digestion system, the fixed-bed bioreactor was used. The bioreactor with bed material packed with zeolite under intermittent illumination condition showed the highest methane concentration in comparison to other conditions. Molecular and microscopic study revealed that intermittent illumination improved the immobilization ability of the methanogens. This result indicated that optimum illumination time improved the activity of the methanogens even with high ammonium concentration. Therefore, intermittent illumination proves to be an appropriate method in mitigating ammonia inhibition from anaerobic digestion. The combination of fixed bed and intermittent illumination method is promising for effective anaerobic digestion.

Development of Fixed-bed Bioreactor for Bio-hydrogen Production

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Over the last few decades, the rising global warming and crisis of fossil fuels have increased the usage of alternate sources of energy. Hydrogen gas is a clean alternative energy carrier due to its high energy content which is higher than fossil fuel such as gasoline. In addition, the hydrogen combustion process is attractive because it generates only water vapor as byproduct; thus, hydrogen is an environmentally friendly, combustible source of energy.

Biological hydrogen production attracts more attention because it is mild, environmental-friendly and economical. Biological hydrogen production from anaerobic digestion process is favorable for generating high rate of hydrogen, simple reactor as well as easy to control. On the other hand, conventionally fixed-bed was used in methane fermentation, which improved the efficiency of anaerobic digestion effectively. However, the research about the usage of fixed-bed in the hydrogen fermentation is limited. Therefore, in this study, a series of experiment with three different bedding materials including loofah sponge (LS), chlorinated polyethylene (CPE) and porous nylon (PN) were carried out. Fermentation was carried out at pH 5 and 35 °C under anaerobic conditions. As the conclusion, CPE showed the best hydrogen concentration (55.6%), compared to PN (25.8%), LS (39.4%) and control (17.7%), and the highest cumulative biogas production of 1040 mL/L was achieved from CPE fixed-bed bioreactor. Hence, fixed-bed can improve the bio-hydrogen production, and CPE is the optimal material as the bedding material.

Prediction of Soymilk Viscosity by Near-Infrared Spectroscopy

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In the present study, viscosity change of soymilk in heating and cooling process was analyzed by using near-infrared (NIR) spectroscopy. Commercial plain soymilk was heated from 20°C to 80°C at 10°C intervals, and cooled to 20°C. During this heating and cooling process, diffuse reflectance NIR spectra and viscosity of the soymilk were acquired every 30 seconds, and correlation between the viscosity and the NIR spectrum was explored with partial least squares (PLS) regression analysis. The viscosity of soymilk decreased with heating and increased with cooling, and viscosity at 20°C increased before and after the heating and cooling process. In the NIR spectra, bands arising from OH group were showed blue shift. These shits mean that hydrogen-bonding was broken along with change in microstructure of soymilk. The PLS regression model of the viscosity showed a high determination coefficient (0.94) and a small RMSE (0.51 mPas) using NH band (Figure 1). From this result, it is suggested that change in hydration of soybean protein induced change in the viscosity, and NIR spectroscopy enables one to predict viscosity of soymilk.

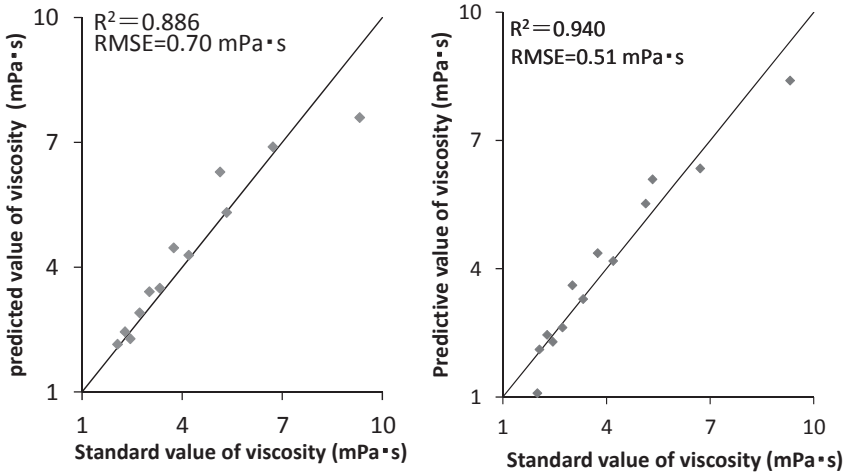

Figure 1. Soymilk viscosity values predicted by the PLS regression model

Microalgae Condensation and Dehydration Using Sedimentation and Cloth Filtration for the Efficient Biomass Production

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Algae biomass is a carbon-neutral resource with high growth rate. It is expected as an alternative to fossil fuels that does not compete with food resources. In addition, algae biomass has attracted a lot of attention in the fields of agriculture, environment, chemical products, pharmaceuticals, and nutraceutical products. The growth of algae in dilute suspension at ca. 0.03 wt% dry solids requires considerable challenges in achieving a feasible energy balance in algal process operations. Furthermore, small size of microalgal cells that are smaller than 15 □m and its similar density to growth medium make an efficient harvesting difficult. In this study, we attempted to condensate and dehydrate the microalgae culture suspension by sedimentation using polyelectrolyte coagulant and cloth filtration for simple and energy efficient process.

Sedimentation using polyelectrolyte coagulant was examined. The addition of polyacrylamide as a polycationic coagulant (courtesy provided by Kyowa Sangyo Co., Ltd.) to microalgae suspension accelerated the sedimentation rate. It took about few minutes for gravitational sedimentation in 16 cm height cylinder. The concentration factor, defined as the ratio of the total volume to sedimentation volume, increased with increasing the coagulant concentration, and then become an almost constant over 40 mg/L of coagulant. The addition of polyacrylamide as a polycationic coagulant enabled to concentrate microalgae suspension up to 13 times with the lower dosage (40 mg/L) than that of conventional inorganic coagulants (over 1,000 mg/L).

Condensation and dehydration of microalgae culture suspension by cloth filtration (courtesy provided by Ohtsuka Jitsugyo Co., Ltd.) was examined. With the addition of the polycationic coagulant, microalgae suspension was concentrated up to 11 wt% with recovery yield of 84 %. Even without the addition of coagulant, it was concentrated up to 10 wt% from 0.034 wt% with recovery yield of 73 %. Condensation and dehydration by cloth filtration without coagulant will make possible the reuse of the filtrate as culture medium of microalgae.

These findings may lead to the development of microalgae downstream process achieving a feasible energy balance.

Filtration Behavior of Organic Wastewater based on Mixing Ratio of Oil and Suspended Solid

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Organic wastewater discharged from food processing factories and restaurants with a lot of animal oil and/or vegetable oil causes clogging of underdrainage pipe and functional depression of wastewater treatment facility. Existing of the oil deeply affects recovery rate of suspended solid (SS) by mesh. If the high percentage separation of oil and SS from the wastewater is successfully attained, performance of the facility is recovered and recycling system of oil and SS is established. Purpose of this research is to clarify filtration behavior of organic wastewater based on mixing ratio of oil for improving and downsizing of existing wastewater treatment system.

Three types of artificial wastewater (30 mL), A (water and vegetable oil), B (water, vegetable oil, and flour as SS), C (water and flour as SS) were used with different mixing ratio of oil and flour as SS by 30,000 mg/L of oil and 3,000 mg/L of SS concentration. 0.4 mm fineness of stainless steel mesh was selected to observe filtration behavior. After filtration with the artificial wastewater, the mesh was dried for 24 hours, and the weight of filtered oil and SS was measured to calculate recovery rate.

19.95%, 20.64%, and 11.08% of recovery rate on the mesh for A, B and C were observed. Molecular weight of the vegetable oil is large and its oil film is strong compared to water, so these characteristics have the possibility to affect the result of the recovery rate. The vegetable oil of A does not largely affect clogging without SS, and gluten of C has high viscosity and stickiness by wheat protein. However, gluten viscosity is weaker than inflow speed of artificial wastewater of C. So its recovery rate was not increased. On the other hand, mixing of Oil and SS in B did not increase viscosity by gluten, because the oil blocks gluten creation in the water by inhibiting chemical bond between proteins. If SS is covered with oil, solidification and viscosity of artificial wastewater were increased by fat-binding properties between oil and protein that covers starch particle in B.

Therefore, artificial wastewater B caused high clogging of the mesh compared with A and C. Therefore, if filtration behavior by the reaction of mixing SS, oil and water as artificial wastewater is analyzed in molecular level, SS recovery system is economically able to be installed as indispensable equipment for pretreatment of wastewater treatment system.

Non-destructive Analysis of Carotenoids in Fruits and Vegetables with a Hand-held Raman Spectrometer

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Non-destructive, on-site analysis of lycopene in fruits and vegetables has been highly desired in Japan because a new labeling system for foods took effect in April 2015. In this new system, food packages can be labeled with the foods' health-promoting benefits. Carotenoids such as lycopene and β-carotene are well-known antioxidant, and high-carotenoids cultivars of fruits are becoming popular in Japan. Raman spectroscopy is a powerful tool for non-destructive analysis of carotenoids in fruits and vegetables.[1-3] Carotenoids in foods show intense bands at 1520 and 1160 cm^{-1} in Raman spectra owing to the pre-resonance Raman effects. In the present study, the feasibility of non-destructive analysis of carotenoids in fruits and vegetables was investigated using a hand-held Raman spectrometer.

A small (15.8 cm x 10.1 cm x 2.9 cm) and lightweight (650 g) hand-held Raman spectrometer (Indicator, Serstech) can be handled with ease. In addition, the spectrometer operates for approximately 4 h on a Li-ion battery, and has a rugged waterproof design. Therefore, this hand-held Raman spectrometer can be used not only for laboratory analysis, but also for on-site analysis in fruit farm.

In Japan, fruits and vegetables are packaged in a plastic bag to improve their shelf life. Figure 1 displays Raman spectra of intact fruits in a plastic bag: Satsuma mandarin, tomato, paprika, and Japanese persimmon. In Figure 1, intense bands at 1520 and 1160 cm^{-1} arising from carotenoids in each fruits were observed successfully. These results suggest that Raman spectroscopy provides a versatile calibration model for carotenoids in fruits and vegetables, and hand-held Raman spectrometers enable to on-site analysis of carotenoids in fruit farm and post-harvest processes.

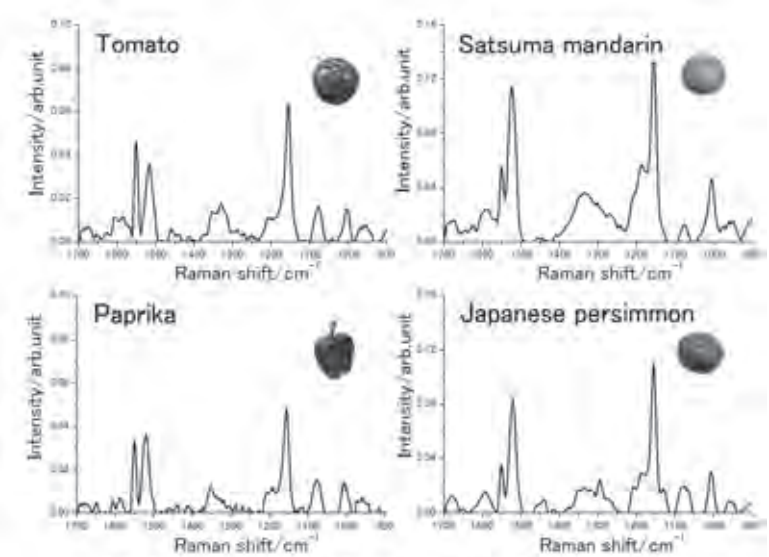

Fig. 1. Raman spectra of fruit and vegetables in a plastic bag.

[1] Ozaki Y., Cho R., Ikegaya K., Muraishi S., Kawauchi K. (1992), *Applied Spectroscopy*, 46 (10), 1503–1510.
[2] Baranska M., Schütze W., H. Schulz H. (2006), *Analytical Chemistry*, 78 (24), 8456–8461.
[3] Qin J., Chao K, Kim M. (2012), *Postharvest Biology and Technology*, 71, 21–31

Fermentation Process and Nutrition Value of Strawberry Wine with Micro Wet Milling Technic

Xinyi LI

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Strawberry is an important fruit of family Rosaceae, occupies an eminent place among the small fruit plants and is grown throughout the world, and strawberries were usually processed into juice, nectar, wine, and puree. With the rich distribution of the antioxidant capacity as well as the contents of ascorbic acid, total phenolics and total anthocyanins, due to the different stage, samples in can contain diverse amount of nutrition value. In my experiment, I am going to try to produce strawberry wine, the find out the way which can release and preserve as much as nutrition in to my wine. Therefore, my studies focus on getting the strawberry wine contained appropriate alcohol and nutrition level with high sensory value.

In my preparation step, due to the high nutrition value skin and seed, I utilized all parts of strawberry to make the wine. I used the apparatus called Micro Wet Milling(MWM) machine to mill my raw strawberries material into small particle size from 10 to 30 "m, to release the whole nutrition contains. In the fermentation process, two different levels particle sizes and distributions of different apparatus(normal mixer and MWM machine) of strawberry juice will be compared. The sterilization process will be determined whether it is before the fermentation or after by detecting this effect on the final production. In addition, pH value, alcohol percentage and Brix will be detected within the fermentation process. I would like to do the filtration after fermentation, to improve the palate and avoid the granular sensation. Particle distribution and total nutrition value will be measured both before and after the fermentation,as well as after the filtration, and compare with each other. Sensory test will be performed on over 30 people, using different preparation and fermentation condition wines.

The expected result would be that the wine went through the MWM machine should contain more nutrition and have higher sensory value than the normal mixed one. And I hope that the wine after filtration should not have a significant decrease in the nutrition value and can get a higher sensory value.

Effect of Silicon Treatments on Growth of NERICA under Saline Conditions

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NERICA (New Rice for Africa) varieties are interspecific hybrid progenies between *Oryza sativa* L. and *Oryza glaberrima* Steud., and have been cultivated under rainfed upland conditions in African countries. In these countries, salt accumulation occurs in dry season and it is a serious problem for them. On the other hand, some researchers reported that silicon alleviates salt damage in crop plants. Although silicon is regarded as a useful nutrient in cereal crops, shortage of silicon is severe in the soil in African countries. Therefore the objective of this study was to examine the possibility of silicon to improve the salt tolerance of NERICA.

The seeds of NERICA (cv. NERICA 1) and Japanese rice (*Oryza sativa* L., cv. Koshihikari) were sown on April 27 and two seedlings were transplanted into a 1/5000a Wagner pots filled with sand on May 27. The seedlings were thinned to one plant per pot on June 4th and grown in a green house. Hoagland solution and salt (0, 3000 ppm, or 6000 ppm NaCl) with or without 20 ppm SiO_2 was added into the pots once a week. Plant length, number of tillers, plant age in leaf number and SPAD were measured weekly. Stomatal conductance of topmost fully expanded leaves was measured with a leaf porometer (SC-1, Decagon Devices). Effects of silicon on the measured parameters of plants were evaluated with the pots without silicon as controls.

NERICA 1 showed shorter plant length, less tillers, higher SPAD than Koshihikari in the cultivation period, while plant ages in leaf number of both varieties were not different statistically. Under salt treatment conditions, plant length, tiller numbers, SPAD were reduced but plant age in leaf number in both varieties were hardly affected. Plant length and SPAD were increased and tiller numbers were reduced under silicon treatment conditions, while there was no significant difference between both varieties. Under silicon treatment conditions, stomatal conductance tended to increase in both varieties. Heading time of NERICA1 was delayed for 5 and 6 days NaCl, and that of Koshihikari was delayed for 3 and 5 days under NaCl treatments conditions. Under silicon treatment conditions, heading time of NERICA1 was also delayed for 2 to 4 days and that of Koshihikari for 0 to 1 day. These results indicated that NaCl treatments inhibited plant growth and delayed heading time of NERICA1 and Koshihikari, while silicon treatments alleviated the effects of NaCl on plant length and SPAD.

Antifungal Compounds Produced by *Quercus acuta* to *Raffaelea quercivora*

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Since 1980's, Japanese oak wilt has expanded and the occasion of this illness varied among 12 *Fagaceae* species in Japan. The causal fungus is *Raffaelea quercivora,* which is vectored by bark beetle, *Platypus quercivorus*. It has been known that the susceptibilities to the fungus are different between tree species. Among *Fagaceae* species, *Quercus crispula* is known as the most sensitive species and conversely, *Quercus acuta* is known as the most resistant species. *Lithocarpus edulis* is also resistant, but more sensitive than *Q. acuta*. Clarifying the chemical defense mechanisms in resistant trees will provide important information to keep from oak wilt in forests. Therefore, using *Q. acuta,* we aimed to identify the antifungal compounds, which can work as one of the chemical defense mechanisms.

For comparison of the total phenolics, young *Q. crispula*, *Q. acuta* or *L. edulis* was inoculated with *R. quercivora* in July 2013 and harvested 30 days after inoculation. The amount of total phenolics were measured according to Folin-Ciocalteau method. Stems were cut off at 5 cm above and 5 cm below the inoculation hole. The logs were separated into barks, heartwood, discolored sapwood and non-colored sapwood. For the large extraction of *Q. acuta*, young trees were inoculated with *R. quercivora* in June 2014. The harvest, cutting off and separation are conducted as described above. Discolored (fresh weight 773.6 g) and non-colored sapwoods (fresh weight 1173.2 g) were separately cut to pieces with a hatchet, placed in 100% methanol (2 L) and extracted for 7 days in the dark. Each methanol extracted was evaporated *in vacuo* and the concentrated samples were extracted ethyl acetate (EtOAc). EtOAc phase was concentrated to be 100 mL and used for TLC bioautography assay, which enables to evaluate the antifungal activity against black mold, *Cladosporium herbarum*. After the incubation at 25°C under humid condition for 4 days, the inhibitory spots were detected on the TLC plates.

The amount of total phenolics of *Q. acuta* was significantly larger than *Q. crispula* and *L. edulis*. According to these results, phenolics seem to enhance the resistant of *Q. acuta*. Both extracts (discolored and non-colored sapwoods) showed positive dose-response effects and discolored sapwood tend to show higher inhibition than non-colored sapwood. Additionally, at least, two antifungal compounds, which show high polarities, were detected (approximately 0.15-0.17 and 0.25-0.29 *Rf* values). To identify antifungal compounds, we are going to isolate and purify them and run them for instrumental analysis. In the future, we also would like to check antifungal activities of isolated compounds against *R. quercivora*.

Bio-based Packaging Plastics from Fish Scale

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Problems related to plastic wastes, which caused adverse impacts on humans and environments, are encountered in Thailand and many other countries. Although plastic recycling can partially solve these problems, consumers are concerning about safety of using recycled plastic in food packaging. Using biodegradable plastic for packaging is a good way to overcome plastic waste problems. Fish scales is considered as a raw material for producing bio-based plastic Fish scales was reported that it has possessed properties such as transparency, flexibility, stickiness and durability. The strength of its gelatin seemed to be increased when it left for a long period of time. More importantly, gelatin extracted from fish scale has been used in medicinal capsules indicating its safeness for consumers and environments. These information support the use of fish scales in place of plastics in packaging. The purpose of this study was to explore the possibility of creating plastics derived from fish scale gelatins as a new material for food packaging. The first part of this experiment aimed at investigating the optimum conditions and the suitable source of fish scales for gelatin extractions. It was reported that soaking snapper fish scales in 2% sodium hydroxide for 2.5 hours followed by 2% acetic acid resulted in high yield and tensile strength of the extracted gelatin. The reported conditions were applied to several sources of fish scales: snappers, nile tilapias, and red tilapias. The results showed that each type of fish scale yielded gelatins with different quality. The snapper scale produced gelatin with highest quality and highest tensile strength. In the second part of the experiment, suitable compositions and quality of the gelatin obtained were examined. It was found that the gelatin obtained from the mixture using ratio of snapper scale to corn flour to glycerin of 5:2:5:1 had the tensile strength of 28.4-MPa. The tensile strength is much greater than the strength of gelatin without corn flour and glycerin. Moreover, the fish scale gelatins added with calcium carbonate and ethanol exhibited a number of properties, such as water solubility, tensile strength, tear strength, and biodegradability. According to the results, the fish scales can be used as a raw material for production of an eco-plastics which is benefit to manufacturers, consumers and environments.

Effect of Harvest Time on Feed Compositions of Different Types of Forage Rice Varieties

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Rice is a staple food in Japan. But the rice consumption per capita has been declining in the past 50 years. The potential rice production surpasses the demand. So, about 40% of paddy field is converted to other crops or no crop is cultivated. On the other hand, the consumption of dairy product and meet has been increasing. But the self-sufficiency rate of forage is only 27% in Japan. From the viewpoint of improving such situation, forage rice cultivation has been increasing in the past several years, the area has reached to about 64,000 ha in 2014. Recently rice varieties for forage has been developed. Such varieties are mainly divided into two types, that is, grain-weight type for grain use and straw-weight type for whole crop silage (WCS). Low-cost and low labor cultivation methods are required for forage rice production. Cultivation methods are investigated for both higher yield and good forage quality. The relationships between forage quality and harvest time is still unclear. We investigated the effect of harvest time on the forage quality of different types of forage varieties under high nitrogen fertilizer condition.

Four forage rice varieties, Momiroman (grain-weight type; Mo), Kusahonami (grain-weight type; Ku), Leafstar (straw-weight type; Le) and Tachisuzuka (straw-weight type; Ta), were cultivated in the paddy field of the Agricultural and Forestry Research Center, University of Tsukuba in 2015. Seedlings with four leaf stage were transplanted at plant density of 30 cm x 15 cm with 3 plants per hill. A plot size is 6 m^2 with 3 replications. N, P_2O_5 and K_2O were applied at 10 g m^{-2} as basal dressing before transplanting. At heading stage each plot was divided with an undulate plate and 4 g m^{-2} of N was applied as topdressing in the half of a plot. The number of stems per hill, plant length and SPAD value of an uppermost leaf were measured at 2-week intervals during the growth stage. The dry-matter yields of above ground part were measured at heading and matured stages. During ripening period rice was harvested at 10, 20 and 30 days after heading (DAH) for measuring dry-matter of above ground and feed compositions.

Stem numbers per hill changed in almost same among varieties during growth. Plant length changed in the order of Ta, Le, Ku and Mo. Heading dates were 11 August, 22 August, 26 August and 5 September for Mo, Ku, Le and Ta, respectively. Panicle numbers per hill and plant lengths at heading stage were 9.7, 9.2, 8.4, 11.3 and 115, 122, 130, 148 cm for Mo, Ku, Le and Ta, respectively. The dry-matter yields at heading stage were 1009, 1079, 1145, and 1349 g m^{-2} for Mo, Ku, Le and Ta, respectively. The measuring of the dry-matter yields and feed compositions during ripening period are progressing. We will compare the changes in the quantity and quality of forage rice during ripening period between basal dressing and topdressing plots. From these analysis the information on the adequate harvest time and nitrogen fertilization for higher yields and better forage quality is obtained.

Evaluation of the Growth, Dry-matter Yield and Feed Compositions of Forage Rice with Sparse Planting in Free-Air CO_2 Enrichment (FACE) Condition

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Rice is a staple food in Japan, but the cultivation area has been decreasing because of the decline in rice consumption. On the other hand, the consumption of dairy products and meet has been increasing. But the self-sufficiency rate of forage for livestock is only 27%. The cultivation area of rice for forage has increased rapidly during the past 10 years to improve this situation. The increase in atmospheric CO_2 concentration is one of the few positive elements in the impact of climate change on crop production. There are a number of reports on the influence of increased CO_2 concentration on the growth and yield of crops. The effects of high CO_2 concentration on the yield and quality of rice has been revealed in the free-air CO_2 enrichment (FACE) experiment in Japan. The forage rice is different from normal rice in its use, especially higher dry-matter yield and good forage quality are required. Low-cost and low-labor cultivation methods are also required for forage rice production. Sparse planting is considered as one such methods. So, we cultivated two types of forage rice varieties in FACE experiment with a sparse planting density and analyzed the effect of high CO_2 concentration on the production and forage quality.

Two forage rice varieties, Kusahonami (grain-weight type for grain use) and Leafstar (straw-weight type for whole crop silage use), were cultivated at a sparse planting density (30 cm x 30 cm) in Tsukuba FACE (Free-Air CO_2 Enrichment) facility in Tsukubamirai city, Ibaraki, Japan in 2015. An ambient CO_2 concentration (AMB: control) and an elevated CO_2 concentration (FACE; AMB + 200 ppm) plots were set with 4 replications. 10 g m^{-2} of N, P_2O_5 and K_2O were applied as a basal dressing before transplanting and 4 g m^{-2} of N was applied as topdressing before heading. Plant length, stem number per hill and SPAD value of uppermost leaf were measured at two weeks interval during vegetative growth period. The dry weight of plant organs were measured at heading and yellow-ripe stages. Morphological characters, such as flag leaf length, culm length, culm diameter, panicle length, were measured in ripening period. Grain yield and feed compositions were measured at harvest.

Stem numbers per hill of both varieties changed higher in FACE than in AMB during growth stage. But stem numbers decreased with growth in both treatment and the difference in panicle numbers were slight in both varieties. The dry-weights of aboveground part at heading stage were larger in FACE than in AMB in both varieties. The analysis of the morphological characters, grain yield and feed compositions are progressing. These analysis are useful for the efficient forage rice production in higher atmospheric CO_2 concentration condition in future.

Improvement Effect of Peony on Infertility Induced by Stress

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Anovulation is induced by a variety of stresses in women, which is considered that reactive oxygen species (ROS) generated by stress is involved in this process. The viability of granulosa cells is closely associated with follicular atresia and ovulation during estrous cycle. Previous studies have shown that heat stress treatment raises the level of ROS in rat and induces apoptosis in granulosa cells, which leads to anovulation. This treatment is useful for screening natural compounds that improve ROS-dependent anovulation.

The medicinal plant Peony, which contains the functional compound called paeoniflorin, has been used for improving infertility as folk remedy. However, there is no scientific evidence for this effect of Peony. The objective of the present study is to evaluate the functionality of Peony with respect to improving infertility. We examined the effects of Peony root extract and paeoniflorin on cultured porcine granulosa cells and heat stress (35℃)–treated Wister rats.

Peony root extract significantly suppressed a heat stress-dependent decrease in the number of ovulation, and increased the expression of the antioxidant enzyme catalase in rat ovary and porcine granulosa cells. Paeoniflorin also increased the expression of catalas and reduced the ROS level in cultured cells. Moreover, paeoniflorin suppressed oxidative stress-induced apoptosis of cultured cells. These results provide the first evidence that Peony improves infertility.

High School Students' International ESD Symposium Collaborating with Sakado's International Sister Schools and Super Global High Schools

Yoshikazu TATEMOTO, Masaki TAKARA, Ryosuke KONNO and Kenichi YOSHIDA

Senior High School at Sakado, University of Tsukuba

What will we do?

Supported by University of Tsukuba Education Bureau of Laboratory Schools, we have invited some students and teachers of the high schools that have had good relationships with Senior High School at Sakado, University of Tsukuba (UTSS). The purpose of inviting them is to hold a symposium "of the students, by the students, for the students" on ESD activities with the students of UTSS, aiming at sharing and discussing the ideas of solving environmental problems in each country from the students' point of view. We would like the audience to hear what high school students think about environmental problems around them, expecting that this symposium will raise the students' awareness of the importance of being positive and active in ESD activities. The schools participating this year are as follows:

- ●Center for Forestry Education and Training, Republic of Indonesia (Indonesia)
- ●Kasetsart University Laboratory School (Thailand)
- ●Kornita High School, Bogor Agricultural University (Indonesia)
- ●University of the Philippines Rural High School (the Philippines)

Our New Challenge

Japanese Ministry of Education, Culture, Sports, Science and Technology have started Super Global High School Project (SGH) since 2014. UTSS is one of SGH high school in Japan. In this project, UTSS have started International ESD field work in Indonesia since 2014 with two Indonesian high schools.

UTSS have hold "High School Students' International ESD Symposium" since 2012. From this year, SGH schools also participate this symposium. They bring their result of research, activities for solving global issue and ESD action by poster presentation. Students can share and discuss about sustainable society for future in this symposium.

UTSS will report these new challenges in Ag-ESD symposium.

Contact us

It would be a great pleasure if you could give us a lot of comments, reactions and suggestions for improving and making International collaborative ESD programs with each other, via email at:

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Nakao Nomura	Associate Professor, Graduate School of Life and Environmental Sciences, UT
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(Laboratory School)

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Morio Kato	Assistant Professor, Agricultural and Forestry Research Center, UT
Seishi Kadowaki	Assistant Professor, Agricultural and Forestry Research Center, UT
Yoshihiko Sekozawa	Assistant Professor, Agricultural and Forestry Research Center, UT
Daiki Mizuta	Assistant Professor, Agricultural and Forestry Research Center, UT
Hideo Yoshida	Assistant Professor, Agricultural and Forestry Research Center, UT

(JICA)

Takao Shibusawa	Director, Training Program Division, Japan International Cooperation Agency (JICA)

(As of Oct.1, 2015)

Executive Committee

Chairperson:

Yooichi Kainoh	Director, Agricultural and Forestry Research Center, UT

Members:

Atsushi Tajima	Professor, Agricultural and Forestry Research Center, UT
Hisayoshi Hayashi	do.
Tomohiro Takigawa	do.
Yoshihiko Tsumura	do.
Naoya Fukuda	Associate Professor, Agricultural and Forestry Research Center, UT
Ryozo Noguchi	do.
Atsushi Asano	Assistant Professor, Agricultural and Forestry Research Center, UT
Naoto Ishikawa	do.
Morio Kato	do.
Seishi Kadowaki	do.
Yoshihiko Sekozawa	do.
Daiki Mizuta	do.
Hideo Yoshida	do.
Hiroshi Hiki	Senior Technical Official, Agricultural and Forestry Research Center, UT
Tsuyoshi Honma	do.
Yasuhiro Matsumoto	do.
Kazuto Yokoyama	Chief Technical Official, Agricultural and Forestry Research Center, UT
Miho Satoh	do.
Kazuo Sakai	do.
Kiyoshi Karube	do.
Hideaki Omiya	do
Keiko Sugawara	do.
Momoyo Itoh	do.
Mutsumi Itoh	do.
Katsuhiro Yoshida	do.
Mizuki Matsuoka	do.
Tomonari Yamamoto	do.
Yoshie Akiba	do.
Akira Saito	do.

Shoichi Hirose	Associate Head, Agricultural and Forestry Research Center, UT
Masami Sakamoto	Chief, Agricultural and Forestry Research Center, UT

Staff:

Tomoko Kondo	Agricultural and Forestry Research Center, UT
Taeko Mori	do.

（As of Oct.1, 2015）

・筑波アジア農業教育セミナー及び
　国際農学ESDシンポジウムの沿革

・国際農学ESDシンポジウム2015の概要

・国際農学ESDシンポジウム2015の日程表

筑波アジア農業教育セミナー及び国際農学ESDシンポジウムの沿革

筑波大学農林技術センターは、1979年にユネスコから、その主事業の一つであるAPEID(The Asia-Pacific Programme of Educational Innovation for Development)の協同センター（Associated Center）として指名され、以来、日本ユネスコ国内委員会との共催により、「筑波アジア農業教育セミナー」（TASAE:Tsukuba Asian Seminar on Agricultural Education）を関係部局との協力のもとに毎年開催してきた。

「筑波アジア農業教育セミナー（TASAE）」の目的は、筑波大学の農業教育活動の一環として、アジア諸国の農業教育および農業研究に従事する専門家を我が国に招聘し、我が国の専門家を交えて各国の実情と問題点を比較検討し、この分野での我が国の教育水準を向上させ、併せてアジア地域の農業教育および農業研究の国際協力推進に寄与することであった。

APEID事業の第２期である1979年から1981年までの３年間は、「中等段階（Secondary Level）の農業教育問題」に焦点が置かれてきた。各年の開催テーマは、以下のとおりである。

1979年　アジア地域の中等段階農業教育の現状と問題点
1980年　アジア地域の中等段階農業教育における実験と圃場実習の重要性
　　－主として、カリキュラム開発について－
1981年　アジア地域の中等段階農業教育における教授法
　　－主として、稲作について－

APEID事業の第３期としての1982年から1986年までの５年間は、前期の総括を受けて、アジア地域の農業教育革新の必要性を、単に中等教育のみでなく、初等教育から高等教育に至るまでの全段階において考慮・検討することとした。そこで、APEID事業の第３期における統一テーマは、「アジア地域における農業教育革新のための戦略」とし、農林学、農林工学、応用生物化学といった具体的観点から、農業教育革新への技術的アプローチを行った。各年のテーマは、以下のとおりである。

1982年　アジア諸国の農業の現状と開発計画および教育の役割（序論）
1983年　アジア諸国の作物生産における技術革新上の問題点（農学からのアプローチ）
1984年　生産性向上のための農業工業分野における技術革新　－主として穀類の調製・貯蔵技術について（農業工学からのアプローチ）
1985年　アジア諸国における農村地域開発のためのバイオマスとバイオテクノロジーの有効利用（応用生物化学からのアプローチ）
1986年　アジア諸国における農業発展のための農業教育　－事例と展望（総括）

なお、1985年のTASAEでは、期間中にサテライトシンポジウム「アジア諸国における農村開発のためのバイオマスとバイオテクノロジーの有効利用」を開催し、また1986年のTASAEでは、ジョイントシンポジウム「アジア各国における農業の研究と教育　－21世紀をめざして」を熱帯特プロとの共催で開催した。

APEID事業の第４期、1987年から1991年までの５年間は、アジア太平洋地域各国において、森林や内水面を含む自然並びに農業生態系との調和のもとに農業生産性の向上を図るために必要な、農業の教育と研究の在り方について考慮・検討した。すなわち、APEID事業の第４期における統一テーマは、「アジア太平洋地域における自然並びに農業生態系を保全しながら農業生産性を高めるための教育と研究」とし、自然並びに農業生態系の保全と有効利用に焦点を合わせたセミナーを開催した。各年のテーマは、以下のとおりである。

1987年　アジア各国における自然並びに農業生態系を保全しながら農業生産性を高めるための教育と研究の現状、問題点並びに展望
1988年　アジア各国における森林の有効利用と保全のための教育と研究に関する現状、問題点並びに展望
1989年　アジア各国における内水面の有効利用と保全に関する教育と研究の現状、問題点並びに展望
1990年　アジア各国における耕地、水の有効利用と保全並びに農薬、化学肥料の適正利用に関する教育と研究の現状、問題点並びに展望
1991年　アジア各国における農業教育と環境教育の結合に関する現状、問題点並びに展望

APEID事業の第５期である1992年から1996年までの５年間は、統一テーマを「アジア・太平洋地域における持続的な農業発展と環境保全のための教育と研究」とし、本期の重点課題や強調点としてうたわれている環境問題と人材養成の２点を念頭に置き、アジア各国における持続的な農業発展と環境保全のための教育と研究の在り方について討議を深めた。各年のテーマは、以下のとおりである。

1992年　アジア各国における農業生産からみた問題土壌とその対応に関する現状、問題点並びに展望
1993年　アジア各国における持続的な家畜生産のための教育と研究の現状、問題点並びに展望
1994年　アジア・太平洋地域における持続的農業発展と環境保全のための森林・林業の教育・研究の現状と課題
1995年　アジア諸国における持続的な農業発展のための植物育種と遺伝資源に関する教育と研究の現状、問題点並びに展望
1996年　アジア諸国における持続的な農業発展のための農業技術教育の現状と問題点並びに展望

APEID事業の第６期、1997年から2001年までの５年間は、統一テーマを「アジア・太平洋地域における農業・環境教育革新のための戦略」とし、アジア各国における持続的な農業発展と環境保全のための職業教育革新について討議を深めた。なお、1989年から期間中において、サテライトシンポジウムを毎年開催した。各年のテーマは、以下のとおりである。

1997年　アジア・太平洋地域における農業・環境教育革新の現状と展望
1998年　アジア・太平洋地域における農業・環境教育革新のための生物資源利用教育の現状と展望
1999年　アジア・太平洋地域における農業・環境教育革新のための地域情報利用教育の現状と展望
2000年　アジア・太平洋地域における農業・環境教育革新のための体験的教育の現状と展望：農業・環境教育の改善に対する大学の役割
2001年　アジア・太平洋地域における参加型アプローチを通じた持続的地域資源管理および環境保全

APEID事業の第７期、2002年から2007年までの６年間は、統一テーマを「持続的発展を前提とした生存・生産環境創成のための水資源利用・保全技術開発と農林業教育の役割」とし、アジア・太平洋州諸国が抱える水資源の問題を分析し、新たな水環境の創生のために農林業教育が果たすべき役割について討議を深めた。各年のテーマは、以下のとおりである。

2002年　水資源の涵養と水災害などに関わる現状把握および農林業教育が果たすべき役割
2003年　人類生存・食料生産に関わる水資源の需要・分配と農林業教育が果たすべき役割

2004年　生存・生産活動と連動した水資源の量的確保に関わる現状把握、効率的利用を図るための技術動向および農林業教育が果たすべき役割
2005年　人類の生存・生産活動のための水資源管理と農林業教育が果たすべき役割
2006年　地球環境的・地域環境的視点からの水資源利用・保全技術動向および農林業教育が果たすべき役割
2007年　アジア・太平洋地域における参加型アプローチを通じた持続的地域水資源管理と環境保全

APEID事業の第８期を迎えた2008年には、これまでの教育セミナー形式を国際会議形式に発展させ、８期６年間（2008年から2013年まで）の統一テーマを「持続可能な未来のための農学ESDの推進」として、キックオフ会議「国際農学ESDシンポジウム（Ag-ESD Symposium 2008）」を開催した。この年のテーマを「< 持続的発展のための農学教育 >に関する大学・関連機関の教育・研究活動の現状と果たすべき役割」として、討議を行った。各年のテーマは、次のとおりである。

2008年　農学ESDのキックオフ会議
「< 持続的発展のための農学教育 >に関する大学・関連機関の教育・研究活動の現状と果たすべき役割 」
2009年 「 農学ESDにおける食の安全と食糧の安全保障 」
2010年 「 農業および環境分野における持続的開発のための中等・高等教育の役割」
2011年 「 農学ESDにおける生物多様性の適正利用 」
2012年 「 農学ESD推進のための環境調和型農業技術開発 」
2013年 「 農学ESDにおける大学の役割 」

2009年には、「 農学ESDにおける食の安全と食糧の安全保障 」をテーマとして第２回目の「国際農学ESDシンポジウム（Ag-ESD Symposium 2009）」を開催した。11月9日から12日までの間、７ヵ国（フィリピン、タイ、インドネシア、インド、マラウイ、ナイジェリア及び日本）から18人の専門家が出席し、テーマに基づいた講演、発表、活発な討議を行った。

2010年は、「 農業および環境分野における持続的開発のための中等・高等教育の役割」をテーマに第３回目のシンポジウム（Ag-ESD Symposium 2010）を開催し、11月8日から11日までの間に８ヵ国（フィリピン、タイ、インドネシア、アフガニスタン、バングラデシュ、マラウイ、ガーナ及び日本）の専門家が出席し、講演、質疑応答を行なった。また、特に、海外交流協定校のフィリピン大学、カセサート大学、ボゴール農科大学の各附属高等学校及び本学附属坂戸高等学校の現職教員による発表セッションを組み込んで、発表、討議を活発に行った。

2011年は、「農学ESDにおける生物多様性の適正利用」をテーマに第４回目のシンポジウム（Ag-ESD Symposium 2011）を開催し、11月7日から11日までの間に９ヶ国（フィリピン、タイ、インドネシア、アフガニスタン、アメリカ合衆国、ガーナ、ケニア、マラウイ及び日本）の専門家が出席し、テーマに基づいた講演、発表、活発な討議を行った。

2012年は、「農学ESD推進のための環境調和型農業技術開発」をテーマに第５回目のシンポジウム（Ag-ESD Symposium 2012）を開催し、10月29日から11月2日までの間に９ヶ国（フィリピン、タイ、インドネシア、アフガニスタン、アメリカ合衆国、ガーナ、ケニア、ラオス及び日本）の専門家が出席し、テーマに基づいた講演、発表、活発な討議を行った。

2013年は、「農学ESDにおける大学の役割」をテーマに第６回目のシンポジウム（Ag-ESD Symposium 2013）を開催し、11月25日から29日までの間に７ヶ国（フィリピン、タイ、インドネシア、アフガニスタン、アメリカ合衆国、ケニア及び日本）の専門家が出席し、テーマに基づいた講演、発表、活発な討議を行った。

今後６年間の統一テーマを「世界的なESD実践プログラムに向けて」とし、2014年には、「農業・食料・食品のプレミアム化」をテーマとして（Ag-ESD Symposium 2014）を開催し、11月10日から14日までの間に９ヶ国（フィリピン、タイ、インドネシア、アフガニスタン、アメリカ合衆国、マレーシア、ガーナ、ザ

ンビア及び日本）の専門家が出席し、テーマに基づいた講演、発表、活発な討議を行った。各年のテーマは、次のとおりである。

2014年　「農業・食料・食品のプレミアム化」
2015年　「食料資源の有効活用と環境保全」

国際農学ESDシンポジウム 2015（ Ag-ESD Symposium 2015 ）の概要

1. 題　目

「食料資源の有効活用と環境保全」
(Food Loss and Food Waste)
〔APEID計画統一テーマ：「世界的なESD実践プログラムに向けて」
（ Ag-ESD Symposium for Global Action Program ）〕

2. 期　間

平成27年11月16日（月）～11月 20日（金）（５日間 ）

3. 会　場

筑波大学 大学会館（ 特別会議室ほか ）、農林技術センター

4. 主　催

筑波大学農林技術センター

5. 共　催

筑波大学大学院生命環境科学研究科
筑波大学生物資源学類
筑波大学北アフリカ研究センター
アジア共生社会を創成するための国際連携教育プログラム委員会
独立行政法人国際協力機構筑波国際センター（JICA筑波）
国立研究開発法人国際農林水産業研究センター（JIRCAS）

6. 後　援

文部科学省、日本ユネスコ国内委員会、茨城大学農学部

7. 参加者

- カセサート大学、ボゴール農科大学、フィリピン大学ロスバニオス校、ユタ州立大学（以上海外交流協定校）、の農学教育または農学研究に従事する教員･研究者
- アフガニスタン、プトラ大学（マレーシア）の農学教育または農学研究に従事する教員･研究者
- 筑波大学、茨城大学の農学教育または農学研究に従事する教員･研究者
- 筑波大学生命環境科学研究科「持続的農村開発（SRD）コース」の修了生
- 筑波大学大学院生、茨城大学大学院生
- 農学教育又は農学研究に従事する一般の研究者 等

8. 会議の形態

基調講演、招待講演、ポスターセッション、若手研究者フォーラム

9. 使用言語

英語

国際農学ESDシンポジウム2015（Ag-ESD Symposium 2015）の日程表

月　日	時　間	プ　ロ　グ　ラ　ム
11月15日（日）		招聘外国人の成田空港到着・宿泊　［ 成田のホテル ］
11月16日（月）	08:30～10:00	招聘外国人の出迎え（大学から成田のホテルへ）
	10:30～12:00	移動（成田から大学へ）
	12:00～13:00	昼食
	13:15～13:30	記念写真撮影（1)集合写真
	13:30～14:00	開会式（学長・センター長挨拶、来賓紹介）
	14:00～14:15	記念写真撮影（2)中庭側の外階段での撮影　［ 大学会館特別会議室 ］
	14:15～15:15	基調講演（1）【 AIT, 明治大学, 前FAO：Konuma】
	15:15～16:15	基調講演（2）【 筑波大学：Isoda 】
	16:15～17:15	受付・オリエンテーション（概要説明）
	18:00～20:00	歓迎パーティ　［ スープファクトリー ］
11月17日（火）	09:20～09:40	講演　【 農林技術センター：Asano 】
	09:40～10:20	招待講演　(1)【 筑波大学：Yoshida 】　［ 大学会館特別会議室 ］
	10:20～11:00	招待講演　(2)【 茨城大学：Miyaguchi 】
	11:00～12:15	休憩・昼食
	12:15～13:30	学生との対話（「専門語学Ⅰ」に対応）　［ 大学会館ホール ］
	13:30～14:00	休憩
	14:00～14:40	招待講演　(3)【 ボゴール農科大学：Seminar 】
	14:40～15:20	招待講演　(4)【 カセサート大学：Raungrusmee 】
	15:20～15:30	休憩　［ 大学会館特別会議室 ］
	15:30～16:10	招待講演　(5)【 フィリピン大学：Mopera 】
	16:10～16:50	招待講演　(6)【 アフガニスタン：Yousufi 】
11月18日（水）	09:00～09:40	招待講演　(7)【 マレーシア：Che Man 】
	09:40～10:20	招待講演　(8)【 ユタ州立大学：Curtis 】
	10:20～10:30	休憩　［ 大学会館特別会議室 ］
	10:30～11:10	招待講演　(9)【 ARENA：Othman 】
	11:10～11:50	招待講演　(10)【 SRDガーナ　：Nyo 】
	11:50～12:00	休憩
	12:00～	移動（中型バス）
		昼食・エクスカーション
	～18:30	移動（中型バス）　＊大学会館別館へ
11月19日（木）	09:00～13:30	ポスター 発表（昼食時間含む）　［ 総合交流会館多目的ホール ］
	13:30～15:00	坂戸高校海外活動報告
	15:00～15:30	招待講演　(11)【ルンド大学：Dejmek 】　［ 大学会館特別会議室 ］
	15:30～16:00	優秀ポスター賞等表彰式
	16:00～18:00	生物資源工学分野パラレルセッション　［ マルチメディアルーム ］
11月20日（金） （若手研究者フォーラム）	09:00～09:30	発表（1）【 茨城大学：Hoshino 】
	09:30～10:00	発表（2）【 ボゴール農科大学：Supriyanto 】
	10:00～10:30	発表（3）【 カセサート大学：Wankhade 】
	10:30～10:40	休憩　［ 大学会館特別会議室 ］
	10:40～11:10	発表（4）【 フィリピン大学：Lizardo 】
	11:10～11:40	発表（5）【 筑波大学：Matsukawa 】
	11:40～13:00	昼食・休憩
	13:00～14:00	閉会式（ 優秀発表賞等表彰式を含む ）　［ 大学会館特別会議室 ］
	14:00～18:00	フリータイム
	18:00～20:00	送別パーティ　［ スープファクトリー ］
11月21日（土）	07:00～09:00	招聘外国人の帰国（大学から成田空港へ）

国際農学ESD シンポジウム 2015

平成 27 年
11月16日（月）～11月20日（金）

「食料資源の有効活用と環境保全」
APEID 計画統一テーマ：「世界的なESD実践プログラムに向けて」

● 主　催　筑波大学農林技術センター
● 共　催　筑波大学大学院生命環境科学研究科
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アジア共生社会を創成するための国際連携教育プログラム委員会
独立行政法人国際協力機構筑波国際センター（JICA筑波）
国立研究開発法人国際農林水産業研究センター（JIRCAS）
● 後　援　文部科学省、日本ユネスコ国内委員会、茨城大学農学部
● 会　場　筑波大学 大学会館（特別会議室ほか）

国際農学ESDシンポジウム組織委員会
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