

Ag-ESD Symposium 2016/ TGSW2016

9/18~19
Sun. Mon.



Education
for
Sustainable Development
Overseas Internship / Agriculture, Food and Environment

Program & Summaries

University of Tsukuba

Contents

Message from the President	1
Message from the Director	3
Background	4
Theme and Objective	5
Program	6
List of Participants	10
Summaries for Overseas Internship Session	13
Summaries for the Young Researcher's Forum	27
Abstracts for Poster Session	37
Organizing Committee	109
Executive Committee	110
筑波アジア農業教育セミナー及びAg-ESDシンポジウムの沿革	113
Ag-ESDシンポジウム2016/TGSW2016の概要	117
Ag-ESDシンポジウム2016/TGSW2016の日程表	118

Date: September 18 (Sun.) to 19 (Mon.), 2016

Venue: Laboratory of Advanced Research A, University of Tsukuba

1-1-1 Tennodai, Tsukuba, Ibaraki, Japan

Organizer: Agricultural and Forestry Research Center, University of Tsukuba



A handwritten signature in black ink, which appears to read 'Kyosuke Nagata'. The signature is written in a cursive style on a light-colored background.

Kyosuke Nagata
President
University of Tsukuba

Dear Colleagues and Friends

It is my distinct pleasure to welcome everyone to “Ag-ESD Symposium 2016” and Tsukuba Global Science Week (TGSW) 2016, now for the 7th year running.

The history of the University of Tsukuba extends back 144 years when it was founded by the Meiji government as Japan’s first institution of higher education and premier Normal School. A little over forty years ago in October 1973, our university relocated from Tokyo to Tsukuba City where it was reborn as a comprehensive institution of higher education.

Since its establishment, the University of Tsukuba has aimed for interdisciplinary education and research and to be a university open to society and the world. In accordance with these principles, we are delighted to host TGSW, which gathers together a number of participants not only from a diverse range of academic fields, but also from many different countries. What started out as an event with a single academic discipline, TGSW 2016 now offers sessions from a wide variety of fields ranging from hard sciences to humanities with prominent researchers from over 40 different countries.

TGSW is a show case of world class researches carried out by our faculty members jointly with fellow scientists throughout the globe, including those associated with

public and quasi-public institutions based in Tsukuba Science City and our partner universities outside Japan. But TGSW is more than that. The radical transformation of a globalized society has brought about a range of global challenges – food crisis, energy issues, environmental risks, never-ending wars, poverty, and the list goes on. These could be solved only by *Trans-Border* collaboration for innovation, so that the greater community of scientists, regardless of their areas of specialty, citizenship, ethnicity, gender, faith, and world views, must get together and collaborate closely. TGSW can serve as an invaluable forum for exchanging views on how to meet those challenges in a way that defies all kinds of traditionally conceived barriers.

The University of Tsukuba, just like other higher education institutions, also confronts a range of issues. How can we stay afloat and relevant in this day and age? In particular, how can we contribute to resolve global problems, how can we attract talented individuals to our fold, the quest for external funding, just to name a few. Universities have long been used to autonomy to the extent of being insulated from society at large. TGSW offers a great chance for transcending a border between countries. We also want to break down such barriers between sectors, for instance, by seeking synergy through collaborations with government and private firms. Hence, our choice as principal theme for this year's TGSW is *Innovation and Collaboration among Industry, Government and University*. We are honored indeed to have as our keynote speakers pre-eminent experts in the area – Dr. John Davis, Dr. Yuko Harayama, and Dr. David Winwood among others.

I would like to thank all of you for your participation and hope that the range of sessions on offer will set off meaningful dialogues among yourselves. The continuing success of this conference means that planning can now proceed with confidence for the event next year.



Yooichi Kainoh
Director
Agricultural and Forestry Research Center
University of Tsukuba

It is my great pleasure to welcome you to this symposium.

The Agricultural and Forestry Research Center has conducted the Ag-ESD Symposium for the past several years, playing a role in providing a forum for international exchange. This year, the symposium focuses on human resources education through internships in the fields of agriculture, food and the environment. I hope many people will take this opportunity to discuss the role of internships for the educational development of university students.

The Agricultural and Forestry Research Center has accepted college students from Asian countries, and carried out internships through training activities in the farmlands of the Center. From now, we can provide internships in the private sector as well as at the University of Tsukuba, these private internships carry out activities while interacting with the local people for a period of time living and working together. We also plan to send Japanese students to Asian universities and private companies. We aim to train students with practical experience through such internships.

Recently, it is said that students hesitate to go overseas. I sympathize with them since getting a job is becoming more and more difficult than ever before. However, there are now a number of students from the College of Agro-Biological Resource Sciences that strongly want to study abroad, and other students that want to have a training experience abroad, we would like to support these activities. If we can find the best ways for internships under the present situations by exchanging information through discussions at this symposium, we will have achieved our goal.

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 fourth 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.

The Ag-ESD Symposium 2015 was held from November 16th to 20th and focused on “Food Loss and Food Waste”. Eighteen participants from 9 countries: Philippines, Thailand, Indonesia, Afghanistan, U.S.A, Malaysia, Sweden, Ghana, and Japan.

Theme and Objective

1) Theme

Education for Sustainable Development

Overseas Internship / Agriculture, Food and Environment

2) Objective

We report on the conditions and outcomes of training programs in the areas of food, the environment, bioresources, and food production. We use information from businesses, universities, and laboratories conducting global operations and internships overseas, particularly in Southeast Asia, a region increasingly receptive to Japanese food production technologies and with which close relationships are expected going forward. We also discuss the opinions of experts from national research institutes on new training programs for nurturing students who thrive in industry, government, and academia in the future. We draw connections with the nurturing of personnel capable of building new global innovations.

Ag-ESD Symposium 2016/TGSW2016 Program

Program of 2016 International Symposium on Agricultural Education for Sustainable Development

A Section Meeting under Tsukuba Global Science Week.

September 16 (Fri.)	Arrival at Narita Airport [Overnight stay at Hotel Nikko Narita]
September 17 (Sat.)	
08:00	Leave Hotel Nikko Narita for University of Tsukuba (By chartered Bus)
09:30	Arrival at International Congress Center (Downtown Tsukuba city)
09:30-12:30	Opening Session [International Congress Center] Industry-Government-University Collaboration & Innovation
12:30-13:30	Lunch
(13:30-16:30)	Session [International Congress Center]
15:00-15:30	Move to the " University Hall Annex " by taxi
16:00-17:00	Orientation and Registration [University Hall Annex, UT]
18:00-20:00	Welcome Party [The Soup Factory, UT]
September 18 (Sun.)	
09:30-09:45	Opening Ceremony [Laboratory of Advanced Research A, UT] Opening Addresses • Yooichi KAINOH, Director, Agricultural and Forestry Research Center (AFRC), University of Tsukuba Welcome Address • Hiroshi MATSUMOTO, Provost, Faculty of Life and Environmental Sciences, University of Tsukuba • Satoshi ASANO, Senior Assistant Director, Tsukuba International Center, Japan International Cooperation Agency (JICA) • Masayoshi SAITO, Director, Research Planning and Partnership Division, Japan International Research Center for Agricultural Sciences (JIRCAS) 【* Chairperson: Ryoza NOGUCHI 】 Group Photograph
	Overseas Internship Session
09:45-10:15	Invited Lecture (1) [Laboratory of Advanced Research A, UT] • Kaori ABE, Programme Officer, Food and Agriculture Organization of the UN ◇ Topic: “Internship at FAO: A Unique Experience in a UN Work Environment ” 【* Chairperson: Atsushi Tajima 】

- 10:15-10:45 **Invited Lecture (2)** [Laboratory of Advanced Research A, UT]
 • Maria Cynthia OLIVEROS, Associate Professor, University of the Philippines Los Baños
 ◇ Topic: “ Capacity Development in Agro-Bioresource through International Internship Program: The UPLB Experience ”
 【 * Chairperson: Internship Student 】
- 10:45-11:00 Break
- 11:00-11:30 **Invited Lecture (3)** [Laboratory of Advanced Research A, UT]
 • Sutkhet NAKASATHIEN, Dean and Assistant Professor, Kasetsart University
 ◇ Topic: “ Internationalizing Our Faculty to the World Class Agriculture Ranking: Lessons Learned from FOA, Kasetsart University ”
 【 * Chairperson: Internship Student 】
- 11:30-12:00 **Invited Lecture (4)** [Laboratory of Advanced Research A, UT]
 • Purwiyatno HARIYADI, Professor, Bogor Agricultural University
 ◇ Topic: “ Local Community Education for Sustainable Food Security ”
 【 * Chairperson: Internship Student 】
- 12:00-13:00 Lunch and Break
- 13:00-13:30 **Invited Lecture (5)** [Laboratory of Advanced Research A, UT]
 • David HOLE, Professor, Utah State University
 ◇ Topic: “ Cross Pollinating Ideas: Research Internships and Exchanges at Utah State University ”
 【 * Chairperson: Internship Student 】
- 13:30-14:00 **Invited Lecture (6)** [Laboratory of Advanced Research A, UT]
 • Aya FUJITA, JICA Expert in Pakistan / Economist Consultant, Asia Engineering Consultant Co., Ltd.
 ◇ Topic: “ Impact of Overseas Field-based Internship on Career Design ”
 【 * Chairperson: Internship Student 】
- 14:00-14:30 **Invited Lecture (7)** [Laboratory of Advanced Research A, UT]
 • Tatsuo SATO, Associate Professor, Ibaraki University
 ◇ Topic: “ Joining Community Service Activity as an Internship Program in Java Island ”
 【 * Chairperson: Internship Student 】
- 14:30-14:45 Break
- 14:45-15:15 **Invited Lecture (8)** [Laboratory of Advanced Research A, UT]
 • Kunio TSUBOTA, Professor, Meiji University
 ◇ Topic: “ Model UN Conference at FAORAP: a Step forward to Overseas Internship ”
 【 * Chairperson: Internship Student 】

- 15:15-15:45 **Invited Lecture (9)** [Laboratory of Advanced Research A, UT]
 • Nakao NOMURA, Associate Professor, University of Tsukuba
 ◇ Topic: “ Internship Program Related with Development of Global Human Resources in University of Tsukuba ”
 【 * Chairperson: Internship Student 】
- 15:45-16:00 Break
- 16:00-16:25 **General Discussion** [Laboratory of Advanced Research A, UT]
 【 * Chairperson: Hiroyuki KONUMA, Professor, Meiji University 】
- 16:25-16:30 **Closing Remarks**
 • Hisayoshi HAYASHI, Vice Director, Agricultural and Forestry Research Center (AFRC), University of Tsukuba

November 19 (Mon.)

- 09:00-12:00 **Poster Session** [Laboratory of Advanced Research A, UT]
 • Student Presentation
- 12:00-13:00 Lunch and Break
- Young Researcher’s Forum**
- 13:00-13:30 **Presentation (1)** [Laboratory of Advanced Research A, UT]
 • Nur Akbar AROFATULLAH, PhD Student, United Graduate School of Agricultural Science, Tokyo University of Agriculture and Technology (Ibaraki University)
 ◇ Topic: “ Introduction of Open Platform Ubiquitous Environment Control System (UECS-Pi) for Greenhouse Management and Agricultural Research Activities ”
 【 * Chairperson: Takumaru HISATOME 】
- 13:30-14:00 **Presentation (2)** [Laboratory of Advanced Research A, UT]
 • Annisa Utami SEMINAR, Graduate Students, Bogor Agricultural University
 ◇ Topic: “ Agroecology Education within Farmer’s Community Towards Food Sovereignty ”
 【 * Chairperson: Nur Akbar AROFATULLAH 】
- 14:00-14:30 **Presentation (3)** [Laboratory of Advanced Research A, UT]
 • Yanika TONTHONG, Master degree student, Kasetsart University
 ◇ Topic: “ Germination and Storability of Germinated Rice (*Oryza sativa* L.) Seed Left Over from the Previous Broadcasting ”
 【 * Chairperson: Annisa Utami SEMINAR 】
- 14:30-14:40 Break

List of Participants

【Opening Address】

Yooichi KAINOH

Director, Agricultural and Forestry Research Center, University of Tsukuba

【Welcome Address】

Hiroshi MATSUMOTO

Provost, Faculty of Life and Environmental Sciences,
University of Tsukuba

Satoshi ASANO

Senior Assistant Director,
Tsukuba International Center, Japan International Cooperation Agency (JICA)

Masayoshi SAITO

Director, Research Planning and Partnership Division,
Japan International Research Center for Agricultural Sciences (JIRCAS)

【Overseas Internship Session】

Invited Lecturer

Kaori ABE

Programme Officer, Food and Agriculture Organization of the UN

Maria Cynthia OLIVEROS

Associate Professor, University of the Philippines, Los Baños **【Philippines】**

Sutkhet NAKASATHIEN

Dean and Assistant Professor, Kasetsart University **【Thailand】**

Purwiyatno HARIYADI

Professor, Bogor Agricultural University **【Indonesia】**

David HOLE

Professor, Utah State University **【USA】**

Aya FUJITA

JICA Expert in Pakistan / Economist Consultant
Asia Engineering Consultant Co., Ltd. **【Japan】**

Tatsuo SATO
Associate Professor, Ibaraki University 【Japan】

Kunio TSUBOTA
Professor, Meiji University 【Japan】

Nakao NOMURA
Associate Professor, University of Tsukuba 【Japan】

Makoto HISHIDA
Section Manager, Recruiting Group, Human Resources Dept.
Kubota Corporation 【Japan】

Chairperson in General Discussion

Hiroyuki KONUMA
Professor, Organization for International Collaboration Director,
Meiji University ASEAN Center 【Japan】

【Young Researcher's Forum】

Presenter

Nur Akbar AROFATULLAH
PhD Student, United Graduate School of Agricultural Science, Tokyo University of
Agriculture and Technology (Ibaraki University) 【Japan】

Annisa Utami SEMINAR
Graduate Students, Bogor Agricultural University 【Indonesia】

Yanika TONTHONG
Master degree student, Kasetsart University 【Thailand】

Maricel Arcega TAPIA
Assistant Professor 1, University of the Philippines, Los Baños 【Philippines】

Takumaru HISATOME
Master Student, University of Tsukuba 【Japan】

**Summaries
for Overseas Internship Session**

Contributors

【Overseas Internship Session】

- **Kaori ABE** < *Food and Agriculture Organization of the United Nations* >

Internship at FAO: A Unique Experience in a UN Work Environment17

[Invited Lecturers from the Universities sharing Academic Exchange Agreements with the University of Tsukuba]

- **Maria Cynthia OLIVEROS** < *University of the Philippines, Los Baños* >

Capacity Development in Agro-Bioresource through International Internship Program: The UPLB Experience18

- **Sutkhet NAKASATHIEN** < *Kasetsart University* >

Internationalizing Our Faculty to the World Class Agriculture Ranking: Lessons Learned from FOA, Kasetsart University19

- **Purwiyatno HARIYADI** < *Bogor Agricultural University* >

Local Community Education for Sustainable Food Security20

- **David HOLE** < *Utah State University* >

Cross Pollinating Ideas: Research Internships and Exchanges at Utah State University21

- **Aya FUJITA** < *Asia Engineering Consultant Co., Ltd.* >

Impact of Overseas Field-based Internship on Career Design22

- **Tatsuo SATO** < *Ibaraki University* >

Joining Community Service Activity as an Internship Program in Java Island23

• **Kunio TSUBOTA**

< *Meiji University* >

Model UN Conference at FAORAP: a Step forward to Overseas Internship24

• **Nakao NOMURA**

< *University of Tsukuba* >

Internship Program Related with Development of Global Human Resources in
University of Tsukuba25

• **Makoto HISHIDA**

< *Kubota Corporation* >

Introducing Kubota26



Kaori ABE

Programme Officer (Partnership and Resource Mobilization)
Regional Office for Asia and the Pacific
Food and Agriculture Organization of the United Nations
Bangkok, Thailand
Email: kaori.abe@fao.org
Specialty: resource mobilization, partnership

Internship at FAO: A Unique Experience in a UN Work Environment

Are you interested in working for an International Organization?

Are you willing to embark on a challenging opportunity that will enrich your personal as well as your professional experience?

If so, consider applying for an internship at FAO. The Organization offers several options within its Headquarters and its decentralized offices worldwide to provide hands-on opportunities for students or young graduates to learn more about what FAO does.

FAO's internship programme is an initiative targeted for talented, highly qualified students and young graduates who would like to learn what FAO does. Under the supervision of a staff member, interns work with international and national staff and are involved in the identification, design, implementation, monitoring and evaluation of FAO activities. Purposes of assignments vary and may have a country-specific, regional, sector-based or thematic focus.

FAO is the UN's specialized agency working on areas of agriculture, food security and nutrition. Improvement in these areas is important to lift millions of people living in developing countries from malnutrition, food insecurity and chronic poverty. Achieving food security for all is at the heart of FAO's efforts – to make sure people have regular access to enough high-quality food to lead active, healthy lives.

FAO creates and shares critical information about food, agriculture and natural resources in the form of global public goods. We play a connector role, through identifying and working with different partners with established expertise, and facilitating a dialogue between those who have the knowledge and those who need it.

For students and young graduates studied in the field of agriculture, food related technologies, natural resource management, it would be a great opportunity to experience how those global public goods are created, being shared and a dialogue being facilitated globally, regionally as well nationally.



Maria Cynthia OLIVEROS

Associate Professor, College of Agriculture
University of the Philippines Los Baños, College, Laguna,
Philippines
Email: mroliveros1@up.edu.ph
Specialty: Animal Production and Animal Products Processing

Capacity Development in Agro-Bioresource through International Internship Program: The UPLB Experience

The University of the Philippines Los Baños (UPLB) is one of the constituent units of the University of the Philippines System. It was first established as the UP College of Agriculture in 1909. It has grown and expanded through the century and is now offering various undergraduate and graduate programs. UPLB's College of Agriculture (UPLB-CA) is a premier institution of higher learning in agriculture and food sciences that promotes the development of a robust agriculture and industry that meets the challenges of food security and safety, poverty alleviation, climate change impact mitigation and environmental sustainability. It is recognized by the Philippine Commission on Higher Education (CHED) as the Center of Excellence in Agricultural Education. UPLB is an active supporter of the enhancement of agriculture graduate programs because of the increasing demand for graduates, particularly in the field of agriculture.

One of the strategic initiatives taken by UP System is the intensification of internationalization and formalization of quality assurance in education. UPLB's strategic plan is composed of two processes: internationalization of the home university and internationalization abroad. The former is being addressed by academic program revisions, recruitment of international faculty, researchers, students and scholars, as well as development of the appropriate infrastructure and upgrading of research laboratories.

The increase in academic mobility programs and research collaboration, and establishing joint degree programs are just some of the measures taken to attain internationalization abroad. An increase in student mobility for the last four years has been noted. Moreover, UPLB has signed agreements with partner universities abroad for the institution of joint and dual degree programs through PhD by Research. It is currently hosting a satellite campus of a foreign university and implementing the Transnational PhD Research Programs in Bio-agricultural Sciences and International Development. The offering of international postgraduate course in Food and Nutrition Security and Sustainable Development in Southeast Asia for credit transfer is already in the planning stage.

The benefits from student mobility are better employment opportunities, career advancement and development of graduates with core competencies that are better suited to the needs of the ASEAN integration.

UPLB commit to take the leadership in the development of a globally competitive educational system that will uphold the tradition of honor and excellence. While we foresee difficulties ahead, we fully take the challenge of internationalization as we believe that as UPLB becomes more and more active in the international arena, the quality of higher education in the Philippines will be uplifted and will redound to better education for Filipinos in the future.



Sutkhet NAKASATHIEN

Dean and Assistant Professor, Faculty of Agriculture,
Kasetsart University
E-mail: agrddj@ku.ac.th

Internationalizing Our Faculty to the World Class Agriculture Ranking: Lessons Learned from FOA, Kasetsart University

This session aims to share information on the Faculty of Agriculture, Kasetsart University, regarding its policy and practice of internationalization. It will start with some examples of successful collaboration efforts in early years with universities, higher education organizations, and other related institutions in the U.S.A., Europe, Asia and other continents. With the designated role as one of the National Research Universities by the Thai government, Kasetsart University has celebrated its 73rd anniversary this year with its continuous growth in overall capacity. For international recognition, Kasetsart University is positioned among the world's top universities for agriculture and forestry, ranked first in ASEAN, fourth in Asia, and 47th in the world with the QS World University Rankings by Subject 2016. The session will consequently focus on how we have met the major ranking criteria, i.e. reputation, publications, and citations, followed by our ongoing attempts to climb up this ranking system, as well as other reliable university ranking systems. Recognizing that the exchange of students, researchers and teaching staff is another key parameter to be assessed, the Faculty of Agriculture has maintained strong partnerships with world-class institutions, and has also worked together with potential partners, particularly those who share missions and international goals with us. All these valuable academic and industrial networks at regional, continental and global scales will continue to be strengthened for the benefit of our future generations who will keep on fighting for greener, cleaner, and thus better agriculture in our country and the world.



Purwiyatno HARIYADI

Professor, Department of Food Science and Technology
Bogor Agricultural University
E-mail: phariyadi@ipb.ac.id
Specialty: Food Process Engineering

Local Community Education for Sustainable Food Security

Food security has been defined as a condition when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life. This definition indicates that the main indicator for food secured country is the number of individual with healthy and active life. Report of the FAO (the State of Food Insecurity in the World (FAO, 2015) indicated that, globally, about 795 million people are undernourished every day, and about 2 billion people lacking the nutrients. This condition is a direct reflection of the global food security condition; hindering individual to have a healthy and active life. Furthermore, rapid growing of world population, coupled decreasing quantity (area) and quality (suitability and fertility) of land provide even more challenge for food security.

In the case of Indonesia, considering the nature of bio-resources, food security should be developed utilizing its abundant and rich variety local food resources. Food security should be strengthen by promoting food diversification, not only to reduce dependency on only a few (one or two) food commodities -especially rice in the case of Indonesia- but also increase variety of food consumption improving the quality of nutritional intake.

Indonesia is rich in local and/or regional foods. Many of those regional foods are locally unique and indigenous in nature. Furthermore, many of them have been traditionally produced by micro, small and medium enterprises (MSMEs) at local community. It is apparent that food MSMEs throughout Indonesia is naturally a driving force for food diversification. However; to be more widely accepted, input of appropriate technology is needed to provide better value of foods for the consumers. Consequently, there is a need to develop local community education support program for the MSMEs; to contribute more toward food diversification, leading to better food security. This paper will illustrate local community education for sustainable food security in Bogor, West Java, Indonesia.



David HOLE

Professor, Plants, Soils, and Climate, Utah State University

2325 Old Main Hill, Logan, UT 84322 USA

E-mail: david.hole@usu.edu

Specialty: Plant breeding/Genetics

Cross Pollinating Ideas: Research Internships and Exchanges at Utah State University

Very few research universities in the US have specific budgets for international exchanges. Yet there are many prospects for infusing current agricultural research with vibrant new ideas. Historically the US recognized the value of participating in international exchanges for research and education, but budgets for these types of activities have long been shrinking. It is now necessary to be more creative in generating opportunities for research exchanges. Utah State University has no formal program for exchanging students or scholars for internship or work experiences. However, many universities are able to generate immigration forms for J-1 visas that allow short term internship programs. It is necessary to individually tailor each internship program, and that becomes the bottleneck in expanding these internships.

A number of productive research internships in agriculture between The University of Tsukuba, Kasetsart University, and Utah State University, with students travelling each direction, has demonstrated the benefits to the host laboratories and to the students. In addition, the university has brokered informal work internships with local agricultural operations which give international students the opportunity to live and work on a local farm. These programs are invaluable to both the students and the host family, but are even more difficult to arrange. The main difficulties to developing these program are related to US immigration regulations. The US H-1B visa program is limited to specialty occupations for which agricultural activities rarely qualify.

By far the largest deterrent to these internships is the relatively few students who can see the value in participating in an exchange at a foreign university. Every student who has completed an international internship or exchange becomes our best ambassador to recruit new students to the program. Our biggest challenge is to nurture those students and provide them resources and avenues for them to use to recruit new students to these exchanges.



Aya FUJITA

JICA Expert in Pakistan / Economist Consultant

Asia Engineering Consultant Co., Ltd. Tokyo, Japan

Email: a-fujita@aec-inc.jp (Company)

aya.fujita112@gmail.com (Private)

Specialty: Development Economics, Human Security

Impact of Overseas Field-based Internship on Career Design

The main purpose of this presentation is targeted for professors, researchers and students of the lecturers and the audience to demonstrate how overseas field-base internship affects the youth's growth in global competency significantly both academic and career building-wise, and to suggest some recommendations how academic society can expand these opportunities and assist students to make their experiences more effective and bigger impact on individuals as well as society.

The presentation consists of three sections: i) introduction of my academic and career path, and internship experience, ii) how significant overseas field-base internship while in school is to build up career path especially in international cooperation, and finally iii) what it takes to seize a unique and best-fit overseas experience and what it takes to improve those experience more effective.

The first section focuses on introduction of one case of myself, how I became a Japan International Cooperation Agency (JICA) Expert, which is one of a few limited paths of international cooperation job soon after graduating from university. My field internship experience related with human security including food security in Food and Agriculture Organization of United Nations (FAO), Pakistan office will be introduced in this section.

Citing the actual experience introduced briefly in the previous section, how influential overseas field-base internship in undergraduate students' future is described in the second section. Before participating in internship, what outputs and outcomes can be expected in terms of academic work and career designing should be visualized by both intern students and their professors.

The final section reviews what components can contribute to expanding opportunities and more fruitful overseas internship experience for undergraduate students from lessons learnt by voices of experience with lots of hope for the future human resource development supported by stronger partnership between academia and industry.



Tatsuo SATO

Associate Professor

Field Science Center, College of Agriculture, Ibaraki University
Ami4668-1, Ami, Inashiki, Ibaraki, 300-0331

E-mail: sugar@mx.ibaraki.ac.jp

Specialty: Agricultural Production Technology

Joining Community Service Activity as an Internship Program in Java Island

What we can do when we meet another culture in the world? We have to find problems, transmit our opinion, discuss the matter, reach a conclusion and do by ourselves. In 2012, Japanese Federation of Economic Organizations had a questionnaire to the participating companies about main point for fresh person's recruitment. 582 companies answered and the best five were 1. Communication ability, 2. Autonomy, 3. Challenging spirit, 4. Cooperativeness, and 5. Sincerity. The personality companies require is quite same as the thesis described above. Thus, Ibaraki University (IU) started an internship program at a rural village in Java island, Indonesia as a collaboration with Universitas Gadjah Mada (UGM) in 2013. "Kuliah Kerja Nyata – Pembelajaran Pemberdayaan Masyarakat (KKN-PPM; Student Community Services – Community Empowerment Learning)" is one of the required subject in UGM which conducted by research based program on community service using multidisciplinary approach method.

During KKN-PPM, students organize small groups and stay two months to conduct community empowering activities in rural areas in Indonesia. Together with UGM student's, IU students stay at villager's home and share approximately one week for support activity of strawberry production, improvement of living condition, and social-cultural exchange. All projects are planned and executed only by students. The collaboration starts three months before departure. Video meeting via "Skype" is effective for exchanging information and discussion smoothly. Students are divided into small sub groups consists of less than ten members and conduct several projects mainly. As an illustration, Strawberry production seminar, soil improvement, water and soil analysis, food processing, Japanese class, Origami, hand washing practice and tooth brushing practice were held for producers, housewives and schoolchildren until now. In almost case, everything never goes on so smoothly and students have to improve the contents on site based on the condition. Students sometimes have to substitute materials which they could get at the site when they couldn't find it around the village. Hence discussion and preparation continues until midnight every day. Although in KKN-PPM sites almost everything (food, religion, custom, etc) is different from Japan, IU students could manage to communicate with the host family day by day.

Around ten students from IU participating this program every year, and for half of them this opportunity is a first experience to visit foreign country. Many IU participants reported about the diligence and highly conscious of UGM students and reflection about their lack of effort including language skill. Though it is impossible to change our personality within only one week, many students felt they succeeded to relate to the foreign people beyond the invisible wall such as language, religion, culture and age after various collaboration.



Kunio TSUBOTA

Professor, department of agriculture
Meiji University, Kawasaki-city, Japan
E-mail: kuniorome@yahoo.co.jp
Specialty: Agricultural economics

Model UN Conference at FAORAP: a Step forward to Overseas Internship

For ordinary Japanese students who hesitate even for local internship, overseas internship is beyond their imagination. Many factors lie behind but language barrier and lack of overseas experience are the single largest reasons. The agriculture department of Meiji university launched a pilot program in 2012 to provide ordinary students with opportunities to feel and learn the reality of overseas agriculture and people's way of life. The program includes several components such as meetings and discussions with Thai students, visits to local markets and food processing companies and a model UN conference in FAORAP. Last 3 year experience indicates that the model UN conference would be a most effective means to let students move forward to the international carrier development. Through its preparation process, teams of multidisciplinary students learn themselves major challenges that food and agriculture in the selected country faces and consider themselves possible solutions. In the conference, they chair the meetings and make presentations and discussions. All are done in English in collaboration with students from two Thai universities. It often happens that students, who could speak only few words in English 4 month before, actively participate in the conference discussions. They look more confident themselves, become more interested in international affairs, and start thinking of overseas education. Although the model UN conference requires intensive and prudent support from university staff as well as full collaboration with UN agencies and other universities, it should be worth trying.



Nakao NOMURA

Associate Professor, Section of Planning and Coordination,
Global Commons Organization
Faculty of Life and Environmental Sciences
University of Tsukuba, Japan
E-mail: nomura.nakao.fa@u.tsukuba.ac.jp
Specialty: Bioprocess Engineering

Internship Program Related with Development of Global Human Resources in University of Tsukuba

It has been more than a decade since ‘internship’ was used in higher education in Japan. The term ‘internship’ is nowadays widely used for several kinds of educational activities which covers beyond original meaning in Japan. Therefore, MEXT (Ministry of Education Culture, Sports, Science and Technology, Japan) published a definition of internship for Japanese higher education in 2009. In Japan, Internship is usually designed for human resource development in line with demand from public and private sectors. Those sectors usually provides space and expertise for university students. One of the most important concepts for human resource development is nurturing students who could contribute global society, as called global human resources. In University of Tsukuba, there are several programs for development of global human resources as international internship. One program conducted throughout university is UN volunteer program. This program provides students with working experience for 6-month in one of UN organization which is located in developing countries. For agricultural education, College of Agro-Biological Resource Sciences has been offering related courses called Agricultural Internship Abroad. Agricultural Internship Abroad has 4 courses (I – IV) depending on the location where program are conducted. The programs in Asian, Japan, Europe and North America region are designated Agricultural Internship Abroad I, II, III and IV, respectively. Every year, more than 40 college students register the courses under Agricultural Internship Abroad and obtain international experiences. All of the participating students utilized knowledge and learning points from the courses for their career development. Some students decide 1-semester or 1-year exchange program abroad to deepen their learning points. There are some students interested in applying for double-degree program established by cooperation of University of Tsukuba and host universities.



Makoto HISHIDA

Section Manager, Recruiting Group, Human Resources Dept.
Kubota Corporation, Osaka, Osaka, Japan
E-mail: makoto.hishida@kubota.com
Specialty: HR

Introducing Kubota

Corporate Information

The KUBOTA Group has numerous products that are leading the market in both Japan and throughout the world. This is a solid proof that we are trusted by the market and our users. The KUBOTA Group will continue striving to maintain its position as a corporate group that pursues the trust and convenience of its users by offering products, technologies and services with unwavering quality and performance.

1) **Agricultural machinery:** Since the food shortage following World War 2, KUBOTA has contributed to the evolution of Japan's agricultural industry and produced agricultural machinery focused on rice cultivation that ensures customers' trust through the solid technology and quality. As a leading company in the domestic agricultural machinery market—tractors, combine harvesters, rice trans-planters—KUBOTA is the driving force behind streamlining and labor-savings in the agricultural industry. Moreover, in Asia, North America and Europe, our products are also used in numerous applications in addition to farming. From Japan to the world, from rice-growing to upland field farming, KUBOTA Group continues to advance in leaps and bounds.

2) **Engines:** Our engines satisfy the requirements of exhaust regulations in countries around the world. The KUBOTA Group holds the world's top share for industrial diesel engines with displacements of less than 100hp.

3) **Construction machinery:** Our small construction machinery plays a major role in urban infrastructure development, etc. KUBOTA Group holds the world's top share in the compact excavators' category (6t or less).

4) **Pipe systems and water treatment facilities:** Represented by the iron water pipes passed down from the founder as its core business, KUBOTA is a comprehensive manufacturer of water-related products that take part in the intake of water to its discharge, including major products such as pumps, valves and water treatment facilities. Within Japan, in addition to our flagship iron pipes, we have made several accomplishments as a top brand in the water treatment field.

Vision of Desired Human Resources

KUBOTA, as a company that contributes to society with products, technology and services that resolves issues relating to food, water and environment. We are recruiting a person who has the eagerness to find a solution for creating a better tomorrow.

Let's take a walk together and carry out our promise "For Earth, For Life".



**Summaries
for Young Researcher's Forum**

Contributors

【Young Researcher's Forum】

- **Nur Akbar AROFATULLAH** *< United Graduate School
of Agricultural Science, Tokyo University of Agriculture and Technology (Ibaraki University) >*

Introduction of Open Platform Ubiquitous Environment Control System
(UECS-Pi) for Greenhouse Management and Agricultural Research
Activities31

- **Annisa Utami SEMINAR** *< Bogor Agricultural University >*

Agroecology Education within Farmer's Community Towards Food
Sovereignty32

- **Yanika TONTHONG** *< Kasetsart University >*

Germination and Storability of Germinated Rice (*Oryza sativa* L.) Seed Left Over
from the Previous Broadcasting33

- **Maricel Arcega TAPIA** *< University of the Philippines, Los Baños >*

Cost-Benefit Analysis and Impacts of Conventional Farming, Organic Farming
and Coffee-based Agroforestry System on the Ecosystem Services of Mts.
Banahaw-San Cristobal Protected Landscape, Philippines34

- **Takumaru HISATOME** *< University of Tsukuba >*

Suppressive Effect of Ashitaba Components on Endothelium Senescence and its
Molecular Mechanism Involved35



Nur Akbar AROFATULLAH

PhD Student, United Graduate School of Agricultural Science,
Tokyo University of Agriculture and Technology
Field Science Center, College of Agriculture,
Ibaraki University, Ami 4668-1, Ami, Inashiki, Ibaraki 300-0331,
Japan
E-mail: akbar1708@gmail.com
Specialty: Plant Biotechnology

Introduction of Open Platform Ubiquitous Environment Control System (UECS-Pi) for Greenhouse Management and Agricultural Research Activities

The existence of low powered microcontroller unit (MCU) and credit card-sized single-board computers (SBC) give a huge opportunity for the development of a generic energy efficient lab equipment and environmental monitoring hardware. In Japan, Ubiquitous Environment Control System (UECS) were established as a standard agreement of a system for greenhouse management based on commercially available low cost MCU and SBC. Various software and hardware which incorporating UECS standard has been developed. UECS-Pi is one of the example of software works on Raspberry Pi SBC created by WaBit company in which the free basic model was available for the public to build a Do-It Yourself (DIY) inexpensive greenhouse management system.

For attaining sustainable production in greenhouse, saving energy is the most essential demand. Efficient energy consumption and maximal crop productivity can be achieved through an optimal greenhouse climate management. For this purpose, precision environmental control system is effective. However, high initial cost, complexity and lack of versatility have prevented to introduce such system, especially in small scale greenhouse. UECS-Pi could be an affordable solution, the system is designed to use a variety of generic sensor and a detailed manual for hardware production were provided by WaBit. Furthermore, UECS-Pi system communicates using Common Corresponding Message (UECS-CCM) which creates the possibility for expanding the basic function to build an autonomous distributed integrated environmental control system, not only for controlling greenhouse but also in agricultural research. The purpose of this project is to introduce the UECS-Pi system at Ibaraki University greenhouse facility. Real time monitoring of greenhouse environment could be performed with the system and therefore, more efficient crop cultivation could be obtained.

We produce the DIY version of UECS-Pi basic according to WaBit manual. With the flexible UECS-Pi basic software, we could connect UECS-Pi Basic hardware with inexpensive Arduino MCU based multichannel thermocouple data logger and sensor expander. By combining SBC based UECS-Pi with Arduino, it was possible to increase the UECS-Pi basic capability to read multiple sensor with reasonable production cost. In addition to the continuous greenhouse monitoring and automation, UECS-Pi with expanded sensor system could also be used for experimental data collection.



Annisa Utami SEMINAR

Graduate Students, Department of Development Communication
for Rural and Agricultural Society
Bogor Agricultural University, Bogor, Indonesia
E-mail: seminar_annisa@apps.ipb.ac.id
Specialty: International communication

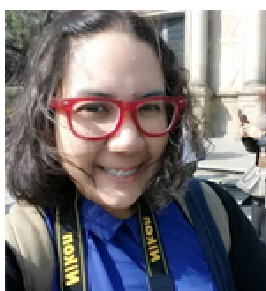
Agroecology Education within Farmer's Community Towards Food Sovereignty

Food sovereignty is an alternative approach attempting to resolve food crisis which the world is facing today. Food sovereignty emphasizes small-scale farmers as main actors in a food and agricultural system. It encourages small-scale farmers to fully participate in the decision-making process of national or international agreement regarding food and agriculture system, so it will benefit and empower small-scale farmers.

Food sovereignty aspires to bring back the food and agriculture system to a domestic level, which gives freedom to small-scale farmers in producing foods fitting to their knowledge and experience that suited with local conditions. Agroecology is a management approach to achieve a sustainable agriculture ecosystem utilizing local resources, local wisdom and farmer's local knowledge in producing foods. Thus, agroecology minimizes production cost, increases the quality and quantity of foods, and gives small-scale farmers more benefit.

Knowledge-sharing as an education theory for explaining farmer-to-farmer ways of learning explained that there are three requirements for an effective learning process: (1) a public space to share knowledge and experience, (2) provision of opportunities for every participant to share and exchange their knowledge, views, and experience, and (3) the need to enhance their competencies. Agroecology approach has already been practiced, maintained, and disseminated within farmer's community in the grassroots level, and shows promising results. It was proved that by practicing agroecology, farmers produced more foods and gain more benefit, meaning agroecology could be one of the answers for food crisis.

Farmer's knowledge and experience are very vital in food and agriculture policy making. Thus, by recognizing their knowledge and their learning process, a fair participatory food and agricultural system can be achieved, an idea that food sovereignty has strived for. This paper focuses on describing the knowledge-sharing process about agroecology within farmer's community towards achieving food sovereignty.



Yanika TONTHONG

Master degree student, Department of Agronomy,
Faculty of Agriculture, Kasetsart University,
Bangkok, Thailand

E-mail: patty_house_1@hotmail.com

Specialty: Seed Science and Technology

Germination and Storability of Germinated Rice (*Oryza sativa* L.) Seed Left Over from the Previous Broadcasting

In rice growing areas where wetland broadcasting is practiced, farmers always face a problem with seed loss from the left-over of germinated seed prepared for broadcasting. However, there is a possibility to reuse this left-over germinated rice seeds if they possess desiccation tolerance ability. Therefore, the objectives of this research were to evaluate the desiccation tolerance and the storability of germinated seed of rice cv. Supan Buri 1. Rice seeds were prepared to germinate by soaking for 24 hours and then incubated for different periods of time, i.e. 0 (hydropriming), 12, 24, 36 to 48 hours comparing with the untreated control. After soaking and incubating, the seed was dried back to 12% moisture content and stored at room temperature and Chamber (13°C). Spilt Plot design (CRD) with 4 replications was employed. The results showed that the germinated-rice seed had the ability to tolerate desiccation and could be stored for a period of time. Before storage (week 0), the germination percentages of all treatments were higher than 88% indicating that the germinated-rice seeds left over from previous broadcastings could be dried and reused as planting materials. At 1 week of storage, the germination percentages of all treatments decreased but still higher than 85% at room temperature and Chamber. At week 6, the germination percentages of the untreated control and the other treatments; soaking for 24 hours plus incubating for 0, 12, 24, 36 and 48 hours stored at room temperature were 90.25, 92.00, 81.00, 80.00, 76.75 and 75.00%, respectively but the treatments stored at chamber still had germination percentage higher than 80% were 91.25, 93.75, 83.75, 82.5, 80.75 and 80%, respectively. At week 7, the germination percentages of the untreated control and soaking for 24 hours without incubating stored at room temperature and chamber and treatments were soaking for 24 hours plus incubating for 12, 24 hours stored at chamber still had germination percentage higher than 80% At week 8, only the untreated control and soaking for 24 hours without incubating that maintained the germination higher than 80%, all the rests of the treatments had germination lower than 70%. Therefore, it can be concluded that the germinated-rice seed prepared following the farmers' normal practice by soaking for 24 hours plus incubating for 12-24 hours could be dried back and stored for 6 weeks at room temperature and 7 weeks at chamber with the germination percentage higher than 80%. This indicates that the germinated-rice seeds left over from the previous broadcasting are desiccation tolerant and can be stored and reused as planting materials after storing at room temperature for 6 weeks and 7 weeks at chamber.



Maricel Arcega TAPIA

Assistant Professor 1, Department of Social Forestry and Forest Governance, College of Forestry and Natural Resources, University of the Philippines Los Baños College, Laguna 4030, Philippines
Email: matapia@up.edu.ph
Specialty: Social Forestry; Climate Change Adaptation

Cost-Benefit Analysis and Impacts of Conventional Farming, Organic Farming and Coffee-based Agroforestry System on the Ecosystem Services of Mts. Banahaw-San Cristobal Protected Landscape, Philippines

Reconciling protection and economic objectives has been considered as incompatible activities in areas inhabited by communities before its declaration as a protected landscape. The same difficulty confronts the Mts. Banahaw-San Cristobal Protected Landscape (MBSCPL), which had been proclaimed as a forest reserve, and later on as a protected landscape to ensure its protection and conservation. The MBSCPL is valued not only for its ecological and economic services but also for its cultural and religious importance. However, the increasing population engaged in intensive agricultural activities in the area has posed negative threats on the ecological integrity of, and sustainability of services provided by MBSCPL.

The farming community (Brgy. Kinabuhayan, Dolores, Quezon), located within the protected area, is the study site on the cost-benefit analysis to assess the impacts of agricultural activities on the ecosystem services of MBSCPL. The potential shifts to sustainable agricultural activities such as organic farming (Option 1) and coffee-based agroforestry system (Option 2) were explored, and their impacts on the MBSCPL were investigated.

A total of 53 household respondents were interviewed in Brgy. Kinabuhayan. Their farming practices were considered conventional, with adverse ecological impacts of intensive agriculture, such as high incidence of pests, soil acidity, and water scarcity upstream and downstream. Net income was calculated at PhP 92,436 per hectare. On the other hand, impacts on ecosystem services (biodiversity/habitat losses, incidence of pests, impacts of pesticides on birds and insects, water used for production, water quality, soil acidity and nutrient loss) were valued at PhP 204,930.42 per hectare.

Shifting to Option 1 and Option 2 would result to net incomes of PhP 126,879.02 and PhP 395,046.00 per hectare, respectively. Organic farming has the highest benefit-cost ratio (BCR) in terms of farm productivity (output less input) at 7.24, followed by conventional farming (4.91) and agroforestry (1.61). Considering the impacts on ecosystem services, however, only coffee-based agroforestry system (Option 2) had BCR greater than one (i.e., 2.37) and a positive net present value (NPV) at PhP 343,214 per hectare.

The coffee-based agroforestry system that balances ecological integrity and meeting the needs of the communities is recommended. Farmers, however, are quite reluctant to adopt the production system due to the long waiting time in realizing the benefits and the substantial financial requirement for its development. Intensive information, education and communication (IEC) campaign and technical and financial support are therefore recommended to support and encourage communities to adopt this production system.



Takumaru HISATOME

Master Student, Graduate School of Life and Environmental Sciences

University of Tsukuba, Tsukuba, Ibaraki, Japan

E-mail: s1421108@u.tsukuba.ac.jp

Specialty: Food Functional Science

Suppressive Effect of Ashitaba Components on Endothelium Senescence and its Molecular Mechanism Involved

Accumulating evidence indicates that the senescence of vein is closely related to aging. In fact, blood pressure rises with age and the ratio of vascular diseases causing death also gets higher with age. Various kinds of stresses in our daily life generate reactive oxygen species (ROS) in the body and ROS causes the senescence of vein by inducing endothelium senescence. Angelica keiskei, also called Ashitaba, is an edible vegetable that is native to Japan. Several components of Ashitaba are known to be beneficial for health. Although xanthoangelol (XA) and 4-hydroxyderricin (4HD), which are unique components of Ashitaba, exhibit an antioxidative activity, their effect on endothelium senescence has not yet been reported. In this study, we investigated whether XA and 4HD can suppress H₂O₂-induced senescence of porcine endothelial cells and also elucidated their signaling pathway involved.

Senescence-associated β -galactosidase staining was used for measuring the ratio of senescent cells. Pretreatment and aftertreatment of the cells with XA or 4HD suppressed H₂O₂-induced endothelium senescence. Besides, western blotting revealed that both XA and 4HD increased the expression level of Sirt1, catalase, and Forkhead box O3a (FoxO3a). Catalase is a typical antioxidative enzyme whose expression is regulated by the transcription factor FoxO3a. Also, Sirt1 is known to deacetylate and inactivate the senescence related protein p53. These data suggest that XA and 4HD suppress endothelium senescence through the reduction of ROS level by catalase and through the deacetylation of p53 by Sirt1 although further investigation is necessary.

The present report is the first to show the suppression of endothelium senescence by Ashitaba components. We believe that the present study will provide a new insight into the suppression of senescence by food.

**Abstracts
for Poster Session**

Contributors

◇ Doctor course

Amira CHERIF

Molecular Characterization of Phylogenetic Relationships between Three *Mayetiola* Species (Diptera: Cecidomyiidae)45

Xiaohong HU

Optimization of H₂ and O₂ Generation in Water-splitting Process by P/Ag/Ag₂O/Ag₃PO₄/TiO₂ Photocatalyst under Solar Light46

Md. Monjurul ISLAM

Suitability Mapping for Crop Production Sites Using GIS and Multicriteria Analysis47

Md Zohurul ISLAM

Physical Properties and Stability of Vacuum Spray Dried Micro Wet Milled Orange Juice with Pulp Powder48

Dheni M. MALA

Indirect Method for Microbial Growth Prediction on Meat by Fluorescence Fingerprint49

Nazia MUHSIN

GIS-based MCA Modeling to Asses Agriculture Land Use Changes in Bangladesh -Locating Suitable Sites for Industries-.....50

Muhammad Ansori NASUTION

Preliminary Design and Optimization Hydrothermal Liquefaction Process of Micro-Algae Pure Material Model for Bio-oil Production51

Sri Imriani PULUNGAN

Characterization of the *Curly Leaf* Tomato Mutant and its Role in Leaf Morphogenesis52

Riska Ayu PURNAMASARI

Assessments of Cassava Production Using MODIS Satellite Remote Sensing and GIS53

Mishma S. STANISLAUS

Photocatalysis as a Novel Pretreatment Method of Microalgal Biomass for Enhanced Biohydrogen Production54

Fu Hsuan TSAI

Optimization of Liquid-core Hydrogel Bead Loaded with Functional Compounds of Radish By-products by Reverse Spherification55

Dhani S. WIBAWA	
Dynamic Material and Energy Flow of Algae Oil Production	56
Yohei YAMANAKA	
Formulation of W/O/W Emulsions Coated by Dietary Fibers Using Layer-by-Layer Deposition	57
Yan ZHANG	
Development of an Autonomous Rescue System for Agricultural Machinery Operators Using Machine Vision	58
Qi ZHU	
Enhancement of P/Ag/Ag ₂ O/Ag ₃ PO ₄ /TiO ₂ Solar-light-driven Photocatalyst by Hydrothermal Method	59
◇ <u>Master course</u>	
Haidar Rafid AZIS	
Formulation of Algal Seed Coatings as Potential Growth Stimulator	60
Zetao DONG	
Synthesization of PEG Modified P/Ag/Ag ₂ O/Ag ₃ PO ₄ /TiO ₂ Photocatalyst	61
Jing DU	
Feasibility Study of Developing Motor Powered Tractor, Based on Basic Physical Rationality	62
Wuren hasi FNU	
Dihydroxyacetone (dha) Production by Acetic Acid Bacteria and Improvement of DHA and EPA Concentration for <i>Euglena</i> to Substrate Using Dihydroxyacetone	63
Haoyuan GAO	
Study on Mitigating Ammonia Inhibition of Anaerobic Digestion with Intermittent Illumination under Mesophilic Condition	64
Risa HARA	
Discriminant Analysis based on Lycopene Content of Intact Tomatoes by Peak Occurrence in Raman Spectra	65
Mizuki INABA	
Effect of Large-Scale Fertilization of Phosphorus and Nitrogen on Grassland Productivity and Total Phosphorus Content in Plant in Inner Mongolia, China	66
Hana ISHIZAKI	
Preventive Effect of Jerusalem Artichoke on Heat-induced Infertility	67
Mizuho KONDOU	
Possible Mechanisms for Functional Maturation of Mammalian Sperm during Epididymal Transit	68

Ghaibulna ABDOL LAJIS Detection of Basal Stem Rot (BSR) Disease of Oil Palm Using Thermal Image Acquisition Sensor	69
Grace R. LARA Acidic Treatment of Fresh Cut Lotus Root (<i>Nelumbo nucifera</i>) for Enhancing Quality Parameters During Storage	70
Meitong LI Effects of Adding Enzymes in the Process of Dry Aging with Dry Aging Bag in Beef	71
Na LIU Effects of Experiment Conditions on the Inactivation of <i>Escherichia coli</i> Using P/Ag/Ag ₂ O/Ag ₃ PO ₄ /TiO ₂ Photocatalyst under LED Irradiation	72
Qiansu MA Preparation of Ag-based Bi ₂ WO ₆ Thin Film on Glass Substrate with Enhanced Photocatalytic Activity for Decomposition of Organic Dye	73
Siti Dian MARDIYANI Paper or Tablet? - Media Effect on Visual Awareness Performance of Elementary Schoolers	74
Nobuyuki MATSUNAMI Process Development for Effective Lipid Extraction from Microalgae (<i>Chlorella vulgaris</i>) by Micro Wet Milling	75
Kasumi MATSUO Evaluation of Energy Efficiency of Batch Type Hydrothermal Liquefaction for Indigenous Microalgae Lipid Extraction	76
Rubaiya Binte MOSTAFIZ Yield Gap Analysis of Rice Production Using MODIS Satellite Time Series Vegetation Datasets and GIS	77
Ryo NOGUCHI Effects of Coating Methods of Palm Oil on Dissolution Rate of Urea <i>in vitro</i>	78
Julius NWEZE Isolation and Evaluation of Xylose-Fermenting Thermotolerant Yeasts for Bioethanol Production	79
Sumika OGO Fungal Species and N Sources Affect on Accumulation of Cesium, Rubidium, and Potassium by Fungi	80
Yuki SAITO Characteristics of Lactic Acid Fermentation in Soy Milk Mixed with Brown Rice	81

Shoichiro SUZUKI Effects of Feeding Ashitaba (<i>Angelica keiskei</i>) on Somatic Cell Count in Milk, Milk Yield and Body Weight of Dairy Cattle under Heat Stress	82
Saki TANIGUCHI Characteristics of Dry Matter Yields and Chemical Composition in Ratoons of Three NERICA (New Rice for Africa) Cultivars	83
Ai USHIYAMA Improvement in Fertilizing Ability of Chicken Sperm Incorporated with Sterols after Cryopreservation	84
Michael WAMBUA Development of a Sweet Potato Lacto Juice	85
Youmei WANG The Processing of Mulberry Powder by Use of Micro Wet Milling System and Spray Drying Technology	86
Sakkrapong WANNAWATTANA Spray Drying of Tomato Fruit Towards the Production of an Edible Vaccine Against Influenza	87
Atsushi YAMAGUCHI Investigation of Interparticle Force between Silica Particles Covered with Lysozymes by Yield Stress Measurement	88
Mitsuki YAMAUCHI Gene Polymorphism in Buckwheat Major Allergen, Fag e 2	89
Abdullah YOUSUFI Effects of 1-MCP Treatment on Fuji Apple in 10 Degree Celsius	90
Wang YUXIN Formulation and Characterization of Highly-concentrated Maslinic Acid Nanodispersions Stabilized by Different Homogenization Pressures	91
Nan ZHANG Semi-continuous Anaerobic Digestion with Ammonia-rich Substrate under Intermittent Illumination Condition	92
Chenyu ZHAO Optimization of the Fixed-bed Reactor by Identifying the Optimal Bedding Material and Substrate Concentration	93

◇ **Undergraduate course**

Takanori HIRANUMA

Development of a Novel Zeolite Absorbent Modified by Shell to Improve Methane Production94

Yuto ISHIZUMI

Search of Effective Wavelength to Measure Ethanol in Strawberry by Non-destructive Method Using NIR and MIR Spectroscopy95

Yukino ITO

Analysis of Frozen Food in Melting Process Using NIR Spectroscopy96

Kazuma IWAI

Effect of Combustion Condition on the Amount of Eluted Soluble Silica in Rice Husk Charcoal97

Sota MATSUMOTO

Formulation and Characterization of Oil-in-water Emulsions Stabilized by Different Types of Carrageenan98

Takahiro MITSUI

Effect of Plant Hormones on Spikelet Sterility of Rice at High Temperatures99

Daichi NAGAI

Comparing the Water Splitting Efficiency by Using Different Temperature of Hydrothermal Synthesis of Photocatalytic Composite under Solar Light 100

Asuka NAKANO

Development and Characterization of Gluten-free Bread by Rice Gel and Rice Milk 101

Kai SAKURAI

Diffusion Simulation of Free Silicic Acid from the Rice Husk Combustion Furnace 102

Rei TAKAHASHI

Effects of Protein Addition on Lactic Acid Fermentation of Rice Milk 103

Eri TAKAI

Evaluation of Wet Aging Effects on Breaking Strength, Water Holding Capacity and Flavor Component of Beef from Three Parts 104

Masato TANAKA

Non-Destructive Analysis of Lutein in Spinach Using Raman Spectroscopy 105

Molecular Characterization of Phylogenetic Relationships between Three *Mayetiola* Species (Diptera: Cecidomyiidae)

Amira CHERIF^{1,2,3}, Jouda MEDIOUNI BEN JEMÂA³ and DeMar TAYLOR¹

¹ Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

² National Agronomic Institute of Tunisia (INAT), University of Carthage, Tunis, Tunisia

³ Laboratory of Biotechnology Applied to Agriculture, National Agricultural Research Institute of Tunisia (INRAT), University of Carthage, Tunis, Tunisia

Cereal midges are considered as the most destructive pests of wheat, barley and oat in most cereal areas of the world. These insects cause significant economic losses to cereals sometimes leading to destruction of an entire crop.

Some species from the genus *Mayetiola* (Diptera: Cecidomyiidae) have been observed in the main cereal culture areas in Tunisia. Two of these species have been identified and investigated: *Mayetiola destructor* that mainly attacks wheat and can infest barley too, and *Mayetiola hordei* that attacks barley. A third species of midges has been observed in oat: *Mayetiola avenae*. Despite, the last species having similar importance to the above two species in terms of frequency, abundance and damage; *M. avenae* has not been studied and is not well documented in Tunisia. Some researchers report that oat is colonized by the two first species of midges, and no other species of *Mayetiola* can be detected. Therefore, a method to easily separate the species at any stage of development is needed to clarify the occurrences of these midge species.

This study aimed to first distinguish between the three species of midges by a molecular characterization and second to reveal phylogenetic relationships within and between these species of *Mayetiola* collected from 5 different regions of northern Tunisia. To achieve these purposes, a region of the cytochrome oxidase subunit I (COI) gene of mitochondrial DNA, commonly used to reveal genetic diversity between gall midges, was amplified by polymerase chain reaction (PCR) and sequenced. A set of 75 individuals, 5 from each species, was used for DNA analysis. Three pairs of primers were tested for the amplification. Only one pair of primers allowed us to distinguish between the different species. The phylogenetic tree created using the different sequences of DNA, clearly showed significant separation of the three different species into dissimilar clades. Each clade contained only specimens from the same species. No phylogenetic differences were detected between samples of the same species collected from different locations. Our results indicate this area of the COI gene can be used as a marker to reveal genetic diversity between species of *Mayetiola*.

Key Words: *Mayetiola*, COI gene, PCR, DNA analysis, Phylogenetic tree

Optimization of H₂ and O₂ Generation in Water-splitting Process by P/Ag/Ag₂O/Ag₃PO₄/TiO₂ Photocatalyst under Solar Light

Xiaohong HU¹, Hangxing SHEN¹, Qi ZHU¹ and Yingnan YANG²

¹Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

²Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

Overall water-splitting using solar energy has received enormous remark as production of renewable hydrogen from water on a large scale. Photocatalytic water-splitting by semiconductors has been researched widely since 1970's. In our previous study, P/Ag/Ag₂O/Ag₃PO₄/TiO₂ was prepared by a reproducible method, and showed high photocatalytic efficiency for Rhodamine B (Rh B) degradation due to its strong absorption band in visible-light region and high separation efficiency of photo excited electron-hole pairs. Therefore, in order to identify the possibility of water splitting by P/Ag/Ag₂O/Ag₃PO₄/TiO₂ powder under simulated solar irradiation, the accumulated amount of oxygen and hydrogen evolution from Rh B and methanol solution was investigated under different conditions.

The results showed that generation of oxygen by P/Ag/Ag₂O/Ag₃PO₄/TiO₂ was confirmed using gas collected system. For generating O₂, Rh B solution showed better performance than pure water. And the overall water-splitting process has been achieved by methanol solution. Using the mixture of Rh B and methanol solution, the highest accumulated gas was achieved when methanol percentage was 20%, Rh B concentration was 1 ppm and the dosage of P/Ag/Ag₂O/Ag₃PO₄/TiO₂ powder was 0.1 g/L. Therefore, P/Ag/Ag₂O/Ag₃PO₄/TiO₂ photocatalyst could be the candidate for photocatalytic water splitting.

Suitability Mapping for Crop Production Sites Using GIS and Multicriteria Analysis

Md. Monjurul ISLAM¹, Tofael AHAMED² and Ryozo NOGUCHI²

¹ Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

² Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

Food security is not just an economic problem but also a social and political issue in as much as food insecurity is a factor to create political instability in the country. Ensuring food security for all is one of the major challenges that Bangladesh faces today. Despite significant achievements in food grain production and food availability, food security at national, household and individual levels remains a matter of major concern of the Government.

Bangladesh has made significant progress in increasing domestic production of food grains. Adequate food availability however was not a sufficient condition for ensuring national food security. Around 21% of the population is considered food insecure. Crop yield gap is regarded as one of the greatest challenge for the northern part of Bangladesh. Yield gaps exist in different crops ranging 20% to 60% in Bangladesh. According to the recent study, the yield gap in rice was estimated at 1.74 t/ha. The existence of yield gaps was observed not only in rice but also in mustard, wheat and maize. Therefore, the aim of the study was to estimate the yield gap of major field crops, identify the yield gap areas and finally, propose the most suitable areas for crop production in the central of northern part. Land suitability analysis is a prerequisite to achieving optimum utilization of the available land resources. Lack of knowledge on best combination of factors that suit production of rice has contributed to the low production. To fulfil the research objective, a multi-criteria analysis was done and produced a suitable map for crop production with the help of Geographical Information System (GIS) and Analytical Hierarchy Process (AHP). Primary and secondary data were collected from ground truth information and sub-districts offices and MODIS satellite databases of vegetation indices provided by USGS. The suitable sites were identified using spatial analysis and compared with the recent raster image from Google Earth Pro® to validate the reliability of suitability analysis. The suitability levels for each factor were ranked based on the structure of FAO land suitability classification as: Not Suitable(N), Marginal Suitable (S4), Moderately Suitable (S3), Suitable (S2) and Very Suitable(S1).

An AHP Process was used to rank the various suitability factors and the resulting weights were used to construct the suitability map layers using weighted sum overlay tool in ArcGIS 10.3® platforms. Then, the suitability map for crop production in the study area was formed. Accordingly, 4.1% (5194 ha) of study area was highly suitable, while 24.3% (58757 ha) was suitable, 43.4% (104941 ha) was moderately suitable and 4.2% (10156 ha) was marginally suitable for rice production. On the other hand, 24% (58032 ha) was not suitable which occupied with river, water body, forest and settlement. This result will help to most suitable fields to practice rice production, thus the yield gap will decline and food security ensure to the greater extend. This research provided information at local level that could be used by farmers to select cropping patterns and land suitability for different field crops.

Keywords: Land Suitability, Spatial Analysis, GIS, AHP, MODIS Vegetation Indices

Physical Properties and Stability of Vacuum Spray Dried Micro Wet Milled Orange Juice with Pulp Powder

Md Zohurul ISLAM¹, Yutaka KITAMURA², and Mito KOKAWA²

¹Graduate School of Life and Environmental Sciences, University of Tsukuba, Japan

²Faculty of Life and Environmental Sciences, University of Tsukuba, Japan

The aim of this study was to produce concentrated orange juice powders by the application of two new techniques, namely Micro-Wet Milling (MWM) and Vacuum spray drying (VSD) process. MWM of orange juice with pulp made the particle sizes smaller (40-50 μ m) which increased the nutritional content and antioxidant potential of the concentrated juice. VSD process was conducted at low temperature (40-60 $^{\circ}$ C) drying powderization of concentrated juice using superheated steam (200 $^{\circ}$ C) as a heating medium and maltodextrin (10DE) as a carrier. The effects of VSD on physical properties of MWM orange juice with four different weight ratios of juice solids to maltodextrin solids; 60:40, 50:50, 40:60 and 30:70 were investigated. The obtained powders were analyzed for moisture content, water activity (a_w), bulk density, hygroscopicity, and particle size and distributions. The solubility and degree of caking showed better quality with the increasing of maltodextrin solids, whereas color parameters showed opposite trends. Among all powders, ratio of 30:70 showed the maximum glass transition temperature (T_g) (82.25 \pm 1.13 $^{\circ}$ C). The VSD showed satisfactory cyclone recovery of powders, ranging from 58.76 to 66.78% and highest total recovery is about 82% obtained from OJ/MD 30:70 powder. Ascorbic acid, total polyphenol, total flavonoid and antioxidant activity of the VSD MWM orange juice and powders was measured before and after drying. The VSD powders retained a higher amount of ascorbic acid, total phenolic content (TPC) and total flavonoid content (TFC) than conventional spray drying.

In order to find the critical storage conditions for stability of VSD MWM orange juice powders, sorption isotherm (GAB) model, and glass transition temperature (T_g , $^{\circ}$ C) (Gordon Taylor model and Khalloufi model) data were plotted as a function of water activity and moisture content, which were obtained considering the ambient temperature of 25 $^{\circ}$ C. The critical water content and/or water activity are the value at which the glass transition temperature is equal to the ambient temperature and when the temperature is higher than glass transition temperature, the quality of foodstuffs seriously altered. Sorption isotherm of VSD orange juice powders followed type III (J-shape) behavior, typical of sugar-rich products and VSD orange powders showed monolayer moisture content in the ranges between 0.04-0.09 gH₂O/g dry solid. The critical water activities of all the powders varied from 0.61 to 0.52 and moisture content from 0.11 to 0.08 g/g of dry solid. VSD powder produced with higher juice solids are susceptible to deterioration, due to its lower critical water activity as well as moisture content. When OJ/MD (60:40) powders stored at a relative humidity higher than 52% (at 25 $^{\circ}$ C) or at a higher temperature (at a_w = 0.52), the powder will suffer physical transformations such as collapse, stickiness and caking. We conclude that the combination of MWM and VSD showed a great potential in the food industry for the production of fruit juice powders and results generated provide valuable information for predicting the stability and suitable storage conditions of VSD MWM orange juice powders.

Keywords: Orange Juice powder, Glass Transition Temperature, Micro Wet Milling, Critical Water activity and Water content

Indirect Method for Microbial Growth Prediction on Meat by Fluorescence Fingerprint

Dheni M. MALA^{1,3*}, Mizuki TSUTA², Susumu KAWASAKI², Masatoshi YOSHIMURA², Mito KOKAWA², Ryoko AIYAMA², Junichi SUGIYAMA², Yutaka KITAMURA¹

¹Graduate School of Life and Environmental Sciences, University of Tsukuba

²National Food Research Institute (NFRI), NARO

³Center for Agro-based Industry, Ministry of Industry of Indonesia

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.

Our previous research shows an appropriate Aerobic Plate Count (APC) prediction 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 val and RMSEP of 0.813 and 0.881 log CFU/cm², respectively. Variable importance of projection (VIP) comes from several wavelength regions related to three kind of intrinsic fluorophores (Tryptophan, NAD(P)H, Porphyrins, and Flavin).

However, 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. In this study, we propose a novel indirect method for microbial growth based on the metabolism or fluorophores trace collected by swabbing the beef surface.

Meat samples (beef and pork) were purchased from a local store. Samples were stored in an incubator at 15 °C and analyzed until 72 hours of storage. The surface of the meat were wiped with a sterile swab. After swabbing, the cotton swab were dilute with a buffer solution. Buffer solutions were used for obtaining microbial load data. FF as explanation variable were obtained by fluorescence spectrophotometer F7000 (Hitachi-High-Technologies, Japan). The FF data obtained after the buffer solution filtered using 0.45 μm and 0.22 μm in order to separate bacterial cell and beef residues. The PLS regression model was developed to estimates an aerobic plate count (APC) from FF.

The PLSR to predict APC on the surface of meat from FF has a R^2 and RMSECV of 0.88 and 0.5 log CFU/cm², respectively. Validation of PLSR model shows the model is robust with RMSEP 0.52 CFU/cm². Microbial load prediction of beef and pork has a different VIP. However, all of the intrinsic fluorophore show a high VIP score, which mean the bacterial growth highly related to fluorophores metabolism.

The microbial growth were not only the multiplication of bacterial cells but also nutrient consumption and metabolites excretions. This results shows FF had an ability to explain the microbial growth with the change of metabolites.

GIS-based MCA Modeling to Asses Agriculture Land Use Changes in Bangladesh -Locating Suitable Sites for Industries-

Nazia MUHSIN¹, Tofael AHAMED², Ryozo NOGUCHI², Tomohiro TAKIGAWA²

¹Graduate School of Life and Environmental Sciences, University of Tsukuba, Japan

²Faculty of Life and Environmental Science, University of Tsukuba, Japan

Land use changes have significant impacts on sustainability of food security, ecological balance and environmental protections in the developing countries. Bangladesh, holding the 10th position for the population density in the world (1033.5/km²), facing the same challenges with limited arable land resources. Studies referred that the agricultural land of Bangladesh is decreasing. The Rio + 20: National Report on Sustainable Development also mentioned that Bangladesh is losing 1% of agricultural land every year for non-agricultural purposes [1]. The loss of agricultural land and increasing land area for urbanization and industrialization certainly indicates unsustainable land use practice. The industries are expanding from the city areas to suburb areas occupying agricultural lands resulting a major challenge for food production in the long run. Due to the lack of availability of land, NSAPR II's (National Strategy for Accelerated Poverty Reduction II) emphasized on efficient land markets and developing modern economic zones for better land use management and to achieve environmentally and socially compliant industrialization [2]. Thus, there is a need for searching land sites for economic zones to expand industries.

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 (LSA). Geographical Information System (GIS) based multi-criteria analysis (MCA) was used for the LSA to find out compact lands suitable for economic zone of industries. In addition, to emphasis on expert's opinion for the decision making process of LSA, analytical hierarchy process (AHP) was used as a multi-criteria technique. The study found, the densely located industrial areas had loss more than 10% of agricultural lands in last two decades. Further, LSA for expanding industries found only 5% of land was most suitable for industrial sites whereas only one compact land of 150 ha was suggested for industrial zone.

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

References

- [1] Bangladesh Ministry of Environment and Forests, (2012). Bangladesh Rio + 20: National Report on Sustainable Development, May 2012.
- [2] Planning Commission (2009). Steps Towards Change-National Strategy for Accelerated Poverty Reduction II (Revised). FY 2009-11. Government Peoples Republic of Bangladesh, Dhaka.

Preliminary Design and Optimization Hydrothermal Liquefaction Process of Micro-Algae Pure Material Model for Bio-oil Production

Muhammad Ansori NASUTION^{1,2}, Ryozo NOGUCHI¹, Mitsutoshi NAKAJIMA¹

and Sosaku ICHIKAWA¹

¹Faculty of Life and Environmental Sciences, university of Tsukuba, 305-8577 Japan

²Indonesian Oil Palm Research Institute (IOPRI), Jalan Brigjend Katamso 51, Kp. Baru, P.O. Box 1103, 20158 Medan, Indonesia

Hydrothermal liquefaction (HTL) is one of some technology to produce bio-oil from biomass. HTL familiar to generate bio-oil from microalgae. HTL technology also known that it can be directly converted wet algal biomass to bio-oil, moreover avoiding the energy consumption for dewatering and drying. Major components of microalgae are lipid, protein and carbohydrate. Percentage components of microalgae is different for different type of microalgae. Each component has different condition when converting into bio-oil or other HTL product. Some microalgae have highest of lipid content or highest of protein or carbohydrate. Condition process of HTL technology known around 200-350°C, 5-15 MPa, and 10-50 min reaction time. Therefore, our studies focus on to obtain optimum HTL process condition of pure material model that were consists of microalgae component. The end of studies, we obtain the process design or mechanism for HTL according optimum conversion condition of each microalgae pure components to generate bio-crude.

In this research, only corn starch reported as a pure material of hydrocarbon model with total solid 20%. However, for lipid and protein pure material model, cooking oil and amino acid used respectively. Stainless steel high pressure reactor with volume 500 ml was used by batch process system. Temperature variation was setting at 150, 180, 200 and 250 °C. Holding time reaction was as another variation of research at 10, 20 and 30 minutes during HTL process. Distribution of mass balance, pH changing and total organic carbon (TOC) was performed to analyzed product, also existence of bio-crude in product was analyzed by think layer chromatograph (TLC). The results showed that HTL reaction at 150 °C was not occurred due to the sample still on gel form or no liquid phase on product. HTL reaction was start occurred at 180 °C. Mass percentage of soluble solid at 250 °C was lower than 200 °C but insoluble solid at 250 °C was higher than 200 °C. In the other hand, mass of insoluble solid increasing in line with increasing the temperature. This phenomenon was commensurate with carbonization process that occur at 220 °C. Generally, those result showed that pH of result was decreasing from around 5.2 to 2.2-2.4. According to TLC analyze, there was bio-crude yielded after HTL process with maximum amount 43,48% of bio-crude at 250 °C and holding time 10 minutes, which 36.81% bio-crude came from soluble solid and 6.67 % came from insoluble solid. At this condition, also lowest TOC was performed. Bio-crude that has been formed changing to gases fraction or smaller molecule if the temperature continued increasing. From the results obtained, HTL with rich carbohydrate as feed stock is most suited to process at low holding time reaction and temperature between 200-250 °C.

Characterization of the *Curly Leaf* Tomato Mutant and its Role in Leaf Morphogenesis

Sri Imriani PULUNGAN¹, Tohru ARIIZUMI¹, and Hiroshi EZURA²

¹ Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

² Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

Tomato (*Solanum lycopersicum* L.) is an economically important crop in either tropical or in temperate region. It belongs to Solanaceae family that contains a large number of important crops consumed by human beings. It is also considered as one of the main sources of nutrition to support our health. Furthermore, tomato has been selected as a model plant for genomic studies in the Solanaceae family. Recently, as a model plant, research in tomato has received much interest including organ and fruit development researches.

It has been known that formation of a normal leaf is a complex process that involves the initiation and differentiation of leaf primordia from the shoot apical meristem (SAM), specification of leaf identity, the establishment of leaf polarity, the control of cell division and expansion, and vascular pattern formation. The rates of division and elongation of cells at each stage is known to govern the final shape of plant and throughout leaf development. Most leaves are dorsoventrally (upper to bottom) flattened and develop clearly upper (adaxial) and bottom (abaxial) surface. Coordination of polarity, cell division, and auxin response is critical for morphogenesis of normal leaves and the success of plant architecture. Any imbalance of these developmental processes results in altered leaf shapes such as curly, crinkly, twisted, rolled, or shrunken leaves. The division of abaxial and adaxial is also the key of growth of the lamina. However, how the polarity is maintained remains unclear.

We are characterizing six lines of *curly leaf* (*curl*) tomato mutant which are dorsoventrally impaired of leaf flatness, exhibiting severe upward bend on transverse axis. The objectives of this study are (1) to characterize morphology, hormone, and cytology of the *curl* mutants, (2) to investigate the responsible gene controlling the mutant phenotype and to characterize its function in leaf morphogenesis. Segregation analysis and allelism test had proved that occurred mutation was monogenic recessive and all mutants were allelic. Map-based cloning had demonstrated that mutation is located in short arm of chromosome 9. The *curl* produced impaired leaf curvature, along transverse axis with high extent. By contrast, longitudinal axis remained flat. The upward curvature was initiated from the tip of leaf, followed by the middle and the basal area. In the mature leaves, all leaf had turned to curve, the highest extent was observed in the middle of leaves. In addition, the *curl* mutants showed narrower leaf and shorter petiole. What is gene mutated, cell division, adaxial-abaxial polarity, and auxin response will be investigated to dissect the complicated process of leaf morphogenesis of the *curl* mutants.

Assessments of Cassava Production Using MODIS Satellite Remote Sensing and GIS

Riska Ayu PURNAMASARI¹, Tofael AHAMED² and Ryozo NOGUCHI²

¹Graduate School of Life and Environmental Sciences, University of Tsukuba

²Faculty of Life and Environmental Sciences, University of Tsukuba

Sustainable cassava production is essential for local food development to support food security in Indonesia. Spatial issues and geographic information on areas suitable for cassava production constitute barriers for developing sustainable cassava production. In this study, a spatial model was developed to assess land suited to support sustainable cassava production. The model was divided into three stages. First, the satellite data on suitability criteria from SRTM digital images were processed, and vector data layers were used as the topography database and MODIS 250 m as the NDVI and LAI databases for Banten Province of Indonesia. Other criteria used accounted for land cover types, rainfall levels, distances from rivers, soil types and distances from roads. Next, a spatial analysis for identifying the most suitable sites for cassava development was conducted through an analysis involving Geographical Information System (GIS) and Analytical Hierarchy Process (AHP) methods. Third, a sustainability assessment was conducted from the resulting 4 classification categories according to the land suitability and time series. A suitable map for cassava production from a weighted overlay was developed, which found that 35.19% of the study area (9226 ha) was highly suitable for cassava production while 18.81% (4932 ha) was moderately suitable and 25.86% (6776 ha) was marginally suitable. On the other hand, 20.16% (5285 ha) of the land was occupied by settlements. Furthermore, we developed a multiple regression model to predict cassava yield using vegetation indices and LAI information for 250 m of spatial resolution of MODIS Terra data sets for the growing seasons of cassava.

Keywords: *AHP (Analytical Hierarchy Process), Cassava, GIS (Geographic Information System), Suitability, Sustainability.*

Photocatalysis as a Novel Pretreatment Method of Microalgal Biomass for Enhanced Biohydrogen Production

Mishma Silvia STANISLAUS¹, Nan ZHANG¹,
Chenyu ZHAO¹, Zhu QI¹ and Yingnan YANG²

¹Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

²Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

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 a few constraints. Therefore, in this research we used *Chlorella vulgaris* as microalgal 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 for the first time. Thermal, acid, alkali and ultrasonic pretreatment methods have been investigated as pretreatment methods of microalgae, but all of them are energy intensive processes. Therefore, in this research we propose to use a newly developed photocatalyst material (P/Ag/Ag₂O/Ag₃PO₄/TiO₂) with high stability for photocatalytic pretreatment of microalgal biomass, for enhanced hydrogen production

The P/Ag/Ag₂O/Ag₃PO₄/TiO₂ photocatalyst was coated on glass tubes which formed a cyclic system. The materials were passed through the system for photocatalytic degradation under simulated solar light (30-35 W/m²). On treating *Chlorella vulgaris* biomass the protein concentration increased to 4.5 times in 72 hr. The release of carbohydrate and proteins from the microalgae and cell wall destruction indicated the efficiency of photocatalytic pretreatment. Also, the SEM images showed a clear destruction of the microalgal cell wall. P/Ag/Ag₂O/Ag₃PO₄/TiO₂ photocatalyst was successful in degrading the cell wall of algae releasing the components into the solution. Also, on subjecting the photocatalytic pretreated algae to fermentation generated higher hydrogen than the algae with no pretreatment. Conclusively, P/Ag/Ag₂O/Ag₃PO₄/TiO₂ photocatalyst can serve as an appropriate material for photocatalytic pretreatment of biomass like *Chlorella*. Furthermore, photocatalysis can be used as a cost effective pretreatment method for practical application.

Optimization of Liquid-core Hydrogel Bead Loaded with Functional Compounds of Radish By-products by Reverse Spherification

F. H. TSAI¹, Yutaka KITAMURA² and Mito KOKAWA²

¹ Division of Appropriate Technology and Sciences for Sustainable Development, University of Tsukuba, 1-1-1 Tennodai, Tsukuba, Ibaraki 305-8577, Japan

² Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

Liquid-core hydrogel bead (LHB) processing is one of the encapsulations which has been used 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 a core material. A difference from basic spherification is utilizing alginate adding into calcium solution. Reverse spherification (RVS) 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 RVS. Currently, residues of radish, i.e., the leaf and the stem, are disposed of as waste during harvesting and processing create significant food waste for producers; however, these residues are edible and contain abundant dietary fiber, phenolic compounds, and total flavonoids. 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 a higher value.

The objective of this work was to process LHB by RVS with calcium lactate (CL) in order to determine its potential as a gelling agent. The effects of the first gelation time (X_1), CL concentration in the first gelation (X_2), the secondary gelation time (X_3), and the CL concentration in secondary gelation (X_4) on hardness (Y_1 , N), loading efficiency (LE, Y_2 , %), release amount of TP in stimulated stomach fluid (SGF) (Y_3 , %) and stimulated intestinal fluid (SIF) (Y_4 , %), swelling capacity (SC, Y_5 , %), and sphericity (Y_6) were evaluated. The results were optimized by response surface methodology with a central composite design.

Optimized LHB was prepared by using 0.13M CL, gelling for 23.99 min during first gelation, followed by 0.058 M CL, and gelling for 6.04 min during secondary gelation. The optimized formulation demonstrated maximum of hardness (25.5 N) and loading efficiency (85.67 %), and a minimum of polyphenol release (27.38%) in SGF. The data of response (dependent) variables were analyzed by the analysis of the variance (ANOVA) of the statistical analysis system (SAS), and fitted to a second-order polynomial equation. R^2 of equations were over 0.88. Furthermore, the lack of fitting of Y_1 , Y_2 , Y_3 , and Y_4 had no significant difference. X_1 greatly affected LE and sphericity, X_2 affected TP release in SGF and SIF, and X_4 affected hardness and SC. The results provided the optimized condition of preparing LHB by RVS.

Dynamic Material and Energy Flow of Algae Oil Production

Dhani S. WIBAWA¹, Muhammad A. NASUTION¹, Ryozo NOGUCHI²

¹ Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

² Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

Energy security is an important factor for every country. Countries in the world depend on energy to fuel its activities, such as transportation, public service, telecommunication, and even for daily activities. A threat to energy security will affect the stability of a country. The issue of fossil fuel depletion and the increasing demand for energy raise concern regarding energy security. As the response, bioenergy is being developed as an alternative to fossil fuel.

There are lots of previous research that calculate mass balance and/or LCA but they are usually using specific technology. This research develops a framework for dynamic material and energy flow in algae oil production. Algae oil production has several methodologies combination and this research will allow user to calculate potential value of the system chosen. This tool will help user outlining their preferred system and obtaining initial estimation of material and energy flow of the chosen pathway.

This research will include the cultivation, harvesting and extraction process based on pilot plant scale microalgae cultivation from University of Tsukuba. This research will not include the transportation from supplier to the site, only the usage from the site will be calculated.

This tool covers the microalgae oil system from cultivation, harvesting, extraction, until its conversion. Each stage consists of processes and each process will have their own processes. This modular design of the framework will help researcher to have rapid assessment of the entire system and while also provided flexibility on its design. In this study, cultivation need 2.06 MJ of energy per day and the harvesting process need 11.94 MJ of energy per day while the extraction process need 5.26 MJ of energy per day. The total energy demand is 19.26 MJ while the energy provided by the algae oil is 34.23 MJ thus we get the energy profit ratio (EPR) of 1.77.

Formulation of W/O/W Emulsions Coated by Dietary Fibers Using Layer-by-Layer Deposition

Yohei YAMANAKA^{1,2}, Isao KOBAYASHI¹, Marcos A. NEVES^{1,3}, Sosaku ICHIKAWA^{1,3},
Kunihiko UEMURA¹ and Mitsutoshi NAKAJIMA^{1,3}

¹ Food Engineering Division, Food Research Institute, NARO, Japan

² Graduate School of Life and Environmental Sciences, University of Tsukuba, Japan

³ Faculty of Life and Environmental Sciences, University of Tsukuba, Japan

Short-chain fatty acid (SCFA) is an important energy source for intestinal epithelial cells. SCFA prevents colon carcinogenesis and helps maintain the colonic environment. Large intestine utilizes SCFA that were produced in proximal colon as its energy source. Accordingly, delivering SCFA directly to the large intestine effectively improves the enteral environment. The water-in-oil-in-water (W/O/W emulsion is a potential carrier of SCFA to the large intestine, whereas the oil phase of W/O/W emulsion is digested by lipase in the stomach and small intestine. Therefore, it is necessary to improve stability of these W/O/W emulsions in the gastrointestinal tract.

In this study we prepared W/O/W emulsions loaded with SCFA, and attempted to improve their stability using layer-by-layer deposition of dietary fibers.

The water-in-oil (W/O) emulsion consisted of an inner water phase containing 5 wt% butyric acid and soybean oil phase containing a hydrophobic emulsifier. The weight fraction of the inner water phase was 5 wt%. W/O emulsions with a Sauter mean droplet diameter ($d_{3,2}$) of 0.4 μm were prepared using high-pressure homogenization. The W/O/W emulsion consisted of W/O emulsion dispersed in an outer water phase containing 0.5 wt% modified lecithin, and the weight fraction of the W/O phase was 20 wt%. The W/O phase was dispersed in the modified lecithin solution to prepare a W/O/W emulsion using rotor-stator homogenization.

The $d_{3,2}$ of the resultant W/O/W emulsion droplets was 16.9 μm , and their ζ -potential was -77.8 mV at pH 5. W/O/W emulsion droplets were coated alternately with chitosan (CHI) and carboxymethyl cellulose (CMC), which is driven by electrostatic interaction. The ζ -potential data indicated successful surface coating of the droplets. W/O/W emulsion droplets coated with dietary fibers were highly stable over 4 weeks. Our results demonstrated that W/O/W emulsions loaded with SCFA could be better stabilized with layer-by-layer coating using dietary fibers.

Development of an Autonomous Rescue System for Agricultural Machinery Operators Using Machine Vision

Yan ZHANG¹, Gao PENGBO¹ and Tofael AHAMED²

¹Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

²Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

Safety of aged agricultural farmers is one of the challenges to maintain the productivity in Japanese and Asian agricultural scenario. We proposed a rescue system to ensure the safety of farmer while driving in farmland. The system was divided into two major units; first, the driver monitoring system was required to recognize driver inattention status – distraction, fatigue. An image capturing Kinect sensor was installed towards the driver to monitor the driver's action in dynamic and static state of a tractor.

In the rescue system, we detected the driver inattention by driver action reorganization due to overwork and aging of farmers. We built a driver inattention action dataset, which consisted of seven driver action classes: blinking, look back, nodding, rubbing eye, look right or left, calling by phone, and yawning. The recognition of driver action was more than 90% in dynamic and static state for the seven classes. The action recognition algorithm was developed using Hankel-based Kernel Mutual Subspace method. When the driver monitoring system detected driver inattention, different countermeasures were proposed by taken to maintain driving safety, depending on the types and levels of inattention. Three levels of inattention and corresponding countermeasures were defined to evaluate the risks: first, risk level 1, danger for inappropriate behaviors (e.g., look back, look right or left and tell phone), to warn the driver that his behaviors easily cause danger; second, risk level 2, high danger (e.g., sleepy: blinking, nodding, rubbing eye and yawning), warn to driver and ask whether need transform to autonomous parking system for a rest or call emergency center; and third, risk level 3, emergency conditions (e.g., pass out), transform to autonomous parking system to auto park the vehicle to a safety place and call rescue center.

Keywords: Rescue System, Drivers Action, Risk Levels, Emergency Countermeasure

Enhancement of P/Ag/Ag₂O/Ag₃PO₄/TiO₂ Solar-light-driven Photocatalyst by Hydrothermal Method

Qi ZHU¹, Xiaohong HU¹, Mishma Silvia STANISLAUS¹, Yingnan YANG²

¹Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

²Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

Due to the rapid development of society and increasing demand, water security has become a worldwide issue. Recently, TiO₂ photocatalyst has attracted considerable interest for water purification. However, some drawbacks still hinder the practical application of TiO₂ for wastewater treatment: the fast recombination of photogenerated electron–hole pairs, large band gap energy and low utilization of visible light. Therefore, it is necessary for us to develop a modified TiO₂ photocatalyst for solving these problems.

According to our previous study, a novel P/Ag/Ag₂O/Ag₃PO₄/TiO₂ photocatalyst with relatively high photocatalytic ability and remarkable stability was prepared by sol-gel method. In this study, hydrothermal method was used for fabrication of P/Ag/Ag₂O/Ag₃PO₄/TiO₂ photocatalyst to create higher photocatalytic ability. The characteristics of the material were analyzed by X-ray Diffraction (XRD), UV-vis spectrophotometer and specific surface area (BET). The photocatalytic activity of material was evaluated by degradation of Rhodamine B, a model recalcitrant of organic waste, under simulated solar light.

From the results, compared to the TiO₂-based photocatalysts prepared by sol-gel method, hydrothermally synthesized material exhibited larger specific surface area and much higher photocatalytic activity under solar light. And the XRD and UV-vis results also suggest that the material is much more suitable for photocatalytic reaction under solar light. Therefore, the hydrothermal synthesis could be an effective way for the development of highly efficient solar-light-driven photocatalysts for water purification.

Formulation of Algal Seed Coatings as Potential Growth Stimulator

Haidar Rafid AZIS¹, Nauman KHALID^{1,2}, Makoto M. WATANABE^{1,2}, Marcos A. NEVES¹,
and Mitsutoshi NAKAJIMA^{1,2}

¹Graduate School of Life and Environmental Sciences, University of Tsukuba, Japan

²Algae Biomass and Energy System R&D Center, University of Tsukuba, Japan

Ever since Haber-Bosch process was invented, nitrogen-based fertilizer is grow rapidly and contribute towards higher plant yield and biomass. However, successive use of synthetic fertilizers posed adverse on soil microenvironment and leading the soils toward salinity and also effects the soil microbiota. The other adverse effect of synthetic fertilizers includes deterioration of environmental parameters, which over all affects the sustainable agriculture development. It is necessary to find another alternative fertilizer that can be more environmental friendly and cost-effective as well. Biofertilizers recently draw more attention as potential alternative fertilizers over chemical fertilizers. There are several types of biofertilizers like peat, dried leaves, different types of manures and the most emerging algal based fertilizers.

Algae is recognized as one of the fast growing organism that can be used as biofertilizer, since it is rich in nutrients and contains certain hormones such as *cytokinin* that can stimulate growth and induce germination. However, the information and discussion about biofertilizers from particular microalgae is still limited Therefore, the present research was carried out to gather more information about utilization of microalgae as biofertilizer in general. The aim of this research is to find out the best formulation of microalgae as a potential growth simulator, particularly as coating material to crop seeds and soil pretreatment.

Concentrated of Poly-culture microalgae (CA) at 0.78% of suspended solid was used in combination with gum arabic (GA) and bee wax (BW). Fourteen seeds of *Brassica rapa L.* were soaked in coating solution overnight and then dried at 40°C in the convection oven overnight. Five coating solutions were comprising, C₁ (CA + 0.5% GA), C₂ (CA + 0.5% BW), C₃ (CA + 0.5% GA + 0.5% BW), C₄ (CA + 0.1% BW), and C₅ (CA + 0.5% GA + 0.1% BW) were used, while Milli-Q water served as control treatment (C). Percentage of germination was observed and measured after 5 days of sowing. Another treatment includes sowing of seeds directly to the pots. Plant growth, including average plant height, width and number of leaves in each pot were measured after every 5 days. At the day 30, average shoot and root length, and fresh and dry weight from all plants were observed and measured. After every two days, about 5-10 mL of CA was sprayed to the soil then mixed prior the sowing as soil pretreatment. Afterwards, 4 untreated seeds were sowed to the soil, and pot culture experiments were performed using the same method as previously described. Results showed that coated seeds gave better result, in comparison to the control. All coated seeds from 10 out of 10 were germinated, while in case of untreated seeds only 8 were germinated. In addition, weight of sprout and length of sprout in C was 10.9 mg and 24.5 mm, respectively; in the same case C₃ gave the best result with 13.7 mg and 36.7 mm, respectively. Coated seeds increased the rate of growth better than control. C₂ treatment showed the best result among all treatments in all parameters. Fresh weight of C₂ at the day 30 was 210.0 mg, twice better than C, which was only 101.3 mg. Similar increase was found in root length, which increased to 76.5 mm in C₃, while in C it was only 33.9 mm. Algae as soil pretreatment (SP) gave superior results over untreated soil (Milli Q). The average height, width of leaves and fresh weight of plant in SP treatment at the day 30 were 48.3 mm, 38.1 mm, and 217.4 mg, respectively, while Milli-Q treated plants had only 28.5 mm, 19.8 mm and 101.3 mg, respectively. All these results strongly indicate that algae has a beneficial effect to the growth of plant and germination, either as seed coating solution or as pretreatment to the soil.

Synthesization of PEG Modified P/Ag/Ag₂O/Ag₃PO₄/TiO₂ Photocatalyst

Zetao DONG¹, Qi ZHU¹, Xiaohong HU¹ and Yingnan YANG²

¹Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

²Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

Titanium dioxide (TiO₂) is known as an important semiconductor for its distinguished properties such as high stability, non-toxicity, low cost and high photosensitivity. In spite of its advantages, TiO₂ could only be utilized under UV light in the solar spectrum. Recombination of electron-hole pairs during organic degradation was considered as another main problem. In order to overcome this problem, doping of different metal or nonmetal oxide semiconductor on the surface of TiO₂ could be a solution. This can shape new energy levels beyond the band gap which could trap photogenerated electrons from conduction band, thus hindering the recombination of electron-hole pairs. In the previous research from our lab, a facile and reproducible method was utilized to prepare P/Ag/Ag₂O/Ag₃PO₄/TiO₂ photocatalyst by doping with different metal ions. However, its instability during photocatalytic reaction was a drawback. Therefore, the stability of the material was investigated in this research.

Subsequently, Polyethylene glycol (PEG) a well-known polyether applied in chemical manufacturing was employed in this research. PEG is one of the most commonly used materials for oligomers because of its nontoxicity, high flexibility and hydrophilic nature, which could be used as a pore forming binder, dispersant and structure-directing reagent.

Sol-gel method was utilized to synthesize the photocatalyst with different molecular weight of PEG (300, 2000, and 20000) and at different dosage (0, 1.0, 0.2, 0.4, 1.0 and 1.2 g). The characterization of the PEGm-P/Ag/Ag₂O/Ag₃PO₄/TiO₂ photocatalytic powders were carried out by X-Ray diffraction (XRD), UV-vis absorption spectrophotometer and Photoluminescence spectroscopy (PL). In the aim of testing the stability, thin film experiments were designed by coating the gel material on the inner surface of glass tubes. The calcination temperature, calcination time and number of coating layers were investigated to optimize the coating condition of PEGm-P/Ag/Ag₂O/Ag₃PO₄/TiO₂ photocatalytic thin film under simulated solar light. Degradation of Rh B was used as one of the important index of evaluation of photocatalytic performance.

It is indicated that PEG2000 was the optimum molecular weight for improving the photocatalytic performance of P/Ag/Ag₂O/Ag₃PO₄/TiO₂ under simulated solar light. The optimum dosage of PEG2000 was 1.0 g. And coating PEGm-P/Ag/Ag₂O/Ag₃PO₄/TiO₂ gel in glass tubes displayed more stability than without PEG. And the optimum condition from coating experiments of PEGm-P/Ag/Ag₂O/Ag₃PO₄/TiO₂ thin film were calcination temperature of 350 °C, calcination time of 2 h and 2 coating layers. During the recycling experiments, after 10 rounds of reuse, the degradation rate of Rh B was around 97% but materials without PEG showed degradation rate of 80% for the same time.

Feasibility Study of Developing Motor Powered Tractor, Based on Basic Physical Rationality

Jing DU¹ and Ryozo NOGUCHI²

¹ Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

² Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

Reducing carbon emission was proven to be one of today's major challenges for the global industry development. Transportation sector contributes over 5 billion tons' carbon dioxide which about 20%(2 for the total carbon dioxide emission. To alleviate this situation, a lot of low carbon emission energy resource powered vehicles such as BEV (battery electric vehicle), HEV (hybrid electric vehicle), PHV (plug-in hybrid vehicle) and FCV (fuel cell vehicle) have been invented. However, only few research about applying these new technologies on agricultural machinery have been done. Can we apply these technologies on agricultural machineries is the main topic of my paper, and the feasibility is based on physical rationality.

The difference of driving parts between conventional tractor and motor powered tractor can be summarized into 3 parts: engine, energy storage medium and power drive. This study tried to find out if the conventional tractor's driving parts can be replaced by the motor driving parts, and what power range and power system are suitable to change. 3 driving plans: FC(fuel cell), RMFC(reformed methanol fuel cell) and BE(battery electric), output power from 20-100 horse power will be studied in this paper and all the data are based on the related references or commercialized products' specifications. The physical rationality is based on the weight and volume. For a specific output power and required working time, the size of each part will be decided. If the motor driving parts are lighter and smaller than conventional ones, it can be considered that the motor driving plan is possible. On the opposite, if the motor driving parts are oversize a lot, the performance also will be affected a lot, and it can be considered that the plan is not suitable.

The results showed that for FC and RMFC, if the working time is 4 hours, compared with ICE, the total weight will not change to much, and the volumes are much smaller. However, for BE the batteries weight is almost 3000kg, this may make the whole vehicle's weight over 6,000kg, while the normal weight of an ICE (John Deere 5100E) is only about 3,600kg. Thus, based on the technology we have now, a fuel cell based tractor will be more compact, and there are no technical problems to make a real one, while, for BE tractor, the battery storage technology will be the biggest barrier to achieve the manufacture.

Dihydroxyacetone (dha) Production by Acetic Acid Bacteria and Improvement of DHA and EPA Concentration for *Euglena* to Substrate Using Dihydroxyacetone

Wuren hasi FNU¹ and Yutaka KITAMURA²

¹Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

²Faculty of Life and Environmental Sciences, University of Tsukuba, Japan

Glycerol which is a by-product of Bio-Diesel Fuel (BDF) made from vegetable oil is used as a substrate of carbon source in the cultivation of acetic acid bacteria (*Gluconobacter* spp).

The bacteria produces dihydroxyacetone(dha : C₃H₆O₃). It is expected to make sure to get high concentration of ω3 oils such as DHA (Docosahexanoic acid:C₂₂H₃₂O₂) and EPA (Eicosapentaenoic acid : C₂₀H₃₀O₂) in the microalgae, *Euglena* using dha as a substrate of carbon source under the condition of heterotrophic cultivation.

The selected acetic acid was the NBRC3261(gene disruptant) and it was cultured in the bio-reactor using culture of broth such as 88.5%-83.5 5 % of pure water, 5%- 10 % of glycerol,1% of yeast extract and 0.5% of Polypeptone. The optimal yield of dha was found at the 5% of glycerol concentration. The higher glycerol concentration, 10% -15%, in the aspect of industrial economic level production of dha will be needed. For this purpose, It is tried to use a methodology of acclimation for acetic acid bacteria which are to be put into higher concentration of glycerol from 10 % to 15%.

Since only a low concentration of EPA in the cell of *Euglena* has been detected, it would be presumed that the *Euglena* could be available for another ω3 oil such as DHA in their cell. The optimal cultivation condition for production of DHA and EPA by using difference concentration of dha as a substrate of carbon source will be sought.

The high concentration of EPA and DHA being available in the *Euglena* would be used for food of human beings, feed of fish and livestock, and these ω3 oils such as EPA and DHA would play a key role in maintaining human health.

Furthermore, as this production system advances recycling use of glycerol system such as waste water treatment from BDF production, it can contribute to prevention of water and environmental pollution.

In the future, it would develop the studying metabolic path way to make EPA and DHA from small molecular of dha after the high concentration of DHA and EPA has been detected in the cell of *Euglena*.

Study on Mitigating Ammonia Inhibition of Anaerobic Digestion with Intermittent Illumination under Mesophilic Condition

Haoyuan GAO¹, Nan ZHANG¹, Mishma Silvia STANISLAUS²,
Chenyu ZHAO¹, and Yingnan YANG²

¹Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

²Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

With the growing population, the demand for meat is increasing, and the quantity of livestock waste is also on the rise. Anaerobic digestion is proved to be an effective method to deal with livestock waste. Anaerobic digestion offers numerous advantages, such as low sludge production, energy recovery, and low energy requirement. Conventionally, anaerobic digestion is operated under dark condition, but some researchers have found that optimal intermittent illumination in anaerobic digesters can increase the biogas production significantly. From the previous research of our lab, intermittent illumination can mitigate ammonia inhibition in anaerobic digestion under thermophilic condition. However, until now, few researchers focused on the anaerobic digestion coupled with intermittent illumination carried out under mesophilic condition. Therefore, the objective of this research is to investigate the intermittent illumination process for mitigating ammonia inhibition during anaerobic digestion under mesophilic condition.

Batch experiments were carried out using illuminated fixed bed bioreactors under mesophilic condition. From the results, intermittent illumination increased the methane production comparing with control (i.e. without illumination) under mesophilic condition. The ammonia inhibition could be mitigated effectively with the assistance of intermittent illumination under mesophilic condition. Moreover, the higher VS removal achieved by illuminated bioreactor proved that intermittent illumination promoted the efficiency of anaerobic digestion under mesophilic condition. Furthermore, the ATP value of microorganism in bioreactor under intermittent illumination condition was higher, which demonstrated that intermittent illumination could improve the activity of microbes. The results indicate that intermittent illumination of anaerobic digestion was effective under mesophilic condition in terms of methane production and mitigation of ammonia inhibition.

Discriminant Analysis based on Lycopene Content of Intact Tomatoes by Peak Occurrence in Raman Spectra

Risa HARA¹ and Takuma GENKAWA²

¹ Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

² Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

Health benefits by foods with functional ingredients are attracting people these days. Because the production of healthy food is increasing, many consumers have doubt if such foods contain rich-functional ingredients. Therefore, the guarantee given by the technology of easy and rapid non-destructive analysis for functional ingredient contents is highly desired.

Raman spectroscopy is a powerful tool for analysis of carotenoids in greengroceries. However, Raman spectroscopy has a challenging subject of obtaining inefficient reproducibility in Raman intensity. So there is still no practical calibration model of Raman spectroscopy, and the new measurement and analysis methods are required. In this study, we tried to make use of discriminant analysis based on the sample's concentration, instead of quantity analysis. An idea of new analysis method named Product of mean intensity ratio (PMIR) is that measuring with conditions of the limit of peak occurrence would result to a peak only in the high concentration of the sample, but not in the low concentration. PMIR aimed to distinguish high concentration from low concentration by the peak occurrence. In this study, the feasibility of discriminant analysis based on lycopene content was investigated using vegetable juice with different lycopene concentration, and then the methods was applied to intact tomatoes with different lycopene content.

In the measurement with the conditions of the limit of peak occurrence, peaks exist only in high concentration samples, but not in low concentration samples. The threshold level of peak occurrence could be adjusted by changing exposure time and laser power. In the measurement of vegetable juice, lycopene content could be distinguished successfully by PMIR with almost 90% hit ratio. Moreover, clear and strong peaks were noted for the high lycopene cultivar tomatoes, whereas, no strong peaks were observed for the intact tomatoes in the other common cultivars. High lycopene cultivar tomatoes could be distinguished successfully with 95% hit ratio based on the PMIR value. In conclusion, the feasibility of discriminant analysis based on lycopene content was investigated using a combination of PMIR and Raman spectroscopy.

Effect of Large-Scale Fertilization of Phosphorus and Nitrogen on Grassland Productivity and Total Phosphorus Content in Plant in Inner Mongolia, China

Mizuki INABA¹, Zhe GONG², Kensuke KAWAMURA³, Hai JING⁴, Masakazu GOTO⁵,
Atsushi ASANO¹, Atsushi TAJIMA¹, Naoto ISHIKAWA¹

¹ Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Ibaraki, Japan

² Graduate School for International Development and Cooperation (IDEC), Hiroshima University, Higashi-Hiroshima, Hiroshima, Japan

³ Japan International Research Center for Agricultural Sciences (JIRCAS), Tsukuba, Ibaraki, Japan

⁴ Biotechnology Research Center, Inner Mongolia Autonomous Region Academy of Agricultural and Stockbreeding Sciences, Huhhot, Inner Mongolia,

⁵ Graduate School of Bioresources, Mie University, Tsu, Mie, Japan

Although overgrazing is believed as a main cause of grassland degradation in Inner Mongolia, China, destruction of material cycle among soil, plant and livestock is suggested as the other significant factor. It was suggested that lack of phosphorus by taking out from grassland during long time could be the cause of the grassland degradation (Kasuga *et al.* 2015). Actually, productivity and total phosphorus (TP) content in plant increased by phosphorus and nitrogen fertilization (Kasuga, 2015). This study, however, was small-scale experiment with 10 × 15 m blocks. On the other hand, when degraded grassland will be restored by using fertilizer, larger scale fertilization will be needed. Therefore, this study was conducted to evaluate the effect of large-scale fertilization of phosphorus and nitrogen on grassland productivity and TP content in plant in Inner Mongolia, China.

Grassland grazed only on spring in Xilingol, Inner Mongolia was used in the present study. Three experimental blocks sized 135 × 200 m were set in the grassland. One block was divided into three treatment areas (control, low and high fertilizations [LF and HF]). Each treatment was fertilized on the surface of soil with 0, 0.92 or 1.84 g/m² of phosphate, 0, 1.36 or 2.71 g/m² of KH₂PO₄ and 0, 1.73 or 1.73 g/m² of urea, respectively. Fertilization was performed on 5th May 2014. All vegetation was cut to ground level using five quadrats in each treatment on 1st August 2014. Plant samples were dried at 110 C° for 48 h, and weighted and milled for chemical analyses. TP content in plant was determined by colorimetric reagent of the vanadomolybdate method. Statistical analysis was not possible by having failed in some fertilization.

Productivity and TP content in plant increased according to the amount of fertilizer. These results were good agreement in our previous findings (Kasuga, 2015), suggesting phosphorus in soil might be racking, also in the condition of larger grassland with wide variation of soil nutrients, plant species and landforms. Meanwhile, plant TP content in HF (0.09% DM) showed lower values than that of general grassland grasses in Japan (0.30–0.50% DM). Thus, it is needed to investigate the effect of higher level fertilization on productivity and TP content in plant.

Preventive Effect of Jerusalem Artichoke on Heat-induced Infertility

Hana ISHIZAKI¹, Takayuki YASUI¹, Daichi KOKUBU¹, Takashi SHIMIZU²,
and Hitoshi MIYAZAKI³

¹Graduate School of Life and Environmental Sciences, University of Tsukuba, Ibaraki, Japan

²Faculty of Life Science and Agriculture, Obihiro University of Agriculture and Veterinary Medicine, Hokkaido, Japan

³Faculty of Life and Environmental Sciences, University of Tsukuba, Ibaraki, Japan

During the summer, infertility is a serious problem among livestock. The number of eggs laid by chickens drop significantly, and the pigs copulated in the summer deliver lower numbers of piglets compared to those in the other seasons. Heat stress raises the level of reactive oxygen species (ROS) and induces apoptosis in ovarian granulosa cells, which leads to anovulation. The viability of granulosa cells is closely associated with follicular atresia and ovulation. In our previous studies, oleuropein in olives and Genseirin Ashitaba protected granulosa cells from heat stress-dependent apoptosis, followed by the prevention of anovulation in rats.

The Jerusalem artichoke (JA) is a species of sunflower native to eastern North America, and a polysaccharide, inulin, is the main component of this plant. The tuber of JA has been reported to have improvement effects on various diseases, but the agonist(s) responsible for these effects as well as their mechanism remain unclear. Several reports demonstrated that the tuber prevents the drop of oviposition rate induced by heat stress among chickens, but there are no reports on the leaves of JA preventing anovulation. Since inulin is a water-soluble dietary fiber and is not incorporated into the body, we consider that other components are the ones giving these beneficial effects. Components contained in the tuber are 47% inulin, whereas in the leaves only 1% of inulin is contained. The objective of the present study is to investigate whether the leaves have effects of improving heat-induced infertility. We performed the 1,1-diphenyl-2-picrylhydrazyl (DPPH) assay on leaf extract to measure radical scavenging activity, and we also examined the effects of leaf extract on cultured porcine granulosa cells and heat stress (35°C) treated Wister rats .

Leaf extract of JA showed radical scavenging activity, suppressed a heat stress-dependent decrease in the number of ovulation, and increased the expression of antioxidant enzymes in rat ovaries and porcine granulosa cells. These results provide the first evidence for leaf extract of JA to improve infertility.

Possible Mechanisms for Functional Maturation of Mammalian Sperm during Epididymal Transit

Mizuho KONDOU¹, Atsushi TAJIMA², Naoto ISHIKAWA², Atsushi ASANO²

¹ Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

² Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

Recently, idiopathic reproductive failure increases in domestic animals and human. However, most of the effort to identify mechanisms that cause it was limited to seeking a problem of female reproductive system. Recent investigation to identify biomarkers of idiopathic male infertility demonstrated the involvement of functional sperm maturation during epididymal transit. During epididymal transit, sperm take up functional proteins present in exosomes that are secreted from epididymal epithelium. Despite of its importance for sperm in the acquirement of fertilizing ability, it still remains unclear how this process orchestrates sperm functional maturation during epididymal transit. When we analyzed proteomic data of epididymal exosomes and sperm in preliminary trial, we found a possibility that Pantophysin (Pphn) might be secreted from epididymal epithelium and acquired by sperm during epididymal transit. Therefore, in this study, we examined this possibility and sought the role of Pphn in sperm functional maturation.

ICR male mice were utilized for these experiments. Epididymis was divided into caput (CT), corpus (CS) and cauda (CD) regions. RNA was extracted from them of sexually immature or mature mice and Pphn mRNA amount was quantified by semi-quantitative RT-PCR. Expression and localization of Pphn in epididymis and sperm were examined by western blot and immunostaining. Because membrane rafts play an important role in exosome-sperm interaction, its marker (G_{M1}) was localized in sperm. Possible role of Pphn was examined by co-immunoprecipitation (Co-IP) with Vesicle-associated membrane protein (VAMP) 2 and 3, membrane fusion associated proteins.

Pphn mRNA amount in epididymis decreased from CT to CD, and it was increased in CT by sexual maturation. Pphn was highly expressed in epididymal epithelium of CT relative to others. Furthermore, sperm took up Pphn during transit from CT to CD. Immunostaining for sperm showed that Pphn and G_{M1} co-localized in cytoplasmic droplet that is released just after epididymal transit. Co-IP showed that Pphn and VAMP 2 and 3 formed a complex in cytoplasmic droplet.

Taking together, our results suggest that cytoplasmic droplet of sperm flagellum takes up Pphn secreted by epididymal epithelium through membrane rafts during epididymal transit and that, Pphn might play a role in membrane fusion resulting in detachment of cytoplasmic droplet. This study would become a foundation to generate a novel treatment for idiopathic male infertility.

Detection of Basal Stem Rot (BSR) Disease of Oil Palm Using Thermal Image Acquisition Sensor

Ghaibulna ABDOL LAJIS¹, Siti Khairunniza BEJO¹ and Tofael AHAMED²

¹ Department of Biological and Agricultural Engineering, Faculty of Engineering, Universiti Putra Malaysia, Malaysia

² Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

Oil palm is one of the most important crops in Malaysia. In 2011, the oil palm industry was the fourth largest contributor to Malaysia's economy, accounting for RM 53 billion (USD 16.8 billion) of Malaysia's Gross National Income (GNI). As of 2015, oil palm plantation area in Malaysia covered up to 5,642,943 hectares. However, the oil palm plantation requires intensive care against the diseases. Basal stem rot (BSR) is one of that which reduced the yield significantly.

Basal Stem Rot (BSR), caused by *Ganoderma boninense* is known as the most destructive disease in oil palm plantations in Southeast Asia. More than 10 % of oil palm plantation areas are infected by BSR. This disease could reduce the productivity of oil palm plantations and potentially reduce the market value of palm oil in Malaysia. Early disease management of BSR could prevent production losses and reduce the use of chemicals.

This preliminary study was focused on the suitable time to capture thermal images to analyse the properties of infected and non-infected oil palm trees taken at oil palm plantations using FLIR E60 thermal camera. A total of 16 samples of oil palm trees were used. The mean, minimum, maximum and average number of image intensity in thermal images taken from trunks and canopies were extracted and analysed using Matlab image analysis environment.

Statistical analysis was done on both BSR and non-BSR to identify which time session gave significant result to differentiate non-BSR and BSR infected trees. From trunk section, both morning and afternoon session did not show any distinguishable difference. Meanwhile, for the canopy section, the afternoon session the probability distribution at 5% level was significant which meant that non-BSR trees had higher image intensity compared to BSR infected trees. The results showed that the trend in image intensity for infected and non-infected BSR not only depends on the tree sections, but also on the time taken during the image capturing process. The difference of average image intensity for non-infected BSR and BSR in the afternoon was more significant compared to the infected BSR and the trend was insignificant in the morning.

Acidic Treatment of Fresh Cut Lotus Root (*Nelumbo nucifera*) for Enhancing Quality Parameters During Storage

Grace R. LARA¹, Kunihiko UEMURA³, Nauman KHALID²
Mitsutoshi NAKAJIMA², Marcos A. NEVES²

¹Graduate School of Life and Environmental Sciences, University of Tsukuba, Japan

²Faculty of Life and Environmental Sciences, University of Tsukuba, Japan

³Food Engineering Division, Food Research Institute, NARO, Tsukuba, Japan

The Food and Agriculture Organization (FAO) has reported that there has been an increasing demand for freshly cut fruits and vegetables as these both offer convenience and freshness to consumers. Global market trends have shown that, for instance, in the United States, it was estimated that fresh cut produce sales have increased values from US\$3.3 billion in 1999 to US\$15.5 billion in 2007. However, freshly cut products are more prone to undesirable reactions such as enzymatic browning and tissue softening because of post-handling processing such as peeling and slicing preparations. Lotus root (*Nelumbo nucifera*) is widely known as an ingredient of various traditional dishes around the world. Freshly cut slices from lotus root have become popular in different countries, however, challenged by its fast rate of browning which decreases its quality. The browning is caused mainly by the polyphenol oxidase (PPO) enzyme which is only stable at a pH range of 5 to 8. In this research we evaluated the effect of acidic treatment (pH 2 and 4) on the storage stability of freshly cut lotus root considering color, texture, enzyme activity and microbial stability. The effect of acidic treatments (with pH 2 and pH 4) is important in understanding the mechanism of browning and the role of the polyphenol oxidase in catalyzing the browning reactions. 2% and 0.002% (w/v) citric acid solutions were used to prepare pH 2 and 4 solutions, respectively. The control consisted of samples without any treatment. Lotus roots were washed, peeled, sliced (5 mm thick) and immersed in acidic solutions for 2 min. Excess solution on the surfaces of the slices was dripped before packing in polyethylene bags. All treatments were performed in duplicates. The color (Konica Minolta CM-5 spectrophotometer), textural (Texture Profile Unit Analyzer) and enzymatic changes (JASCO UV-VIS spectrophotometer) were evaluated during storage at 5 °C up to 16 days.

Results have shown that samples immersed in pH 2 and pH 4 solutions were significantly lighter than control samples, between the two acidic treatments the results showed that pH 2 yielded higher L^* values. The L^* value expresses the whiteness/lightness or darkness of samples. In addition, the researchers were also interested in the effect of acidic treatments in the texture quality of the fresh cut lotus root, in terms of hardness. It was found out that there was a decreasing hardness values of all samples with increasing storage time. However, visible decrease in hardness was observed in pH 2 samples. Moreover, preliminary results of the microbial analysis have shown that both pH 2 and pH 4 treatments reduced total *Bacillus subtilis* counts. In conclusion, lowering the pH of acidic treatments to pH 2 is an effective strategy in improving the storage stability of fresh cut lotus root. However, pH is not sufficient to enhance the quality fresh cut lotus root; rather it is further recommended that the effect of pH can be intensified with the effect of other strategies, such as lowering oxygen levels.

Effects of Adding Enzymes in the Process of Dry Aging with Dry Aging Bag in Beef

Meitong LI¹ and Yutaka KITAMURA²

¹ Graduate school of Food Quality and Safety, China Jiliang University, China

² Faculty of Life and Environmental Science, University of Tsukuba, Japan

Dry aging beef is a process whereby meat stored at refrigeration temperatures for one to five weeks, the natural enzymatic and biochemical processes result in improving tenderness and the development of the unique flavor. With aging process, the growth of microorganisms will be inhibited, water-holding capacity will be recovered, and protein will be decomposed, leading the meat taste tender.

The process changes beef by two means. Firstly, moisture is evaporated from the muscle. The resulting process of desiccation creates a greater concentration of beef flavour and taste. Secondly, the beef's natural enzymes break down the connective tissue in the muscle, which leads to more tender beef.

The main purpose of this study is to find out if we can shorten the dry aging process or improve the beef quality by adding the proteolytic enzymes or yeast. And with adding the additional microorganism, it is necessary to monitoring the aging condition by determine the pH, water-holding capacity, aerobic plate count, texture and etc. of the aging beef.

For the pre-experiment, we decided to use sirloin(the part of meat associated with adipose tissue, and easy to get the whole part) which is provided from hanamasa.

The initial aging condition will be set as follow:(1) days of aging:0~4weeks,(2) storage temperature:0~4°C, (3) relative humidity:70%~90%,(4) air flow:0.5~2m/sec.

Before putting the materials into dry aging vacuum packing bag, apply a proper amount of proteolytic enzymes on the beef surface. And then put the sample into the special refrigerator which can adjust the aging condition. As time goes on, the characteristics both on the surface and inner part of the beef will be change in pH, water-holding capacity, aerobic plate count, texture and etc. By determine these data, we can tell the changes among the materials between using enzymes and not. The data will be detected by every week(from 0~4weeks). Furthermore, with applying the enzymes in the aging process, we can change the parameters like relative humidity and air flow to adjust best condition for aging process.

Effects of Experiment Conditions on the Inactivation of *Escherichia coli* Using P/Ag/Ag₂O/Ag₃PO₄/TiO₂ Photocatalyst under LED Irradiation

Na LIU¹, Qi ZHU¹, Nobuaki NEGISHI² and Yingnan YANG³

¹Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

²Environment Management Research Institute, AIST, Tsukuba, Japan

³Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

Growing number of population around the world have caused an increase in clean drinking water problems. In developing countries, more than 50% of the people are exposed to polluted water sources. Many water sources are not only polluted by hazardous chemicals but also by pathogenic microorganisms and therefore, have to be disinfected before use. The conventional water disinfection methods including chlorination, ozonation and ultraviolet, are effective against most pathogens. Unfortunately, all of these methods have some disadvantages, including high cost and by products. For example, a number of biohazards are naturally resistant to traditional UV and chlorination treatments; the toxic and corrosive characteristics of ozone hinder its practical application; the formation of disinfection byproducts with potential carcinogenicity is an additional drawback of chlorination. As such, versatile new technologies are highly desirable to inactivate biohazards. Among the processes currently in development, semiconductor photocatalysis has emerged as a very attractive, environment-friendly technology for water disinfection due to its superior photocatalytic oxidation ability, nontoxic and stable characteristics.

According to the previous studies, a novel, silver doped photocatalyst P/Ag/Ag₂O/Ag₃PO₄/TiO₂, firstly synthesized by our lab, has been demonstrated as a promising material with remarkable photocatalytic efficiency in decomposing the organic matter under simulated solar light. In this study, the efficiency of photocatalytic disinfection, evaluated by inactivating *Escherichia coli* under LED irradiation was examined. The results showed that P/Ag/Ag₂O/Ag₃PO₄/TiO₂ photocatalyst had higher bactericidal activity than other photocatalysts. The influence of different parameters including photocatalyst loading, pH of solution and temperature on the efficiency of photocatalytic bacterial activity were also studied. The present results suggest that this new photocatalyst material could greatly facilitate practical water disinfection.

Preparation of Ag-based Bi₂WO₆ Thin Film on Glass Substrate with Enhanced Photocatalytic Activity for Decomposition of Organic Dye

Qiansu MA¹, Xiaohong HU¹, Qi ZHU¹ and Yingnan YANG²

¹Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

²Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

In recent years, various technologies have been developed for degradation of organic dye, including physical adsorption method and chemical decomposition. And among these methods, photocatalysis has been considered as a cost-effective alternative. Bi₂WO₆ has drawn worldwide attention for water treatment due to its high efficiency and low toxicity.

In general, the photocatalytic activity of the photocatalyst can be promoted by increasing the separation efficiency of photoinduced electron-hole pairs. Some researchers have studied the modification of Bi₂WO₆ by doping with nonmetal elements, metals and semiconductors, in order to enhance its photocatalytic ability. In our study, Bi₂WO₆ modified with silver salt has been developed. Novel visible-light-driven photocatalysts are usually utilized as suspended powders, however they did not fit for the reutilization process. In order to solve post-preparation problem, the preparation of photocatalytic films has been promoted as a method to enhance the adsorption of solar spectrum and improve the photocatalytic performance. The synthesis of modified Bi₂WO₆ thin film was optimized by investigating the effects of calcinations temperature at 100°C, 120°C, 140°C, calcinations time of 3, 4, 5, 6 hours and number of coating layers. Modified Bi₂WO₆ thin film with calcinations temperature at 120°C and calcinations time of 4 h showed the best performance in degradation of Rh B. Comparing with pure Bi₂WO₆ thin films, the modified composite film exhibited wider visible light absorption spectrum and higher photocatalytic activity, which could be used in practical application of water treatment.

Paper or Tablet? – Media Effect on Visual Awareness Performance of Elementary Schoolers

Siti Dian MARDIYANI¹, Naohiro HIGUCHI², Toshiharu ENOMAE³

¹ Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

² Faculty of Human Sciences, University of Tsukuba, Tsukuba, Japan

³ Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

The use of digital devices is expanding in school for Information and Communication Technology (ICT)-based education. Along with the development of ICT educational systems, in terms of the application or impact of the media, our research is focusing on the comparison between paper media and tablet PC subjected to elementary school students in grades 4, 5 and 6. The use of digital media like tablet for elementary school student in Indonesia is still variate as each school has a right to decide to introduce digital media to develop their own learning activity. For the case of Japan, ICT-based education reform is directed as a policy. Publishers of school textbooks have started developing their own digital textbook materials complying with the guidelines issued by the ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan. As schools facing this ongoing transition have come to facilitate ICT-based education and provide children with devices like tablet PC, the children might also have to change their reading media from paper-based textbook to electronic textbook (e-textbook) with having no other options. This research is focusing on the media effect on proofreading efficiency between paper and tablet PC for elementary school students in grades 4, 5 and 6. The objective of this research is further consideration of the media choice for reading at elementary school level.

Students were asked to do a simple proofreading test by finding misspelled words in various tasks on different media. A4 size copy paper and tablet were used, with the digital materials prepared in pdf file and delivered using Adobe pdf reader application. The tasks and media were randomly assigned to test subjects. The misspelled words in the tasks were categorized into three different patterns: (1) substitute of a letter(s), (2) addition/elimination of a letter(s), and (3) change of the order of letter(s). Both patterns (1) and (2) have two sub-patterns: ‘another word’ and ‘incorrect word’. ‘Another word’ refers to correctly spelt but inappropriate new word and ‘incorrect word’ refers to a misspelled word. Statistical analysis of variance (ANOVA) was applied to this test result with variables of the grade, task, and media as the primary independent factors to evaluate each effect with the number of found misspelled words. Further, we also investigated how the misspelling patterns and word change might affect the finding efficiency and analyzed it using multivariate analysis of variance (MANOVA).

The total average number of found misspelled words in grades 4, 5, and 6 consecutively increased and the differences in average spent time between the media decreased both with the grade. In addition, the results revealed that there is no significant difference in the visual awareness performance between the media. However, after analyzing it on a misspelling pattern basis, paper media help children improve their finding efficiency. In addition, ‘task’ and ‘grade’ are also considered to be the most influential factors which gave significant differences to the result in this study.

Keywords: ICT-based education; paper vs. tablet; reading performance

Process Development for Effective Lipid Extraction from Microalgae (*Chlorella vulgaris*) by Micro Wet Milling

Nobuyuki MATSUNAMI¹, Yutaka KITAMURA² and Mito KOKAWA²

¹Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

²Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

In recent years, renewable source of energy such as solar power, wind power, geothermal power, and biomass has been developed actively due to global warming and the depletion of fossil fuel. Biodiesel is one of the renewable energy which is carbon neutral. It is an alternative fuel of the light oil, and is obtained by transesterification of the lipids from biomass with alcohol and a catalyst. While a 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 its high lipid content and, high growth rate, and because it does not compete with food production.

The general process of microalgae biodiesel production is performed in the order of cultivation of the microalgae, harvesting, dewatering, oil extraction, and conversion to fuel. Lipid extraction from microalgae cells is performed using organic solvents such as hexane, however, the extraction rate is low. To improve the lipid extraction rate, the addition of a cell disruption process of algal cells before lipid extraction has been studied. Already, cell disruption by ultrasonic treatment, high pressure homogenization, brad beating, and microwave radiation has been studied, and also it has been reported that these cell disruption method improve the extraction rate of lipid. However, these methods require large energy, and energy saving in the cell disruption method is desired for the cost reduction of microalgae biodiesel production.

This study examined 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 materials because the grinding work index is smaller than other grinders. Also MWM is considered effective in reducing the energy of a cell disruption compared to 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. Therefore, this study aims to clarify the characteristics of the wet milling of microalgae by Micro Wet Milling.

The microalgae strain used in this study was *chlorella vulgaris*. which is commercially available (water content : 86%). The samples were ground by MWM. After the milling, the particle size (median diameter) was measured by a laser diffraction particle size distribution meter (SALD-2200) to see the shape change of the algal cells. In addition, the shape of the algal cells were confirmed by an optical microscope. Furthermore, ground algae lipids were extracted by the Blich Dyer method, and the extraction rate was calculated. By determining the milling conditions which maximized the lipid extraction rate, we acquired the basic data to establish microalgae biodiesel production that utilizes a Micro Wet Milling process.

Evaluation of Energy Efficiency of Batch Type Hydrothermal Liquefaction for Indigenous Microalgae Lipid Extraction

Kasumi MATSUO¹, Muhammad Ansori NASUTION¹, Nugroho Adi SASONGKO¹,
Eriko ANKYU¹, Satoshi MATSUMOTO², Toru ARAMAKI¹, Jyunko ITO³,
Sosaku ICHIKAWA⁴, Mitsutoshi NAKAJIMA⁴,
Makoto M. WATANABE^{3,4} and Ryozi NOGUCHI⁴

¹ Graduate School of Life and Environmental Sciences, University of Tsukuba, Japan

² School of Life and Environmental Sciences, University of Tsukuba, Japan

³ Algae Biomass and Energy System R&D Center, University of Tsukuba, Japan

⁴ Faculty of Life and Environmental Sciences, University of Tsukuba, Japan

Minamisoma City in Fukushima Prefecture was dramatically damaged by the Great East Japan Earthquake in 2011 and huge abandonment of cultivated land area is still remained. Then, microalgae biofuel production with cultivation as new energy industry is expected as one of solutions to these farmlands rehabilitation. On the other hand, hydrothermal liquefaction (HTL) decomposes microalgae and produces a lipid by steam heating. In this research, four combinations of temperature and pressure in HTL were examined to clear the lipid extraction ratio from native microalgae in Minamisoma City (*Desmodesmus sp.*).

500 mL of reactor of HTL equipment and 50 g of microalgae (90% of water content, 5.0 g of solid weight) were used in a) 150°C & 1.5 MPa, b) 150°C & 3.3 MPa, c) 200°C & 1.5 MPa and d) 200°C & 3.3 MPa in the HTL treatment.

Total lipid content was increased from 0.025 [g/g-DW] to a) 0.192 [g/g-DW], b) 0.128 [g/g-DW], c) 0.178 [g/g-DW] and d) 0.1790 [g/g-DW] respectively. There is a possibility that hydrolysis of protein and carbohydrate of the microalgae is converted to hydrocarbon, triglyceride, glycolipid and phospholipid, and/or destruction of algae's cell wall contributes to increase the lipid. On the other hand, a) 0.334, b) 0.224, c) 0.311 and d) 0.332 of energy profit ratio (EPR) were shown by 1200 kJ of input energy in the HTL experiment and a) 0.325, b) 0.979, c) 0.289 and d) 0.979 of EPR was calculated by a) 1234.0 kJ, b) 274.50 kJ, c) 1292.0 kJ and d) 382.60 kJ of theoretical energy consumption. Results of the HTL showed a possibility to save input energy by middle temperature and low pressure HTL compared with subcritical treatment.

Yield Gap Analysis of Rice Production Using MODIS Satellite Time Series Vegetation Datasets and GIS

Rubaiya Binte MOSTAFIZ¹, Md. Monjurul ISLAM¹ and Tofael AHAMED²

¹ Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

² Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

Crop yield gap is regarded as one of the challenges for the northern part of Bangladesh. Therefore, the aim of this study is to estimate the yield gap of major field crop rice, locate the yield gap areas, and suitability analysis in different administrative units of Rangpur district of Bangladesh. To meet this research objectives, multi-criteria analysis was done using Geographical Information System (GIS) and Analytical Hierarchy Process (AHP). The normalized difference vegetation index (NDVI) from MODIS VI product (MOD13) was used according to the cropping calendar for upland, wet season and dry seasons varieties of rice. The raster layers of factors and constraints were generated in ArcGIS 10.3® to perform reclassification. Moreover, weighted overlay was done to find out the suitable areas of crop production. The spatial analysis was performed to identify the suitable zone produced by the ArcGIS and compared to raster images from Google Earth Pro® to validate the reliability of suitability assessment.

The main focus was to find out the suitable areas to increase crop yield based on criteria and factors. These were selected in context of food security according the professional expert's opinions. The weighted overly was performed and found that 1.22% of area was highly suitable, while 30.20% was suitable, 5.66% was moderately suitable and 22.70% was marginally suitable for rice production. Moreover, 1.22% of area was not suitable and 38.62 % was restricted area, which was occupied with settlement, river, water body and forest. On the other hand, for individual three types; upland, wet and dry seasons paddy cultivation suitable areas were covered 450 km², 691 km² and 969 km², respectively. The study revealed that the yield predicted by a regression model-based on combination of NDVI and LAI provided the better fit with reference of ground truth data. This coordination could serve a significant role to agricultural extension department to identify most suitable location to increase yield against the challenging climate of Bangladesh.

Keywords: Yield Gap, Normalized Difference Vegetation Index (NDVI), Leaf Area Index (LAI), Geographical Information System (GIS), Analytical Hierarchy Process (AHP).

Effects of Coating Methods of Palm Oil on Dissolution Rate of Urea *in vitro*

Ryo NOGUCHI¹, Osamu ENISHI², Naoto ISHIKAWA³, Atsushi TAJIMA³
and Atsushi ASANO³

¹ Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

² National Institute of Livestock and Grassland Science, Tsukuba, Japan

³ Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

Urea has been used as a supplement for the ruminants because some ruminal microbes have the ability to synthesize proteins by using non-protein nitrogen compounds. The supplementation of urea into feeds promotes the increase of microbes and improves fiber digestibility of the low quality roughage such a straw in ruminants. However, excess supplementation of urea sometimes causes the ammonia toxicosis in ruminants by rapid increase of ammonia concentration in rumen because of urea's fast-acting property. As a solution for this problem, Slow Release Urea (SRU) which release nitrogen slowly in rumen was developed. But there are few reports about releasing rate of urea from SRU and appropriate rate for the growth of microbes. To investigate the effect of coating methods of palm oil on dissolution rate of urea which shows appropriate rate of nitrogen-releasing for microbes, the dissolution rate of urea were compared among 12 types of SRU made by different methods.

Dissolution rates of urea in 12 types of SRU were prepared by using different quantity, solidification time and coating times of palm oil. These SRU were incubated for 0, 1.5, 3, 6, 12 and 24 h in artificial saliva at 39.5 °C were measured by the spectrophotometer with the indophenol method.

1) Dissolution rate of urea from SRU with big size particle (2 ~ 4 mm) was lower than that with small size particle (1 ~ 2 mm), although the difference was not significant. 2) SRU coated with 30 wt% oil had significantly smaller dissolution rate of urea than those with 20 wt% oil ($P < 0.05$). 3) SRU with 0.5 % emulsifier and SRU with crushed urea (0.2 ~ 1 mm) had higher dissolution rates of urea, although the differences were not significant. 4) SRU which was coated twice had greatly lower dissolution rate of urea (less than 40%). 5) SRU solidified for longer time (more than 45 minutes) had significantly lower dissolution rate of urea than that solidified for shorter time ($P < 0.05$).

These results show that the dissolution rate of urea from SRU can be controlled by different condition.

Isolation and Evaluation of Xylose-Fermenting Thermotolerant Yeasts for Bioethanol Production

Julius NWEZE^{1,2}, Ifeanyi NDUBUISI², Yoshinori MURATA³, Hide Omae³,
James OGBONNA², and Yutaka KITAMURA⁴

¹ Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

² Department of Microbiology, University of Nigeria, Nsukka, Nigeria

³ Japan International Research Centre for Agricultural Sciences, Tsukuba, Japan

⁴ Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

Xylose is the main fermentable sugar obtained by hydrolysis of hemicellulosic fraction of lignocellulosic materials, and xylose-fermenting microorganisms are essential for the economic conversion of lignocellulose to ethanol. The aim of this work was therefore to isolate and evaluate thermotolerant xylose fermenting yeasts. Natural habitats of yeasts were examined for the presence of thermotolerant strains able to produce ethanol from xylose. Among the 320 thermotolerant yeasts isolated, 45 produced more than 1g/l of ethanol from 20g/l of xylose medium. When their fermentation ability was tested in 3% xylose medium, only three isolates (Pa27, Ma9, and Pi131) produced more than 7g/l of ethanol after 72 hours, and were selected for further studies. Molecular identification was carried out using ribosomal DNA (rDNA) Internal Transcribed Spacer (ITS), and the results showed that isolate Pa27 and Pi131 were strains of *Pichia kudriavzevii* while Ma9 was strain of *Candida tropicalis*. Optimization studies were carried out to check the effects of different process parameters such as initial pH, inoculum size, temperature, concentration of xylose, and xylose-glucose ratio on ethanol production and yield. The optimal conditions were: pH 5.5 for Pa27 and Pi131, and 4.5 for Ma9, inoculum size of 1.2-1.5 O.D (600nm), temperature of 35-38°C and xylose concentration of 70g/l. Under these conditions, isolate Pa27, Ma9 and Pi131 produced maximum ethanol concentrations of 24.30 ± 0.17 (g/l), 22.61 ± 0.18 (g/l) and 25.70 ± 0.17 (g/l) after 120 hours, and maximum ethanol yields of 0.35 ± 0.002 (g/g) after 120 hours, 0.35 ± 0.007 (g/g) and 0.39 ± 0.002 (g/g) after 96 hours respectively. At a fermentation temperature of 42°C and other optimum operating conditions, the maximum ethanol concentrations were 14.60 ± 0.28 (g/l), 14.07 ± 0.28 (g/l) and 15.70 ± 0.28 (g/l) after 168 hours, while the maximum ethanol yields were 0.27 ± 0.005 (g/g), 0.27 ± 0.005 (g/g) and 0.29 ± 0.006 (g/g) after 96 hours for isolate Pa27, Ma9 and Pi131 respectively. The isolates co-fermented glucose and xylose to ethanol and the presence of small amount of glucose improved the xylose utilization rate. The performance of these yeasts compared favourably with those reported for some other xylose-fermenting yeasts.

Fungal Species and N Sources Affect on Accumulation of Cesium, Rubidium, and Potassium by Fungi

Sumika OGO¹, Takashi YAMANAKA², Keiko AKAMA² and Keiko YAMAJI¹

¹ College of Agrobiological Resource Science, University of Tsukuba, Tsukuba, Japan

² Forestry and Forest Products Research Institute, Tsukuba, Japan

After the accident at the Fukushima Dai-ichi nuclear power plant in 2011 in Japan, high concentrations of radiocesium were extended into many fields. Fungi are considered to play an important role in the dynamics of radiocesium in forest ecosystems because fungi can accumulate cesium (Cs) abundantly into their fruit bodies. Although it is known that ectomycorrhizal (EM) fungi can accumulate cesium more than saprotrophic (SA) fungi, the mechanisms of the absorption of Cs have not been investigated.

We examined the content of Cs, rubidium (Rb), and potassium (K) in the mycelium of 15 isolates of EM species and 9 isolates of SA species after culture in a synthetic medium with NaNO₃ or NH₄Cl as the sole N source, supplemented with 1 ppm CsCl and RbCl. The mycelia were harvested after 8 weeks of incubation in darkness at 23°C. The contents of Cs, Rb, and K in the mycelium were measured by inductively coupled plasma-mass spectrometry. The dry weight of the mycelium in the medium containing NH₄Cl was significantly higher than that with NaNO₃, although some EM species, *Hebeloma*, *Astraeus*, and *Scleroderma*, grew well in the medium with NO₃. Among SA species, *Crucibulum* and *Cyathus* grew in the medium with NO₃. Generally, Cs uptake in the medium with NO₃ was higher than that with NH₄. There was no significant difference in Cs content among the isolates when they grew on the medium with NH₄; however, Cs in *Scleroderma* and *Astraeus* in the medium with NO₃ was higher than that in other EM and SA species. The content of Cs was well correlated with those of Rb and K, indicating that the pattern of Cs uptake could be characteristic of monovalent cation absorption. In this way, the pattern of the contents of these elements was different depending on fungal species and N source.

Characteristics of Lactic Acid Fermentation in Soy Milk Mixed with Brown Rice

Yuki SAITO¹, Yutaka KITAMURA² and Mito KOKAWA²

¹ Graduate School of Life Environmental Sciences, University of Tsukuba, Tsukuba, Japan

² Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

There are many kinds of fermented foods using Lactic acid such as Kimchi, pickles and sweet sake. Above all, yogurt is well known as a fermented food made from milk. Intestinal regulation functions and blood cholesterol-lowering functions are generally known as the effect of yogurt. On the other hand, milk is perceived as the second highest cause of food allergy next to egg. Thus, the development of a lactic acid fermented food made from soy milk mixed with brown rice that is safe for people who are allergic to milk and has a yogurt-like function would be significant. Furthermore, soy milk and brown rice contain a lot of dietary fiber, vitamins and minerals, and food made from these raw materials would contain a high level of nutrition. For these reasons, the purpose of this study is to produce lactic acid fermented yogurt-like food which is fermented by plant lactobacillus using soy milk and brown rice as the raw material.

This study used *Lactobacillus* sp.FPL1, which is resistant to both artificial gastric juice and intestinal juice. The processing of brown rice with mixed soy milk was investigated by two methods. In the first method, brown rice which was cooked using soy milk was mixed in a high-speed mixer to make a gel-like sample. In the second method, the characteristics of raw brown rice with soy milk were investigated by use of Micro Wet Milling system. Micro Wet Milling system is a method using two modified electric stone mills with wet materials. This study compared the operability and the particle size of the brown rice due to the differences in the processing methods.

Since the high-speed mixer and Micro Wet Milling system could mill brown rice into samples with small particle size, lactic acid bacteria fermentation was quicker and the mouthfeel of the resulting yogurt-like food was better.

Effects of Feeding Ashitaba (*Angelica keiskei*) on Somatic Cell Count in Milk, Milk Yield and Body Weight of Dairy Cattle under Heat Stress

Shoichiro SUZUKI¹, Atsushi ASANO², Atsushi TAJIMA², and Naoto ISHIKAWA²

¹Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

²Faculty of Life and Environmental Science, University of Tsukuba, Tsukuba, Japan

The mastitis in summer gives an economical loss for dairy farming. Under heat stress, reactive oxygen species (ROS) increases and immunity is depressed. Mastitis increases the number of somatic cell count (SCC) in Milk and depresses milk production. Our research group focuses on addition of functional feeds to dairy cattle to solve the problem. It is known that Ashitaba contains rich antioxidant chemicals, such as chalcones and coumarines. Therefore the purpose of this experiment is to reveal the effect of feeding Ashitaba on somatic cell count in milk, milk yield and body temperature of dairy cattle under heat stress.

Four Holstein milking cows in Agricultural and Forestry Research Center were used in a double switch-back experiment. All of the animals were *ad libitum* offered base feed throughout the experimental period. Two cows were given 0.3 Kg Ashitaba supplement (made by SNOW BRAND SEED Co., Ltd., containing 45% Ashitaba plants) per day (Ashitaba feeding group) for 12 days as the first feeding period. Other 2 cows were for control group at the first feeding period and were assigned to Ashitaba feeding group during 12 days after 2 days interval following the period. After 2 days, all cows were assigned to same group as the first feeding period. Milk yield was measured twice a day. SCC in milk was measured on the last 5 days of every feeding period. Body weight was recorded every other day. Regression analysis between Temperature Humidity Index (THI) and each measurement was performed.

No significant correlation between THI and SCC was found in Ashitaba feeding group, although a positive correlation in control was significant. Farther, SCC in milk of a mastitis cow was decreasing during Ashitaba feeding period. However, Ashitaba feeding group had a stronger negative correlation between THI and milk yield than that of control. A negative correlation between THI and body weight was found only in Ashitaba feeding group.

Above results might indicate that Ashitaba feeding could control aggravation of the mastitis caused by heat stress. On the other hand, Ashitaba feeding is possibly to cause an adverse effect for feed intake of milking cow. Further research will be needed to evaluate the effect of Ashitaba on the mastitis and feed intake in milking cow.

Characteristics of Dry Matter Yields and Chemical Composition in Ratoons of Three NERICA (New Rice for Africa) Cultivars

Saki TANIGUCHI¹, Hisashi URAYAMA², Morio KATO³, Atsushi ASANO³,
Atsushi TAJIMA³ and Naoto ISHIKAWA³

¹Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

²Overseas Agricultural Development Association, Tokyo, Japan

³Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

The greater part of smallholders in Africa has no sufficient agricultural field for producing livestock feeds. NERICA, cultivars were developed to solve the food shortage, have been spread to produce a lot of rice in Africa. The ratoon of NERICA can be a high quality feed, because it was shown that ratoon of *Japonica* had relatively higher nitrogen content. This study aims to characterize the regrowing ability and chemical composition of NERICA cultivars as feedstuffs.

NERICA (1, 4 and 10), Toyohatamochi and Yumenohatamochi were cultivated in triplicates in Agricultural and Forestry Research Center in University of Tsukuba. The ratoons of all cultivars were started regrowing after reaping from 20 cm above ground on 24th August 2015. The regrowing ratoons reaped at ground level were sampled on 27th September 2015 (the 1st harvest: regrowing for 35 days). The regrowing ratoons reaped at ground level were sampled on 10th October 2015 (the 2nd harvest: regrowing for 48 days). The number of stem, plant height and dry matter yield of samples were recorded. The regrowing ability is indicated by these measurements. Crude ash, neutral detergent fiber, acid detergent fiber and crude protein in the samples were analyzed. Effect of cultivar, harvesting time and interaction between cultivar and harvesting time on all of the measurements were analyzed by two way factorial ANOVA (SAS stat, 1999).

Significant differences of cultivars, harvesting time and interaction between those were found in plant height, dry matter yield and crude protein ($p < 0.05$). Dry matter yield of the 2nd harvest in NERICA1, 4 and 10 were 112.6g/m², 157.8g/m² and 69.3g/m², respectively.

The regrowing abilities of early maturing cultivars (NERICA 10 and Toyohatamochi) were lower than that of high yield cultivar (NERICA 4). Among the cultivars, decreasing rate of crude protein in NERICA4 between the 1st and 2nd harvest was the lowest. Although dry matter yields of the 1st and 2nd harvest in NERICA4 were significantly larger than those in other cultivars, decreasing rate of crude protein in NERICA4 between the 1st and 2nd harvest was the lowest. From the results obtained, it was shown that there was a wide variation of characteristics of ratoons as feed among cultivars of NERICA.

Improvement in Fertilizing Ability of Chicken Sperm Incorporated with Sterols after Cryopreservation

Ai USHIYAMA¹, Atsushi TAJIMA², Naoto ISHIKAWA² and Atsushi ASANO²

¹Graduate School of Life and Environmental Sciences, University of Tsukuba, Japan

²Faculty of Life and Environmental Sciences, University of Tsukuba, Japan

In sperm, cryopreservation is known to cause serious damages to functions necessary for fertilization, which limits use of this technology for commercial production and the genetic preservation of chicken. Cellular membranes are primary site for cryopreservation-induced damages. Previously, we demonstrated in chicken sperm that freeze-thaw process induces removal of cholesterol from cellular membranes leading to apoptosis. This led us to hypothesis that enrichment of sterols in membranes might rescue cryopreserved chicken sperm from the damages resulting in the decline of fertilizing ability. In this study, we tested this possibility to generate a novel methodology for cryopreservation of avian sperm.

Semen were collected from matured Rhode Island Red. For incorporation of sterols to membranes, sperm (1.2×10^8 cells) were treated with 0 - 6 mg cholesterol-loaded cyclodextrin (CLC) or desmosterol-loaded cyclodextrin (DLC). Exp 1: cholesterol content in membranes of CLC-treated sperm was quantified following by freeze-thaw process. Distribution of exogenous sterol was visualized in sperm labeled with BODIPY-cholesterol. Exp 2: post-thaw survivability, motility, and acrosome integrity were examined in CLC- and DLC-treated sperm. Exp 3: apoptotic status was assessed in CLC- and DLC-treated sperm following by freeze-thaw process. Exp 4: post-thaw acrosomal responsiveness was assessed in fresh, CLC-treated and DLC-treated sperm after stimulation with or without inner perivitelline layers (IPVL). Exp 1: exogenous cholesterol was incorporated into sperm membranes in CLC-concentration dependent manner. Exogenous cholesterol was preferentially localized to the sperm head region. Exp 2: the survivability and motility were improved when cryopreserved sperm were pre-treated with 1.5 mg CLC or 3 mg DLC, and the acrosome integrity was retained in both CLC and DLC concentrations. Exp 3: apoptosis was inhibited in cryopreserved sperm by pre-treatment with CLC or DLC compared with sperm treated with conventional. Exp 4: acrosome responsiveness in response to IPVL treatment was improved in sperm pre-treated with CLC or DLC compared to sperm cryopreserved with conventional.

In present study, we demonstrated that pre-treatment of chicken sperm with 1.5 mg CLC or 3 mg DLC improves post-thaw survivability and functionality by suppressing apoptosis. Our results would provide a foundation to generate a novel methodology of avian sperm cryopreservation.

Development of a Sweet Potato Lacto Juice

Michael WAMBUA¹, Mito KOKAWA², Yutaka KITAMURA²

¹Graduate School of Life and Environmental Sciences, University of Tsukuba, Japan.

²Faculty of Life and Environmental Sciences, University of Tsukuba, Japan.

Sweet potato (*Ipomoea batatas* {L} Lam) is a very important food crop in the world. It's a staple food in many countries and also used as a raw material in many food and animal feed industries. Sweet potatoes are rich in starch, sugar, minerals and dietary fiber. Some varieties are rich in colored pigments such as carotene, anthocyanin, and phenolic compounds.

This research aims at developing a sweet potato lacto juice using micro wet milling and lactic acid fermentation; study the effect of various micro wet milling parameters on particle size, determine the effect of micro wet milling and lactic acid fermentation on biochemical characteristics of the lacto juice and later consumer acceptability of the juice will be determined using sensory analysis.

The sweet potato roots will be washed and cut into small pieces, steamed at 90-100⁰C for 15 minutes. A sweet potato slurry will be made by using a mixer and micro wet milling system. A saccharification enzyme will then be used to saccharify the sweet potato slurry to convert starch to sugar before fermentation. Lactic acid fermentation using *Lactobacillus pentosus* will then be done at 30⁰C for 48 hours. Biochemical characteristics; titratable acidity, total soluble solids, total sugar, pH, lactic acid, will then be analyzed.

It's expected that this research will benefit farmers, sweet potato processors, and consumers. Farmers will benefit from the reduction of postharvest losses; processors will benefit by having a new product thus increasing the variety of products they can process while consumers will benefit by having a more convenient nutritious and sensory juice.

The Processing of Mulberry Powder by Use of Micro Wet Milling System and Spray Drying Technology

Youmei WANG¹ and Yutaka KITAMURA²

¹Graduate school of Life and Environmental Sciences, University of Tsukuba, Japan

²Faculty of Life and Environmental Sciences, university of Tsukuba, Japan

Background

Mulberry belongs to the Moraceae family. It is widely distributed in Asia and well-known on its significantly nutritional qualities such as polyphenols and anthocyanin. Due to its fragile structure in the storage, it is usually processed as freezing food or dry product as fruit powder. In the other hand, the roots and seeds of mulberry are difficult to remove, so in this study, Micro Wet Milling System (MWM) which can degrade material into smaller particles by stone milling is used in order to keep full nutrition. And Spray Drying (SD) which can produce dry powder from liquid by rapidly drying with hot gas is used to produce the whole mulberry powder due to its benefits of high performance and low residence time.

Objectives

The milling characteristics of mulberry are investigated for the processing of the whole mulberry powder with MWM system. The spray drying characteristics of mulberry are investigated for evaluating the physical and functional properties of the whole mulberry powder and providing a positive effect on portable healthy lifestyle.

Materials and Methods

The harvested mulberries (Shimane-ken,2014) are stored in a freezer and thawed in the use for the further experiment. 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. Particle size and its size distribution is determined by a laser diffraction particle size analyzer (SALD-2200). Glass transition temp(T_g) is determined by a Differential Scanning Calorimeter (DSC-60). Water activity: Measurement of water activity is carried out using a water activity meter. Color characteristics: the color of whole mulberry powder is determined by Colorimeter.

Expected Results

Micro Wet Milling System (MWM) can degrade material into smaller particles by stone milling is used in order to keep full nutrition. And Spray Drying (SD) can produce dry powder from liquid by rapidly drying with hot gas is used to produce the whole mulberry powder due to its benefits of high performance and low residence time.

Spray Drying of Tomato Fruit Towards the Production of an Edible Vaccine Against Influenza

Sakkrapong WANNAWATTANA¹, Yutaka KITAMURA², Mito KOKAWA²,
and Michiyuki ONO²

¹Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

²Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

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 and ratio of excipients before pilot-scale spray drying. Spray-dried tomato powder will be determined by various parameters such as yield, glass transition temperature (T_g), 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 Western blot analysis to confirm the potential of using spray drying process in the production of edible vaccine.

Investigation of Interparticle Force between Silica Particles Covered with Lysozymes by Yield Stress Measurement

Atsushi YAMAGUCHI¹ and Motoyoshi KOBAYASHI²

¹Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

²Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

Transport of colloidal particles such as clays, humic substances, and proteins affects sustainability of agriculture and conservation of environments since colloidal particles in environments work as carrier of nutrients, agrichemicals, pollutants, and so on. The interparticle force affects the transport and rheological behaviors of suspension of colloidal particles through their aggregation-dispersion. In a suspension with a variety of particles, small particles adsorb to large particles. As a result, the surface of large particles becomes heterogeneous and surface properties are also changed. Thus, the mechanisms of interparticle force between large particles covered with small particles are complicated and not fully understood.

For better understanding of the mechanisms of interparticle force in suspension with a variety of particles, we chose the model system composed of silica particles with 302 nm in diameter and lysozymes (LSZ). Silica particles are negatively charged at experimental conditions (pH 5 and 7). LSZ is a positively charged protein with a size of 3 nm. We characterized surface properties of silica by measuring the adsorption mass of LSZ to silica and the zeta potential of silica covered with LSZs. Moreover, we measured the yield stress of mixed suspension of silica and LSZ as an indicator of the interparticle force.

The measured yield stress is plotted against the zeta potential in Figure 1. We see that the yield stress takes maximum values around isoelectric points, where zeta potential is 0 mV, at both pH 5 and pH 7. Increasing of magnitude of the zeta potential results in decreasing of the yield stress. These trends show that the zeta potential significantly affects the yield stress of suspension and interparticle forces. Besides, the maximum yield stresses depend on pH. Additionally, yield stresses take different values even if zeta potentials are the same. These trends cannot be explained by zeta potential only. We suggest that the relative adsorption mass, which is defined as the ratio of the adsorption mass to the maximum adsorption mass, is another important parameter governing the interparticle force.

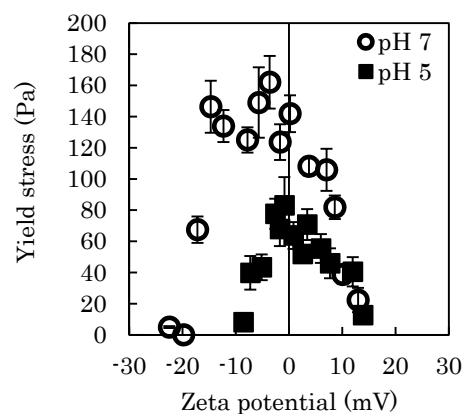


Figure 1 Zeta potential vs. yield stress in 10 mM KCl suspension.

Gene Polymorphism in Buckwheat Major Allergen, Fag e 2

Mitsuki YAMAUCHI¹, Takashi HARA², Rie SATOH³ and Ryo OHSAWA²

¹Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

²Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

³Division of Food Function Research, Food Research Institute, NARO

Buckwheat (*Fagopyrum esculentum* Moench) is one of important crops in East Asia such as China, Japan, Korea, and so on. The buckwheat is known well as healthy food because of rich functional component like rutin. However, buckwheat is also known to cause immediate-type hypersensitivity reactions including anaphylaxis, which is mediated by specific Immunoglobulin E (IgE) antibodies (Tanaka 2002, Sato 2008). First, Satoh et al (2012) analyzed the role of Cys residues in the allergenicity of the 16-kDa protein Fag e 2, one of the major allergens in buckwheat, and by mutational analysis of recombinant Fag e 2, revealed that 7 out of 10 Cys mutants showed weaker IgE binding to patient's serum than wild-type Fag e 2. These report suggested that the gene polymorphism in *Fag e 2* region will reduce or delete the protein, but no report had tried to explore the gene polymorphism in *Fag e 2* region. In this study, we tried to explore the gene polymorphism in *Fag e 2* region within genetic resources of buckwheat in Japan.

Buckwheat is a typical outcrossing plant, so each cultivar includes the several genotypes. Therefore, we made many self-fertilizing individuals from crossing eight local varieties and “Kyukei PL4”, which gives self-compatibility to the progeny. That is, all F1 individuals become self-compatible. If we found mutations in *Fag e 2* region, we can get progenies from the individual. To find gene polymorphism in *Fag e 2*, DNA was extracted from F1 (n = 237) individuals and PCR was performed with the *Fag e 2* specific primer. These PCR products (632 bp) were sequenced by using BigDye Terminator ver. 3.1 and ABI PRISM 3130 Genetic Analyzer. These sequence data was processed by free software Phred/Phrap/consed and DnaSP in *Fag e 2* coding sequence (450 bp).

As the result of sequencing, 34 base substitutions were found on the *Fag e 2* and 17 of them were assumed to cause amino acid substitution as non-synonymous mutation. Every Cys was not mutated, but considering amino acid hydrophobicity, this gene polymorphism may induce some conformational change and also affect allergenicity of Fag e 2 to varying degrees. This result is the first report of *Fag e 2* genetic variation in buckwheat existing varieties. To help breeding non-allergen cultivars, further research is needed to reveal association between sequence and allergenicity of Fag e 2.

Effects of 1-MCP Treatment on Fuji Apple in 10 Degree Celsius

Abdullah YOUSUFI¹, Yoshihiko SEKOZAWA², Sumiko SUGAYA²

¹ Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

² Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

1-methylcyclopropene (1-MCP) is classified as plant growth regulator. It's a competitive inhibitor of ethylene action, binds to the ethylene receptors and inhibit ethylene action. Initially 1-MCP was approved to use on ornamental plants. Apple was the 1st crop for which 1-MCP was used commercially in year 2000. The mechanism of 1-MCP action involves its tight bindings to the ethylene receptors in plants, thereby blocking the effect of ethylene. In apple 1-MCP dramatically inhibit ripening, the extent of this inhibition is related to; cultivar, temperature, concentration of 1-MCP, and storage environment.

After Fuji fruits were harvested at commercial harvesting stage, from Nagano Fruit Tree Experiment Station, fruits were transferred to pomology lab, University of Tsukuba. Injured fruit were removed, then Fruits were divided in to two groups, one group was treated with 1ppm, 1-MCP for 24 hours in 59 liter glass desiccator. The 2nd group (control) fruits were kept at the same conditions in 59 liter glass desiccator for 24 hours without 1-MCP fumigation. After treatment samples were kept in 10⁰ C chamber for 120 days, in their cartons as stored in commercial storage. Observations were performed every 30 days, the data recorded for Firmness, TSS, TA, Ethylene production and respiration rate is the mean of 4 samples, data recorded for weight loss and color value is the mean of 10 samples calculated in each observation. The objective of this study was to know the response of Fuji apple to 1-MCP in 10°C.

Firmness, TSS, and TA of 1-MCP treated fruits were higher than control throughout the storage period. However, no difference has been observed in weight loss and hue angle between 1-MCP treated fruits and control. 1-MCP has kept the respiration rate of apple fruits lower than control. Ethylene production rate showed intense increase on day 30 and 60 in control fruit while the ethylene production rate of 1-MCP treated fruit were maintained low. It is mentionable that the occurrence of superficial scald was lower in 1-MCP treated fruits. To know the effects of 1-MCP on apple in room temperatures more detailed studies have to be conducted.

Formulation and Characterization of Highly-concentrated Maslinic Acid Nanodispersions Stabilized by Different Homogenization Pressures

Wang YUXIN¹, Nauman KHALID^{1,2}, Satoshi FUKUMITSU³, Yuki YAMAUCHI³, Marcos A. NEVES^{1,2}, Hiroko ISODA^{1,2}, Mitsutoshi NAKAJIMA^{1,2*}

¹Graduate School of Life and Environmental Sciences, University of Tsukuba, Japan

²Faculty of Life and Environmental Sciences, University of Tsukuba, Japan

³Nippon Flour Mills Co., Ltd. Atsugi, Kanagawa, Japan

Maslinic acid, also known as crategolic acid or (2 α ,3 β)-2,3-dihydroxyolean-12-en-28-oic acid, is a pentacyclic triterpene widely distributed in the plant kingdom. Several nutraceutical properties have been attributed to maslinic acid (MA), like antitumor, antidiabetic, antioxidant, antiparasitic, neuroprotective, cardioprotective and growth-stimulating properties. MA is isolated from both plants and fruits especially olives. The solubility of MA in aqueous solutions is quite poor, and this problem limit the bioavailability as well. Emulsions and nanodispersions have ability to increase the solubility of lipophilic bioactives. The present study was conducted to increase the solubility of MA in different nanodispersions and to evaluate the MA concentration in formulated nanodispersions.

MA powder was supplied by Nippon Flour Mills Co., Ltd. Japan. The extraction of MA from powder (0.5% (w/w)) was conducted using 99.5% ethanol for a period of 24 h. Later, the MA was extracted using table centrifugation at 12,000 rpm for 40 min and the solid residue was separated using 0.45 μ m syringe filter. The supernatant was again filtered with 0.45 μ m filter before conducting emulsification. The continuous phase of nanodispersions include either 0.1% (w/w) Tween 80, polyglycerol esters of monooleate (MO-7S) or sodium casinate (Na-casinate) in Milli Q water. The nanodispersions were formulated using 10% volume fraction of ethanolic solution of MA powder and later homogenized using high-pressure homogenization (NanoVater, NV200, Japan) at 10-150 MPa in 2 cycles. Later, the ethanol was removed from nanodispersions using vacuum rotary evaporator at 40°C for 30 min. The droplet diameter (d_{av}) was measured by Zetasizer nano ZS (Malvern Instruments Ltd. UK), and the concentration of MA in nanodispersions were determined using Ultra-pure High Pressure Liquid Chromatography (UHPLC) (Thermo Fisher Scientific Inc., USA).

The results showed the d_{av} of nanodispersions formulated at different homogenization pressures ranged between 60 to 85 nm when formulated with Tween 80 and MO-7S, while the nanodispersions formulated with Na-casinate have larger d_{av} and varied between 60 to 200 nm with increasing homogenization pressures. The nanodispersions stabilized by Tween 80 retained about 0.25 to 0.38 mg/mL MA with different homogenization pressures. The MA concentration ranged between 0.15 to 0.36 mg/mL when stabilized with MO-7S. The nanodispersions showed physical stability of more than 10 days at 25°C and showed higher stability when stored at 4°C. The optimized formulation conditions include low homogenization pressures between 30 to 50 MPa with retention of MA between 0.35 to 0.38 mg/mL. However, the emulsifiers had almost no significant effect on retention profiles other than droplet sizes.

Acknowledgments

This research was partially supported by the Center of Innovation (COI) Program from MEXT, Japan and by the Science and Technology Research Partnership for Sustainable Development (SATREPS) from JICA/JST, Japan.

Semi-continuous Anaerobic Digestion with Ammonia-rich Substrate under Intermittent Illumination Condition

Nan ZHANG¹, Mishma Silvia STANISLAUS¹, Chenyu ZHAO¹ and Yingnan YANG²

¹Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

²Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

Along with the development of world population, the demand for meat products has risen drastically. The 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. In our previous study, the intermittent illumination method proved to be efficient in mitigating ammonia inhibition with batch operation. Therefore, a long-term semi-continuous anaerobic digestion with illuminated system under ammonium-rich condition was carried out under thermophilic condition to discuss the practical effect of intermittent illumination on mitigating ammonia inhibition.

In this experiment, a long-term 118-day semi-continuous anaerobic digestion with illuminated system was carried out under thermophilic condition (55 °C) by using ammonium-rich synthetic medium as substrate at nitrogen concentrations of 3000 mg/L. The bioreactors were illuminated for 60 minutes per day followed by treatment under dark conditions. After start-up, the bioreactors were fed with synthetic medium at different organic loading rate (OLR) and hydraulic retention time (HRT). During the semi-continuous operation, the illuminated bioreactor achieved shorter start-up period, apparently higher methane concentration and higher methane yield than that of the dark bioreactor. The illuminated system successfully provided a much easier condition for the microorganisms to tolerate the severe high ammonium by adsorbing ammonium efficiently and maintaining more optimal C/N ratio. The ATP value of the corresponding bioreactors indicated that illuminated system improved the activity of the methanogens even with high ammonium concentration. SEM analysis revealed that illuminated system improved the immobilization ability of the methanogens during the long-term operation. The result indicated that the illuminated system contributed to high efficiency and stability of the ammonia-rich anaerobic digestion process with long-term operation. An eco-friendly, low cost, easy operation process for high ammonium livestock waste treatment could be useful for practical application.

Optimization of the Fixed-bed Reactor by Identifying the Optimal Bedding Material and Substrate Concentration

Chenyu ZHAO¹, Nan ZHANG¹, Mishma Silvia STANISLAUS¹ and Yingnan YANG²

¹Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

²Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

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 and it generates only water vapor as byproduct; thus, hydrogen is an environmental friendly, combustible source of energy. Biological hydrogen production from anaerobic digestion process attracts more attention because it generates high rate of hydrogen, simple reactor as well as easy to control. On the other hand, conventional fixed-bed was used in methane fermentation, which improved the efficiency of anaerobic digestion effectively by improving the immobilization of bacteria. However, the research about the usage of fixed-bed in the hydrogen fermentation is limited. Therefore, the main purpose of this study is optimization of the fixed-bed reactor by identifying the optimal bedding material and different initial substrate concentration for enhanced biohydrogen production.

Fermentation was carried out at pH 5 and 35 °C under anaerobic conditions. Firstly, the effect of the fixed-bed bioreactor in hydrogen fermentation was investigated, as well as the optimal bedding material. Three different materials including loofah sponge (LS), chlorinated polyethylene (CPE) and porous nylon (PN) were selected as bedding materials. The highest cumulative hydrogen production of 676.4 mL/L was achieved from CPE fixed-bed bioreactor, which is 4 times higher than the LS (161.6 mL/L), 9 times than the PN (71.8 mL/L) and 65 times than the control (10.4 mL/L). The results showed that fixed-bed bioreactor improved the biohydrogen production compared with bioreactor without fixed-bed. Different bedding materials showed different performance, and CPE was obtained as optimal bedding material. After that, in order to study the effect of the initial substrate concentration, three different substrate concentrations of 3 g/L, 5 g/L and 7 g/L were investigated in the bioreactors. In all of the fixed-bed bioreactors, when the initial substrate concentration increased, the performance was better, with 7g/L achieving the highest production. Conclusively, fixed-bed reactors demonstrated positive results with regards to hydrogen production and immobilization of bacteria. Therefore, fixed-bed reactors have prospects over conventional reactors in the future.

Development of a Novel Zeolite Adsorbent Modified by Shell to Improve Methane Production

Takanori HIRANUMA¹, Nan ZHANG² and Yingnan YANG³

¹College of Agrobiological Resources Sciences, University of Tsukuba, Tsukuba, Japan

²Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

³Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

Anaerobic digestion is usually considered as a promising option for the treatment of livestock waste because it not only solves the problem of waste contamination gas emission, but also helps in obtaining energy, economic and social benefit. However, anaerobic digestion of ammonia-rich livestock waste is seriously inhibited by the ammonia generated during the biodegradation of organic nitrogenous compounds such as proteins, nucleic acid and amino acids. To mitigate ammonia inhibition, adding ammonium-selective adsorbents like zeolite could be the most attractive and practical method because of easy operation, cost-efficient, and the ammonium-saturated adsorbents can be further used as nitrogen fertilizer. But the adsorbents need to be further modified to enhance its adsorption capacity and improve its structure for immobilization of microorganisms. Therefore, this study focuses on development of modified zeolite as ammonium adsorbent and bed material in anaerobic digestion of ammonium-rich livestock waste.

In this research, natural zeolite was modified using shell, lignite and starch. Shell is a major food waste, widely distributed and rich in calcium, which is an important ion to improve ion exchange. Lignite and starch have also shown distinguished properties for ammonium adsorption from previous experiments. Therefore, these materials were chosen for modifying the zeolite.

Adsorption experiment was carried out at room temperature by using ammonium nitrogen solution (4000 mg/L). Contact times ranged from 0 to 24 h with 10 g/L of natural zeolite and modified zeolite immersed in that solution. After 24 h, ammonia concentration was measured, and the ammonia adsorption capacity was determined. As a result, the ammonia adsorption capacity of modified zeolite was higher than that of natural zeolite. For Ho's pseudo-second-order, the correlation coefficient ($R^2=0.997$) was high and no obvious difference occurred between the experimental (117.235 mg/L) and theoretical adsorbed mass (126.582 mg/L). The ammonium adsorption by modified zeolite fitted Ho's pseudo-second-order kinetics, which suggested to be a chemical process. Therefore, zeolite modified with shell showed prospects as an effective adsorbent in ammonia adsorption.

Search of Effective Wavelength to Measure Ethanol in Strawberry by Non-destructive Method Using NIR and MIR Spectroscopy

Yuto ISHIZUMI¹, Miho HATANAKA² and Takuma GENKAWA³

¹College of Agro-biological Resource Sciences, University of Tsukuba, Tsukuba, Japan.

²Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan.

³Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan.

E-mail: genkawa.takuma.fm@u.tsukuba.ac.jp

When the strawberry performs anaerobic respiration, the sugar in the strawberry changes to an anaerobic metabolism product and it causes the bad smell. If it is possible to distinguish the existence of anaerobic respiration in the strawberry by the non-destructive method, it is the help of study of the quality maintenance technology of the strawberry. The previous study reported to be able to capture generation of ethanol (main anaerobic metabolism product) in the strawberry by the destructive and non-destructive measurement using near infrared (NIR) spectroscopy. In this study, we measured the strawberry during storage for 0–3 days in an anaerobic state by non-destructive method using visible/NIR and mid-infrared (MIR) spectroscopy. Then, we searched the effective wavelength that could capture ethanol generation definitely by comparing the result of this non-destructive measurement using visible/NIR and MIR spectroscopy.

A range of 850–920 nm of the NIR 2nd derivate spectrum of the strawberry during the storage is discovered. In this range, it is known to observe the 3rd overtone of the C-H group. The band intensity at 890 nm decrease and the band intensity at 904 nm increase during the storage. The band at 890 nm is belong to sucrose and the band at 904 nm is belong to ethanol. Therefore, it is possible to capture changes from sucrose (sugar) to ethanol (anaerobic metabolism product) by the anaerobic respiration of strawberry. However, a spectrum during the storage for 1–3 days was piled up and it was not able to obtain a clear change.

A range of 900–850 cm^{-1} of the MIR 2nd derivate spectrum of the strawberry during the storage is discovered. In this range, it is known to observe the C-O group. The band intensity at 877 cm^{-1} increase during the storage. The band at 877 cm^{-1} is belong to ethanol. This range is able to capture ethanol production by the anaerobic respiration of strawberry more definitely than NIR range (850–920 nm).

In conclusion, it was believed that the effective wavelength to be able to capture the ethanol generation in the strawberry definitely was 877 cm^{-1} of MIR range.

Analysis of Frozen Food in Melting Process Using NIR Spectroscopy

Yukino ITO¹, Ayuko YAMAWAKI² and Takuma GENKAWA³

¹ College of Agro-biological Resource Sciences, University of Tsukuba, Japan

² Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

³ Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

Recently, the amount of the frozen food (low temperature food) production increases due to change of the eating habits and the cold chain development. However, the melting distinction of the frozen food is evaluated in melting time and experience of a worker. Therefore, the frozen food often caused a thawing irregularity and overheating. In previous study, a spectrum of ice and water was observed using near infrared (NIR) spectroscopy and succeeded in catching a consecutive melting change. The objective of this study was to confirm the possibility of NIR spectroscopy for the monitoring frozen food in melting. Commercial frozen oyster was used as a sample. NIR spectrometer was able to measure a frozen oyster every 5 seconds. Figure 1 showed the SNV-treated NIR spectra of melting frozen oyster in the region of 1100–1330 nm. The O-H band shifts shorter wavelength during melting. It is well known that the shift is observed in NIR spectra of water in heating and reflects intensity change in the hydrogen bands. In previous study, it was considered that the band shift reflects the change in the hydrogen bond induced by structural change of ice; from crystalline state to non-crystalline state. Figure 2 showed the first PC accounts for 99% of the region of 1100–1330 nm of the SNV-treated spectra. The score increases with time, and reached almost constant value after 30 minutes. This result shows that ice of the oyster surface have melted 30 minutes later from the previous study. In conclusion, a fusion evaluation of the frozen food is possible by using NIR spectroscopy.

Graphical Abstract

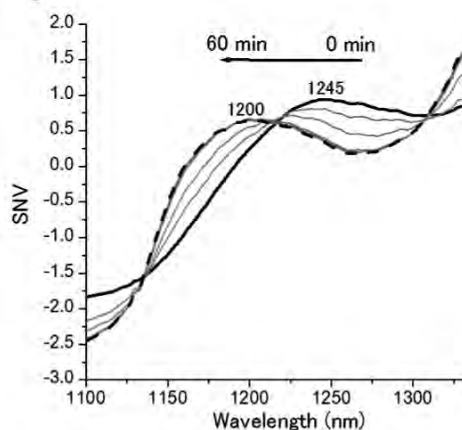


Fig. 1 The SNV-treated NIR spectra of melting frozen oyster

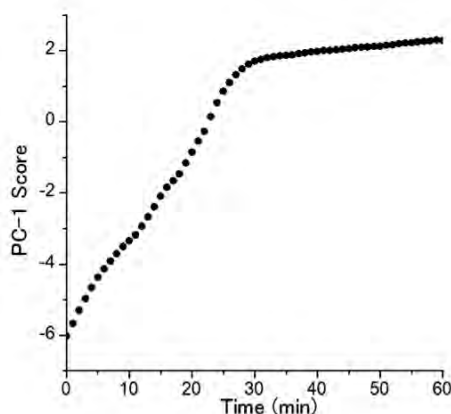


Fig. 2 The first PC accounts

Effect of Combustion Condition on the Amount of Eluted Soluble Silica in Rice Husk Charcoal

Kazuma IWAI¹, Eriko ANKYU², Ryozo NOGUCHI³ and Takuma GENKAWA³

¹ College of Agro-biological Resource Sciences, University of Tsukuba, Tsukuba, Japan

² Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

³ Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

Rice husk charcoal (RHC) that is by-product of rice husk combustion includes silicon dioxide abundantly. Currently, heat utilization of rice husk combustion in grain drying facilities is considered because of development of rice husk combustion furnace. Therefore, RHC is manufactured as by-product abundantly and expected to be used as soil amendment. Silicon dioxide changes into silicate acid (soluble silica) in the soil and it is absorbed to plant body. Soluble silica has an effect to raise the stress tolerance of plant body and to promote photosynthesis by standing straight the blade of grass. These material recycling in the agriculture is expected to be establish sustainable agriculture with reducing outside energy and material utilization. In this research, the amount of soluble silica included in RHC was measured with changing combustion temperature and time to obtain maximum amount of soluble silica. Additionally, the mechanism that soluble silica elutes on each combustion condition was proposed.

RHC as the experiment sample were manufactured on 12 combustion conditions that multiplied 6 conditions of combustion temperature from 400°C to 900°C every 100°C and 2 conditions of 3 minutes and 60 minutes of combustion time. The amount of soluble silica was measured by molybdenum blue absorptiometry. In addition, specific surface areas of each RHC were measured by BET method. Specific surface area shows degree of the crystallization of silica. In other words, crystallization of silica is restrained when specific surface area is big, and crystallization of silica progresses when specific surface area is small.

As a result, it was clarified that in 3 minutes combustion, crystallization of silica was restrained. It was likely that there was not crystallization of silica in the factor to decide amount of elution of soluble silica. It is considered that much plant fiber were removed under the condition of high combustion temperature and long combustion time. In 60 minutes combustion, crystallization of silica progressed because combustion temperature was high. Therefore, the amount of eluted soluble silica was decreased. As the mechanism of elution of soluble silica in RHC, degree of removal of plant fiber and crystallization of silica were considered to be related. It was considered that elution of soluble silica was likely to increase in RHC that removal of plant fiber was enough and crystallization of silica was restrained.

Formulation and Characterization of Oil-in-water Emulsions Stabilized by Different Types of Carrageenan

Sota MATSUMOTO¹, Nauman KHALID², Marcos A. NEVES^{3,4}, Isao KOBAYASHI⁴ and Mitsutoshi NAKAJIMA^{2,3,4}

¹College of Agro-biological Resource Sciences, University of Tsukuba, Japan

²Algae Biomass and Energy System R&D Center, University of Tsukuba, Japan

³Faculty of Life and Environmental Sciences, University of Tsukuba, Japan

⁴Food Engineering Division, Food Research Institute, NARO, Tsukuba, Japan

Synthetic emulsifiers are commonly used in food industry for production of different emulsified products. These synthetic emulsifiers at high concentrations, are at risk of human health. It is necessary to substitute the synthetic emulsifiers with natural emulsifiers and carrageenan is one of the potential candidate. Carrageenan is a kind of food hydrocolloid extracted from red seaweed and used as thickening or gelling agent in food products. It consists of sulfated disaccharides, and is roughly classified into 3 types (κ , ι and λ) depending upon the sulfated site. In the literature, carrageenan had a little interfacial activity, but its role as emulsifier in food products is limited. Keeping in view, this study was conducted aiming to formulate oil-in-water (O/W) emulsions stabilized by different types of carrageenan, and to evaluate its emulsification characteristics.

The continuous phases were prepared by heating 0.25-1.0% (w/w) κ , ι or λ -carrageenan solutions in Milli-Q water at 65°C for 30 min, and stored at 5°C overnight for complete hydration. Later, the solutions were heated at 65°C for 30 min and their respective density and interfacial tension were determined at 25, 50 and 65°C. Soybean oil (volume fraction, 5% (w/w)) was used as a dispersed phase. The mixture was heated at 80°C before homogenization. Later, the mixture was homogenized with rotor-stator homogenizer at 10000 rpm, for 5 min followed by high pressure homogenization at 100 MPa for 2 passes at ambient temperature. The emulsions were stored at room temperature for 10 days and the droplet sizes (d_{av}) were measured by Laser Scattering Diffraction method for 10 days.

The interfacial tension of each carrageenan solution decreased with increasing temperature. The lowest interfacial tension was recorded at 65°C. The interfacial tension of κ -carrageenan decreased with increasing concentration, however the interfacial tension increased with increasing concentration of ι -carrageenan. There was almost no change in interfacial tension of λ -carrageenan with increasing concentration from 0.25 to 1.0% (w/w). The d_{av} of 1% (w/w) different carrageenan emulsions were slightly increased with storage time. However, different types and concentrations showed different physical stability profile. The O/W emulsions phase separated after 3 days when stabilized with 0.5% (w/w) carrageenan solutions, with d_{av} increased from 15 to 30 μm . The O/W emulsions partially phase separated when stabilized with 1.0% (w/w) carrageenan solutions. The O/W emulsions were relatively stable when formulated with ι -carrageenan probably due to viscosity difference.

Effect of Plant Hormones on Spikelet Sterility of Rice at High Temperatures

Takahiro MITSUI¹ and Sachio MARUYAMA²

¹ College of Agro-Biological Resource Sciences, University of Tsukuba, Tsukuba, Japan

² Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

Rice (*Oryza sativa* L.) is sensitive to high temperature stress at reproductive stage. Heat stress at booting stage increases spikelet sterility and reduces grain yield. In barley, plant hormones alleviate spikelet sterility at high temperatures, but the effect has not been confirmed in rice. We thus examined whether plant hormones could reduce spikelet sterility of rice at high temperatures or not.

A high-temperature tolerant rice cultivar, Akitakomachi, and a high-temperature susceptible cultivar, Hinohikari, were transplanted in 1/10000 a pots filled with soil in a plastic house at Agricultural and Forestry Research Center, University of Tsukuba. Auxin or jasmonic acid (0, 10^{-6} , 10^{-5} , 10^{-4} M) were sprayed 4 times at panicle development stage, then a half of the plants were moved to a growth chamber at 37/25°C (day/night) (high-temperature treatment) at booting stage (from 12 to 7 days before heading). The rest of the plants were placed in an artificial climate room at 25/25°C (day/night) during the treatment to serve as controls. After the treatment, the plants were back to the plastic house, and grown until maturity.

As a result, plant hormones hardly affected the number of spikelets in both cultivars treated with high-temperature. Plant hormones reduced spikelet sterility of the plants with the high-temperature treatment, except Hinohikari treated with 10^{-4} M auxin. The results suggest that plant hormones alleviate spikelet sterility at high temperatures, although the alleviation effect is different among cultivars, hormones and their concentrations. In addition, plant hormones even reduced spikelet sterility in the control plants grown at normal temperature of 25°C. The results indicate that plant hormones could increase grain yield at optimum temperatures. It is necessary that the further investigations on the effects of plant hormones. Specifically, the effects on other cultivars, wider range of concentrations and several plant hormones treated together.

Comparing the Water Splitting Efficiency by Using Different Temperature of Hydrothermal Synthesis of Photocatalytic Composite under Solar Light

Daichi NAGAI¹, Qi ZHU², Hangxing SHEN² and Yingnan YANG²

¹College of Agro-biological Resource Science, University of Tsukuba, Tsukuba, Japan

²Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

The growing demand for energy in today's world has been met with a massive exploitation of fossil fuels which resulted in the increase of pollutants emission. This state of affairs requires the development of alternative and environmentally friendly energy sources. Hydrogen is one of the promising clean energy sources to address the energy and environmental issues. Photocatalytic water splitting under solar light has been extensively studied as an effective and clean way to obtain hydrogen. For efficiently utilizing the sunlight, a photocatalyst must be responsive to visible light, which makes up the major part of the solar spectrum. Unfortunately, most of the photocatalysts have a wide band gap which makes them only absorb the ultraviolet part of the sunlight spectrum. According to our previous study, P/Ag/Ag₂O/Ag₃PO₄/TiO₂ photocatalyst has been successfully synthesized by using hydrothermal method with small band gap (about 2.2 eV) and high separation efficiency of photo-excited electron-hole pairs, which could attribute to its enhanced photocatalytic performance. However, the efficiency of photocatalytic water splitting under solar light by using P/Ag/Ag₂O/Ag₃PO₄/TiO₂ has not been completely investigated.

In this study, the efficiency of H₂ and O₂ production through photocatalytic water splitting by using P/Ag/Ag₂O/Ag₃PO₄/TiO₂ photocatalyst which prepared at different calcination temperature, 120°C and 140°C were investigated. Rhodamine B and glycerol were used as sacrificial agent for increasing the H₂ and O₂ production.

From the results, water splitting under solar light was achieved and P/Ag/Ag₂O/Ag₃PO₄/TiO₂ calcined at 120°C shows higher activity than 140°C. The 120°C of hydrothermal synthesis of P/Ag/Ag₂O/Ag₃PO₄/TiO₂ could be a promising material for hydrogen production.

Development and Characterization of Gluten-free Bread by Rice Gel and Rice Milk

Asuka NAKANO¹, Yutaka KITAMURA² and Mito KOKAWA²

¹College of Agrobiological Resource Sciences, University of Tsukuba, Japan

²Faculty of Life and Environmental Sciences, University of Tsukuba, Japan

In recent years, new sources of demand rice has been attracting attention in Japan for several reasons: 1) the grain prices are rising on a global scale due to increasing in the grain demand, 2) the improvement of food self-sufficiency rate is an urgent issue in Japan because it is particularly low among developed countries, and 3) there are many patients in the world who have wheat or gluten allergy (celiac disease). To solve the problems above, making bread from rice without using wheat has been proposed. However, making rice flour bread has many problems such as low bulge, short shelf life, bad texture and high price. Furthermore, the production of rice flour bread came to a peak in 2011, and then decreased.

For these reasons, we thought that rice flour bread needed an introduction of new processing methods in place of the rice flour. Although there are multiple forms of processed rice, this experiment focused on two of them, rice gel and rice milk. Rice gel is a gel-like food material, which is made by shearing cooked rice at high speed. The advantages of using rice gel are that it is possible to reduce the cost because it uses high-amylose rice and that its addition to rice flour bread prevents the hardening of the bread compared with that of only rice flour. Rice milk is a very simple and nutritious liquid food material produced from brown rice and water. The advantages of using rice milk are that it is excellent in operability due to its liquid form and that it can be expected to reduce both starch damage and cost by an abbreviation of the drying process.

In this study, experiments were conducted by focusing on the water content, which is an important factor in bread. The objectives of this study were to develop and find the optimal production conditions for a gluten-free bread made from rice gel and rice milk.

Rice gel was prepared by high-speed shear treatment of gelatinized high-amylose rice. Rice milk was prepared by using the MWM (micro wet milling), which is a machine that mills materials with liquid. The bread was made by an automatic bread machine. After baking, the bread loaf height and specific volume were measured, and a cross-sectional photograph was taken. In addition, the texture of the samples after 1 to 3 days was measured.

This study is expected to be effective in improving the quality of bread made from rice by using other rice processed goods instead of rice flour, and be one of the new consumption forms of rice.

Diffusion Simulation of Free Silicic Acid from the Rice Husk Combustion Furnace

Kai SAKURAI¹, Eriko ANKYU² and Ryozo NOGUCHI³

¹ College of Agro-biological Resource Sciences, University of Tsukuba, Tsukuba, Japan

² Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

³ Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

Rice production is 8.5 million ton in Japan. Rice includes 20% of rice husk. 20% of rice husk is not used due to difficulty of decompose structure. Therefore, usage of unused rice husk is expected. Biomass combustion furnace is one of the way to use rice husk. Rice husk charcoal made by combustion furnace is possible to be used as fertilizer. Combustion process transforms silica included in rice husk into free silicic acid. It has been reported that inhaling of free silicic acid in long term causes lung disease. Japan Society for Occupational Health set permissible concentration of free silicic acid. It is necessary for installation of combustion furnace to simulate diffusion. The purpose of this study is risk assessment of rice husk combustion furnace.

Two basic simulation model called plume model and puff model were used. These models used to simulate diffusion in the atmosphere. Plume model is applicable when emission rate is constant. Puff model is applicable when emission rate change temporarily. Simulation model required some parameters; stack height, wind speed, atmospheric stability parameter and velocity of emission. Assumed parameters were 2 m stack height, 3.5 m/s wind speed, three types of atmospheric stability parameter (stable, mean, unstable), 2.4 m³/s velocity of emission, 0.03 mg/m³ permissible concentration.

Result shows that free silicic acid diffused beyond permissible concentration reached up to 125 m from source. In this case, location to install combustion furnace was desired 125 m away from living environment. Concentration was influenced by atmospheric stability and stack height. In the case of that emission rate change temporarily, free silicic acid diffused beyond permission concentration was maximum 5 second. Farther from the source, exposure time is short, however the concentration was lower than the permissible concentration. It shows that to change emission rate temporarily is small influence. It is possible to reduce concentration by increasing stack height. It is considered to be more accurate result by adding weight of the particles in the simulation.

Effects of Protein Addition on Lactic Acid Fermentation of Rice Milk

Rei TAKAHASHI¹, Yutaka KITAMURA² and Mito KOKAWA²

¹ College of Agrobiological Resource Sciences, University of Tsukuba

² Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba

Rice milk is a new liquid food material made from brown rice by wet milling. Rice milk has higher operability than rice flour, so it can be processed into foods that rice flour cannot be, for example, ice cream, pudding and drinks. In addition, there is less damaged starch compared to conventional milling, and nutrients such as vitamins are retained because frictional heat is not generated during the process. Lactic acid fermentation is the reaction where glucose changes into lactic acid by lactic acid bacteria, and is expected to be a new method of a processing rice milk. It has some advantages such as the 2improvement of safety and storage stability of rice milk because the pH value is decreased by the lactic acid bacterium. Additionally, lactic acid fermentation can add functions of probiotics to the rice milk, for example, functions of regulating the intestine, improvement of the immune system and suppression of cancer.

In this study, we aimed to produce a yogurt-like food made from rice milk. The principle of yogurt congealation is that the pH value is decreased due to the production of lactic acid, and the protein in milk is denatured (this is called acid coagulation). However, rice milk contains a lot of starch and less protein, and consequently, coagulation of protein does not occur. Therefore, we thought that protein addition would be effective to introduce acid coagulation. The purpose of this study is to determine the effects of protein addition on lactic fermentation and characteristics of congealation.

The materials used were brown rice and rice protein. Both materials were milled by micro-wet milling (MWM) using an improved electric stone mill. Before lactic fermentation, brown rice went through a saccharification process. The milled brown rice and rice protein were named rice milk and rice protein milk. Mixed milk was also made by changing the ratio of two kinds of milk. The protein contents of the milk samples were measured before fermentation. After fermentation, pH value, lactic acid content, glucose content and viscosity were measured. From this study, we were able to show the potential of a yogurt-like food made from rice.

Evaluation of Wet Aging Effects on Breaking Strength, Water Holding Capacity and Flavor Component of Beef from Three Parts

Eri TAKAI ¹, Yutaka KITAMURA ², Mito KOKAWA ²

¹ College of Agrobiological Resource Sciences, University of Tsukuba

² Faculty of Life and Environmental Sciences, University of Tsukuba

In Japan, approximately 500,000t of domestic beef is produced in one year. Roughly 30% (150,000t) of the beef are from dairy cattle, of which 100,000t are from steer dairy cattle. Most of the male dairy cattle, excluding some candidates for seed bull, are fattened after castration and shipped for human consumption. In comparison with Japanese cattle (wagyu), dairy cattle are cheap, and their meat tends to contain less fat and to be tough. On the other hand, meat aging is practiced to improve flavor and texture of beef. Previous research have shown that some muscles tend to be improved more effectively than others by aging because hardness and fat content vary greatly between different muscles. Therefore, some muscle may have little advantage of long time aging. For the reasons stated above, it is necessary to improve the tenderness of meat from dairy cattle by aging and to examine the aptitude of different muscle for aging.

The objective of this study was to examine the aging aptitude of three muscles (*Longissimus dorsi*, *Psoas major*, *Semitendinosus*) from Holstein steer meat, by measuring breaking strength, water holding capacity and flavor component during aging. The three muscles used as samples were all different in items of hardness and fat content. The muscles which had the highest fat content was *longissimus dorsi*, followed in order by *Psoas major* and *semitendinosus* and tenderness was in the same order. The three parameters measured were indices for assessing the extent of improvement of meat quality by aging. Firstly, the load, which is the breaking strength of the cooked meat when bitten with the front teeth, was measured by the Warner-Bratzler method. Secondly, the amount of water held by the meat when subjected to centrifugal force were measured, and was defined as water holding capacity. These two values indicated the tenderness and juiciness of the meat. Thus, the effect of aging on the three muscles was observed by measuring them. Moreover, it was reported that marbling and method of packing the meat affected on flavor component. In this work, flavor component of the three muscles were measured using gas chromatography-mass spectrometer (GC-MS). Aptitude of the three muscles for aging were examined by judging if the components obtained were favorable or not.

Non-Destructive Analysis of Lutein in Spinach Using Raman Spectroscopy

Masato TANAKA,¹ Risa HARA,² Takuma GENKAWA³

¹College of Agro-biological Resource Sciences, University of Tsukuba, Tsukuba, Japan

²Graduate School of Life and Environmental Sciences, University of Tsukuba,
Tsukuba, Japan

³Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

Lutein; it is mainly included in leaf vegetables, is one of the carotenoids. Due to commercial reason, easily and speedy inspecting method for check the lutein content in the spinach is required. In prior work, spectra of carrot were observed by Raman spectrometer for laboratory use, it succeeded in analyzing of peaks assigned to carotenoids. First objective of the present work was to analyze lutein and carotenoids included in spinach using Raman spectroscopy, especially portable Raman Spectrometer. Second objective was to confirm portable Raman spectrometer has enough performance to analyze carotenoids by comparing present and prior work.

Eighteen leaves of fresh spinach were used as a sample. About leaf blade and petiole, 3 points each of both surfaces of a leaf were analyzed by Raman spectrometer. 108 spectra were counted as average for leaf blade and petiole. As a result, intense bands are observed at 1520 cm^{-1} (C=C str.) and 1156 cm^{-1} (C-C str.), and a relatively intense band is observed at 1004 cm^{-1} on the spectra of the leaf blade. On the other hand, there was no intense band on the spectrum of the petiole. It was reported that content of lutein in spinach is high in the leaf blade, low in the petiole. For this reason, there were some intense bands in the leaf blade, but not in the petiole. Spectra of leaf blade shows similar wave pattern to one of the previous research. Therefore, it was confirmed that portable Raman spectrometer has enough performance to analyze carotenoids.

- **Organizing Committee**
- **Executive Committee**

Organizing Committee

Chairperson:

Yooichi KAINOH Director, Agricultural and Forestry Research Center, UT

Secretary-General:

Ryozo NOGUCHI Associate Professor, Agricultural and Forestry Research Center, UT

Members:

(Biosphere Resource Science and Technology)

Ryo OHSAWA Professor, Faculty of Life and Environmental Sciences, UT
DeMar TAYLOR Professor, Faculty of Life and Environmental Sciences, UT
Yuichi YAMAOKA Professor, Faculty of Life and Environmental Sciences, UT
Seungwon KANG Associate Professor, Faculty of Life and Environmental Sciences, UT

(Appropriate Technology and Sciences for Sustainable Development)

Toshiharu ENOMAE Professor, Faculty of Life and Environmental Sciences, UT
Motoyoshi KOBAYASHI Associate Professor, Faculty of Life and Environmental Sciences, UT
Hisato SHUTO Associate Professor, Faculty of Life and Environmental Sciences, UT
Tofael AHAMED Associate Professor, Faculty of Life and Environmental Sciences, UT
Takuma GENKAWA Assistant Professor, Faculty of Life and Environmental Sciences, UT
Marcos NEVES Assistant Professor, Faculty of Life and Environmental Sciences, UT

(Bioindustrial Sciences)

Yingnan YANG Professor, Faculty of Life and Environmental Sciences, UT
Nakao NOMURA Associate Professor, Faculty of Life and Environmental Sciences, UT

(Laboratory School)

Yoshikazu TATEMOTO Teacher, Senior High School at Sakado, UT

(Agricultural and Forestry Research Center)

Tomohiro TAKIGAWA Professor, Agricultural and Forestry Research Center, UT
Atsushi TAJIMA Professor, Agricultural and Forestry Research Center, UT
Yoshihiko TSUMURA Professor, Agricultural and Forestry Research Center, UT
Hisayoshi HAYASHI Professor, Agricultural and Forestry Research Center, UT
Naoya FUKUDA Associate Professor, Agricultural and Forestry Research Center, UT
Atsushi ASANO Assistant Professor, Agricultural and Forestry Research Center, UT
Naoto ISHIKAWA Assistant Professor, Agricultural and Forestry Research Center, UT
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

(JICA)

Takao SHIBUSAWA Deputy Director General, Tsukuba International Center,
Japan International Cooperation Agency (JICA)

(JIRCAS)

Kunimasa KAWABE Head of International Relations Section,
Japan International Research Center for Agricultural Sciences (JIRCAS)

(As of Sep.1, 2016)

Executive Committee

Chairperson:

Yooichi KAINOH Director, Agricultural and Forestry Research Center, UT

Members:

Atsushi TAJIMA Professor, Agricultural and Forestry Research Center, UT

DeMar TAYLOR Professor, Faculty of Life and Environmental Sciences, UT

Seungwon KANG Associate Professor, Agricultural and Forestry Research Center, UT

Ryozo NOGUCHI Associate Professor, Agricultural and Forestry Research Center, UT

Atsushi ASANO Assistant Professor, Agricultural and Forestry Research Center, UT

Morio KATO Assistant Professor, Agricultural and Forestry Research Center, UT

Tsuyoshi HONMA Senior Technical Official, Agricultural and Forestry Research Center, UT

Mizuki MATSUOKA Chief Technical Official, Agricultural and Forestry Research Center, UT

Shoichi HIROSE Associate Head, Agricultural and Forestry Research Center, UT

Masami SAKAMOTO Chief, Agricultural and Forestry Research Center, UT

Tomoko KONDO Staff, Agricultural and Forestry Research Center, UT

Taeko MORI Staff, Agricultural and Forestry Research Center, UT

(As of Sept.1, 2016)

- ・筑波アジア農業教育セミナー及び
Ag-ESDシンポジウムの沿革
- ・Ag-ESDシンポジウム2016/TGSW2016の
概要
- ・Ag-ESDシンポジウム2016/TGSW2016の
日程表

筑波アジア農業教育セミナー及びAg-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
ー主として、カリキュラム開発についてー
- 1981年 アジア地域の中等段階農業教育における教授法
ー主として、稲作についてー

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 ー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 ー事例と展望 (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 ー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な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カ国（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カ国（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」をテーマとしてシンポジウム（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。

2015年は、「食料資源の有効活用と環境保全」をテーマにシンポジウム（Ag-ESD Symposium 2015）を開催し、11月16日から20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、スウェーデン、ガーナ及び日本）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。

Ag-ESD Symposium 2016/TGSW2016 の概要

1. 題 目

「海外型インターンシップを通じた食料・生物資源分野の国際人材育成教育」

〔 Education for Sustainable Development
Overseas Internship / Agriculture, Food and Environment 〕

2. 期 間

平成 28 年 9 月 18 日(日)～9 月 19 日(月)

(エクスカージョンを含めると 9 月 20 日(火)まで)

(TGSW2016 の開催期間は 9 月 17 日(土)～9 月 19 日(月))

3. 会 場

筑波大学 総合研究棟 A

4. オーガナイザー

筑波大学農林技術センター

5. 後 援

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. 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
- ・ FAO、JICA、民間企業
- ・ 筑波大学、茨城大学、明治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

7. 会議の形態

招待講演、ポスターセッション、若手研究者フォーラム

8. 使用言語

英語

Ag-ESD シンポジウム 2016 (Ag-ESD Symposium 2016) / TGSW2016 の日程表

月 日	時 間	プ ロ グ ラ ム
9月 16日 (金)		招聘外国人の成田空港到着・宿泊 [成田のホテル]
9月 17日 (土)	06:00~07:30 08:00~09:30 09:30~12:30 12:30~13:30 (13:30~16:30) 15:00~15:30 16:00~17:00 18:00~20:00	招聘外国人の出迎え (大学から成田のホテルへ) 移動 (成田から国際会議場へ) オープニングセッション+産官学連携企画 昼食・休憩 各セッション 移動 (国際会議場から大学会館別館へ) 事務手続き・オリエンテーション (概要説明) 歓迎パーティ [国際会議場] [大学会館別館] [スープファクトリー]
9月 18日 (日)	09:30~ ~09:45 09:45~10:15 10:15~10:45 10:45~11:00 11:00~11:30 11:30~12:00 12:00~13:00 13:00~13:30 13:30~14:00 14:00~14:30 14:30~14:45 14:45~15:15 15:15~15:45 15:45~16:00 16:00~16:25 16:25~16:30 16:30~17:00 17:00~20:00	挨拶 (センター長、系長、JICA 筑波、JIRCAS)、 全体説明、記念写真撮影 招待講演 (1) 【 FAO : ABE 】 招待講演 (2) 【 フィリピン大学 : OLIVEROS 】 休憩 招待講演 (3) 【 カセサート大学 : NAKASATHIEN 】 招待講演 (4) 【 ボゴール農科大学 : HARIYADI 】 昼食・休憩 招待講演 (5) 【 ユタ州立大学 : HOLE 】 招待講演 (6) 【 AEC : FUJITA 】 招待講演 (7) 【 茨城大学 : SATO 】 休憩 招待講演 (8) 【 明治大学 : TSUBOTA 】 招待講演 (9) 【 筑波大学 : NOMURA 】 休憩 総合討論 議長 【 明治大学 : KONUMA 】 挨拶 (副センター長) 休憩 インターン学生主催夕食会 [総合研究棟 A]
9月 19日 (月・祝)	09:00~12:00 12:00~13:00 13:00~13:30 13:30~14:00 14:00~14:30 14:30~14:40 14:40~15:10 15:10~15:40 15:40~16:00 16:00~16:30 17:30~18:00 18:00~20:00	ポスターセッション 昼食・休憩 発表 (1) 【 茨城大学 : AROFATULLAH 】 発表 (2) 【 ボゴール農科大学 : SEMINAR 】 発表 (3) 【 カセサート大学 : TONTHONG 】 休憩 発表 (4) 【 フィリピン大学 : TAPIA 】 発表 (5) 【 筑波大学 : HISATOME 】 休憩 表彰式 移動 (大学からホテルグランド東雲へ) TSUKUBA 宣言 & 懇親会 [総合研究棟 A] [ホテルグランド東雲]
9月 20日 (火)	07:00~17:00	エクスカージョン (日光)
9月 21日 (水)	09:00~10:00	招聘外国人の帰国 (大学から成田空港へ)

Ag-ESD シンポジウム 2016 / TGSW2016

平成 28 年 9 月 18 日 (日) ~ 9 月 19 日 (月・祝)

海外型インターンシップを通じた食料・生物資源分野の国際人材育成教育

- オーガナイザー 筑波大学 農林技術センター
- 後援 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)
- 会場 筑波大学 総合研究棟 A

Ag-ESDシンポジウム組織委員会

発行者：筑波大学 農林技術センター

発行日：2016 年 9 月 18 日