

International Symposium on the UN's Sustainable Development Goals

生物圏科学研究科 国際シンポジウム

Date: 2 October, 2018 (Tue.) 9:00 – 16:45

Venue: Room C206, Graduate School of Biosphere Science, Hiroshima University

日時：平成30年10月2日（火） 9:00 – 16:45

場所：広島大学大学院生物圏科学研究科（生物生産学部） C206 講義室



Message

国連の持続可能な開発目標（The UN's Sustainable Development Goals : SDGs）は相互に関連する17のゴールからなり、2030年までの達成が求められています。私たち生物圏科学研究科は少なくともこれら半分のゴールを直接カバーする、包括的な研究・教育を行っています。

このシンポジウムにおいては、環境～生物多様性～生物資源の生産～食品科学の幅広い分野を網羅する7つのセッションを通して、アジア圏の8つの協定大学等から招いた研究者や学生が研究成果や自国の実情を発表します。また、生物圏科学研究科の大学院生による関連した研究の口頭発表・ポスター発表も行われます。これら発表を通して、持続可能な開発目標を達成し、真に持続的であり平和的な世界を構築するための包括的な解決方法やブレークスルーを議論したいと考えています。

The UN's Sustainable Development Goals (SDGs) consist of 17 interdependent goals that are expected to be achieved by 2030. We at the Graduate School of Biosphere Science have conducted comprehensive research and education which are directly involved in at least half of the goals (No Poverty, Zero Hunger, Good Health and Well-being, Clean Water, Responsible Consumption and Production, Climate Action, Life Below Water, Life of Land). In this symposium, through a total of 7 sessions covering environment ~ biological diversity ~ bio-resource production ~ food sciences, researchers and students from eight partner universities in Asia will deliver their research outcomes or country reports which will then be followed by relevant research presentations (oral or poster) by GSBS students. At the end, we are going to discuss how we could elaborate comprehensive solutions or breakthroughs to help achieve the UN's SDGs, to pursue a sustainable and peaceful world through our researches.

Program

General Chairperson: Dr. Lawrence M. Liao

9:00 Opening Message

Dr. Yoshihiro Sambongi, Dean

Rationale of the Symposium

Dr. Lawrence M. Liao

9:10 Session 1 (Chair : Dr. Tamiji Yamamoto)

Dr. Md. Jahangir Sarker (Noakhali Science and Technology University, Bangladesh)

"Heavy Metals in Fishes: A Potential Human Health Risk Assessment in Bangladesh"

Mr. Jamaluddin Fitrah Alam (Graduate School of Biosphere Science, Hiroshima University)

"Sustainably Managing Forests and Sea with Timber Reefs"

Ms. Afsana Kabir Dipty (Noakhali Science and Technology University, Bangladesh)

"Impact of Fish Culture on Nearby Agricultural Production in Greater Noakhali District, Bangladesh"

9:55 Session 2 (Chair : Dr. Susumu Otsuka)

Dr. Soh Ho Young (Chonnam National University, Republic of Korea)

"Species Diversity and Occurrence Patterns of Planktonic Copepods from Korean Coastal Waters"

Ms. Sakie Yoshioka (Graduate School of Biosphere Science, Hiroshima University)

"Effects of Water Temperature, Irradiance and Nitrate on the Growth of Sporelings of the Nongeniculate Coralline Alga *Lithophyllum okamurae* Foslie (Corallinales, Rhodophyceae)"

Ms. Lim Young Hui (Chonnam National University, Republic of Korea)

"Marine Ecosystem Protection"

Mr. Fariz Kevin Harlens (Airlangga University, Indonesia)

"Current Status of the Indonesian Fisheries Sector: Approach to the Shrimp Culture"

10:50 Break time

11:00 Session 3 (Chair : Dr. Toshinori Nagaoka)

Dr. Weerakkody Arachchilage Palitha Weerakkody (University of Peradeniya, Sri Lanka)

"Protected Culture, the Appropriate Agri-technology for Ensuring Food and Nutritional Security in the Tropical Region"

Mr. Hiroaki Furutani (Graduate School of Biosphere Science, Hiroshima University)

"Characterization of LaMATE-PI1, a Candidate of Citrate Transporter Isolated from Cluster Roots of White Lupin"

Ms. Pitiye Gedara Ayesha Sanjeevani Warnasooriya (University of Peradeniya, Sri Lanka)

"Enhancing Production Stability of Tropical Fruits through Variety Selection and Propagation"

11:45 Lunch break

12:50 Session 4 (Chair : Dr. Taketo Obitsu)

Dr. Lolito Casane Bestil (Visayas State University, Philippines)

"Fight Hunger and Poverty with Goats: Developing Nutritional Supplements from Farm By-Products for Increased Survival and Performance of Pre-Weaning Kids"

Mr. Masaru Matsumura (Graduate School of Biosphere Science, Hiroshima University)

"Use of Green Forage: Phytol from Plant Chlorophyll for Ruminant Nutrition"

Ms. Marjorie Almario Licatan (Visayas State University, Philippines)

"Fight Hunger and Poverty with Goats: Improving Animal Health using Ginger (*Zingiber officinale* Roscoe) Pulp as Dewormer"

13:35 Session 5 (Chair : Dr. Hirofumi Nariya)

Dr. Alonzo A. Gabriel (University of the Philippines Diliman, Philippines)

"A Mathematical Model for the Influences of Intrinsic Fruit Juice Properties on the Ultraviolet-C Inactivation Energy of a Resistant Reference Spoilage Yeast Species "

Mr. Emil Emmanuel Estilo (Graduate School of Biosphere Science, Hiroshima University)

" Effects of Diluents, Temperature and pH on the Enumeration and Growth Kinetics of *Alicyclobacillus acidoterrestris* in Standard Growth Media "

Mr. Richard Paolo M. Aba (University of the Philippines Diliman, Philippines)

"Inactivation of Pathogens in Human Breast Milk, Infant Formula Milk, and Cow's Milk during Holder Pasteurization"

14:20 Poster presentations by HU students

15:00 Session 6 (Chair : Dr. Takuya Suzuki)

Dr. Tran Van Hung (Ho Chi Minh City University of Food Industry, Vietnam)

"Use of Natural and Naturally Derived Compounds in Preserving Meat, Seafood and Agricultural Products in Vietnam "

Ms. Jakia Sultana Jothi (Graduate School of Biosphere Science, Hiroshima University)

"Effect of Trehalose on the Physical Stability of Deep-fried Food Characterized by Glass Transition Temperature"

Mr. Nguyen Tri Khoi (Ho Chi Minh City University of Food Industry, Vietnam)

"Research on Ingredients and Biological Activity of Polyphenol from Green Tea of Vietnam"

15:45 Session 7 (Chair : Dr. Thanutchaporn Kumrungsee)

Dr. Sasitorn Tongchitpakdee (Kasetsart University, Thailand)

"New Value-Added Products From Thai Sweet Cassava"

Ms. Mahisanunt Busakorn (Graduate School of Biosphere Science, Hiroshima University)

"Effects of Tripalmitin and Tristearin on Crystallization of Coconut oil"

Ms. Palita Pornchaiwannachat

"Edible Insects in Thailand : New Alternative High Protein Sources"

16:30 General Discussion (Chair : Dr. Lawrence M. Liao)

16:40 Closing Remarks

Dr. Kazuhiko Koike, Vice Dean

Heavy Metals in Fishes: A Potential Human Health Risk Assessment in Bangladesh

*Md. Jahangir Sarker¹, Nazmun Nahar Rima¹

¹Department of Fisheries and Marine Science, Noakhali Science and Technology University, Noakhali-3814, Bangladesh.

Abstract

Health risk due to consumption of fish food from aquatic ecosystems contaminated with hazardous chemicals including metals has been increased globally especially in developing countries like Bangladesh. Exposure to heavy metals has linked to several human diseases such as development retardation or malformation, kidney damage, cancer, abortion, effect on intelligence, behavioral and even death in some cases of exposure to very high concentrations. This study is therefore aimed to assess the heavy metals contamination and health risk in most commercially important 6 marine fish species (*Lates calcarifer*, *Penaeus monodon*, *Encrasicholina heteroloba*, *Polynemus paradiseus*, *Sillaginopsis panijus* and *Ilisha megaloptera*) collected in June 2016 from Meghna estuary, Noakhali, Bangladesh. Analysed heavy metal concentrations using inductively coupled plasma mass spectrometer (ICP-MS, Agilent 7700 series) in 6 marine fish (Cu, Pb and Cd) species were below the Food Safety Guideline (FSG) by WHO/FAO except Zn and Cr. Safe dietary intake (CR_{lim}) and maximum allowable fish consumption rate (CR_{mm}) were also calculated and presented. Assessment of noncarcinogenic health hazard by target hazard quotient (THQ) indicated no concern from consumption of these fishes (<1). Interestingly the target cancer risk (TR) of Cr for intake of these fishes with the average of $2.29E-04$ suggested significant ($P < 0.025$) cancer risk through consumption of these 6 fish species.

Keywords: Heavy metal, Health risk, Target hazard quotient (THQ), Hazard index (HI), Target Cancer Risk (TR), Meghna river estuary

Introduction:

Increased urbanizations and industrialization gradually added new term “heavy metal pollution” in Bangladesh. Human beings intake fishes to support good health (Dural, *et al.*, 2007), but there is a growing concern that metals accumulated in fish may represent a health risk, especially for populations with high fish consumption rates (Burger and Gochfeld, 2009; Diez, *et al.*, 2009). Heavy metals accumulate in vital organs in the human body resulting in numerous serious neurotoxic and carcinogenic effects (Duruibe *et al.* 2007; Sapkota *et al.* 2008). Although there are some reports on human health assessment in Bangladesh through fresh water carp fish consumption (Kawsar *et al.*, 2016), carcinogenic assessment of heavy metals through marine fish consumption has yet been untouched.

Materials and Methods:

6 different fresh marine fish species (*Lates calcaifer*, *Penaeous monodon*, *Encrasicholina heteroloba*, *Polynemus paradiseus*, *Sillaginopsis panijus*, *Ilisha megaloptera*) were collected from the fish landing center of Meghna River estuary (Fig. 1) on June, 2016 and were analysed ($\mu\text{g/g}$) for heavy metal concentrations (Cu, Pb, Cd, Zn, Cd and Cr) using inductively coupled plasma mass spectrometer. Estimation of safe dietary intake (CR_{lim}), maximum allowable fish consumption rate (CR_{mm}), noncarcinogenic health hazard by target hazard quotient (THQ) and target cancer risk (TR) were done based on assumptions to assess human health risk.

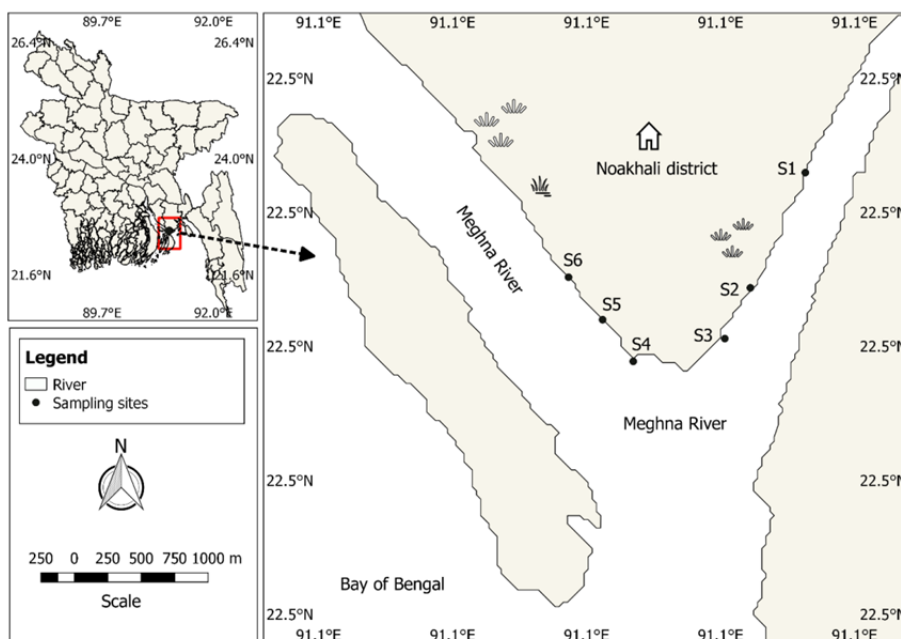


Fig. 1. Map showing the Meghna river estuary in Bangladesh.

Result and Discussions:

The concentrations of Cu, Pb and Cd in all fish species were below the Food Safety Guideline by WHO/FAO except Zn and Cr (results not shown). Assessment of noncarcinogenic health hazard by THQ indicated no concern from consumption of these fishes (Table 1). Interestingly the TR of Cr for intake of these fishes with the average of $2.29\text{E-}04$ suggested significant cancer risk through consumption of these fish species (Table 1).

Table 1. Target hazard quotients (THQs), hazard index (HI) and target cancer risk (TR) for intake of heavy metals of fish from Meghna estuary.

Fishes	Target Hazard Quotient(THQ)					HI	Target Cancer Risk(TR)		
	Cu	Zn	Pb	Cd	Cr		Cd	Cr	Pb
<i>Lates calcaifer</i>	1.45E-02	1.87E-02	8.75E-05	1.5E-03	3.16E-01	0.3507	4.85E-06	2.03E-04	1.48E-08
<i>Penaeous monodon</i>	1.29E-01	3.89E-02	1.12E-04	1.50E-03	3.16E-01	0.4855	4.85E-06	1.99E-04	1.91E-08

<i>Encrasicholi na heteroloba</i>	6.65E- 02	3.7E-0 2	1.06E- 04	4.25E- 03	3.57E- 01	0.482 9	1.38E- 05	2.29E- 04	1.80E- 08
<i>Polynemus paradiseus</i>	1.66E- 02	2.42E- 02	8.13E- 05	7.50E- 04	5.73E- 01	0.614 5	2.43E- 06	3.68E- 04	1.38E- 08
<i>Sillaginopsis panijus</i>	6.19E- 02	1.64E- 02	8.13E- 05	3.05E- 02	5.73E- 01	0.681 8	9.87E- 05	2.27E- 04	1.38E- 08
<i>Ilisha megaloptera</i>	6.24E- 02	3.49E- 02	1.19E- 04	1.25E- 03	2.37E- 01	0.335 7	4.05E- 06	1.52E- 04	2.02E- 08
All samples	5.8E-0 2	2.8E-0 2	9.78E- 05	6.62E- 03	3.95E- 01	0.492	2.14E- 05	2.29E- 04	1.66E- 08
Guideline value(USEP A 2011)	----- 1.0 -----						E-6 to E-4		

Conclusion:

The current study showed that 6 marine fish species collected from Noakhali area in Bangladesh accumulate Zn and Cr at high concentrations compared to the maximum acceptable limits. This study recommends continuous monitoring of this area. However, no metals were found to be considered as potential health hazard for consumer. Alarmingly there is a potential risk in cancer of all the fishes for Cr intake of these fishes.

References:

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Sustainably Managing Forests and Sea with Timber Reefs

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Aquatic Environmental Management

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Japan as a country with most of its land area covered by forests depends on the forest thinning to maintain the forests in a healthy condition. Meanwhile, in the sea, fisheries production is reported to be depleted in recent decades. Then, we deployed timber reefs, artificial reefs made of thinning timbers from forest thinning, in the sea to improve the fisheries production. This effort is expected to be a solution to the problems currently faced by this nation mentioned above. We applied a benthic-pelagic coupling model that expresses phosphorus and nitrogen cycles to understand how the deployment of timber reefs may alter the food web structure. The model was developed using the STELLA Architect (ver. 1.6.0) and ran with a fourth-order Runge-Kutta method and a time step of 0.125 days for three years. Furthermore, we conducted seasonal observations on water quality, benthic/attached organisms and fish to validate the calculated outputs. The results showed that an increase of internal regeneration due to the increase of organism biomass in the timber reef deployed area. Additionally, the timber reefs also functioned as nutrient source to the surrounding area. The calculated biomass of benthic and attached animals fit the observed data, increasing in warmer season than in other seasons. This temporal variation may depend on seasonal changes in temperature and nutrient supply. Moreover, fish biomass also increased in the timber reef area, although the variation was likely affected not only by temperature but also the availability of their feed and behaviour. Therefore, the observed data on fish abundance recorded with underwater cameras were incorporated into the model. The results obtained in this study suggest that the deployment of timber reefs promote the biotic and abiotic complexity and contributes to the acceleration of the nutrient cycle in the deployment area. Thus, our study may be beneficiary to establishing a recycle-oriented society as a way of sustainably managing the forests and sea.

Impact of Fish Culture on Nearby Agricultural Production in Greater Noakhali District, Bangladesh

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Abstract

An experiment was conducted to observe the influence of water and soil quality parameters of fish farms on its nearby agricultural land of greater Noakhali district. A total 256 Soil and a water samples (pH, temperature, salinity and nutrients) of the fish farms (FF), near agricultural land (NL), distance agricultural (DL) land and control side were collected and were analyzed at Soil Resource Development Institute (SRDI) Noakhali using standard methods during July 2017 to January 2018. Considering the observed mean values of soil (9) and water parameters (11) in the studied areas were found suitable for fish culture in Greater Noakhali district which were also similar to referenced values. To find out the potential influence of fish farms activities on nearby agricultural land independent sample *t*- test (2-tail) were performed ($P < 0.025$). Water and soil parameters such as organic carbon (%), organic matter (%) and total nitrogen (%) in FF, NL and DL were significantly higher than the control side of the entire study areas suggesting significant influence of fish farms on its nearby agricultural land.

Keywords: Water, Soil, nutrients, fish farm, agricultural land, greater Noakhali.

Introduction

Bangladesh has one of the biggest and most active deltas, fed by three mighty rivers: the Padma, the Meghna and the Jamuna with a coastline of 710 km on the northern littoral of the Bay of Bengal. There is a network of 230 rivers with their tributaries and distributaries spread over the country. Increased urbanizations and industrializations minimize agricultural opportunities that ultimately influence advanced technology in aquacultural activities to mitigate protein demand in Bangladesh. There are many supplementary feeds and fertilizers are continuously used in aquaculture farms. In the monsoon, by the overflow of water from the aquaculture ponds and in the dry season by seepage various nutrients (organic carbon, organic matter, total nitrogen, phosphorus, sulphur, potassium and boron) can be transported to the surroundings agricultural areas. Therefore, aquaculture farms are being increased here and there in different areas of Bangladesh that may have detrimental effect on its nearby agriculture which has yet been untouched.

Materials and Methods

A total 256 Soil and water samples (pH, temperature, salinity and nutrients) of the fish farms (FF), near agricultural land (NL), distance agricultural land (DL) and control side were collected and were analysed at

Soil Resource Development Institute (SRDI) Noakhali using standard methods during July 2017 to January 2018. To find out the potential influence of fish farms activities on nearby agricultural land independent sample *t*- test (2-tail) were performed.

Result and Discussion

Organic carbon (OC %)

Soil OC% of FF, NL and DL were significantly ($P<0.025$) higher than the control side of the entire study areas suggesting significant influence of fish farms on its nearby agricultural lands, but opposite scenario were observed for water OC% (Table 1). Boyd et al. (2002) recommended the best range (1.0-3.0%) of organic carbon for coastal aquaculture. S.A. Haque (2006) reported that, OC ranged from 0.46-1.8% which supported the present study results.

Organic matter (OM %):

OM% of both soil and water of FF, NL and DL were significantly ($P<0.025$) higher than the control side of all the 3 districts suggesting significant influence of fish farms on its surrounding agricultural lands (Table 1). A good soil should have at least 2.5% organic matter (BARC, 2005). S.A. Haque (2006) estimated OM ranging 0.8- 3.1% which supported the current research findings. But the present study value of Lakshnipur water OM% was higher than this value might be due to use of excess fertilizer and supplementary feeds to the fish ponds.

Table 1: Soil and water parameters (Mean \pm Standard deviation) of Noakhali, Feni and Lakshnipur in Greater Noakhali District.

Districts		Soil			Water		
		OC (%)	OM (%)	TN (%)	OC (%)	OM (%)	TN (%)
Noakhali	FF	1.20 \pm 0.63	1.36 \pm 0.22	0.10 \pm 0.05	0.75 \pm 0.14	2.13 \pm 1.12	0.06 \pm 0.01
	NL	1.18 \pm 0.83	1.19 \pm 0.35	0.10 \pm 0.07	0.70 \pm 0.20	2.04 \pm 1.44	0.06 \pm 0.02
	DL	1.14 \pm 0.42	1.18 \pm 0.21	0.09 \pm 0.05	0.74 \pm 0.18	1.96 \pm 0.72	0.07 \pm 0.01
	Control	0.71 \pm 0.15	1.17 \pm 0.23	0.15 \pm 0.29	0.63 \pm 0.18	2.17 \pm 0.44	0.05 \pm 0.01
Feni	FF	1.54 \pm 0.84	2.66 \pm 1.45	0.13 \pm 0.07	0.92 \pm 0.48	1.50 \pm 0.82	0.07 \pm 0.04
	NL	1.55 \pm 0.75	2.68 \pm 1.30	0.16 \pm 0.12	0.79 \pm 0.34	1.37 \pm 0.59	0.06 \pm 0.02
	DL	1.73 \pm 0.85	2.98 \pm 1.46	0.15 \pm 0.07	0.92 \pm 0.37	1.59 \pm 0.65	0.07 \pm 0.03
	Control	0.90 \pm 0.37	2.99 \pm 1.81	0.19 \pm 0.05	0.58 \pm 0.23	1.01 \pm 0.31	0.03 \pm 0.02
Lakshnipur	FF	1.11 \pm 0.72	1.91 \pm 1.24	0.09 \pm 0.06	2.32 \pm 0.63	4.00 \pm 1.09	0.20 \pm 0.05
	NL	1.60 \pm 0.50	2.76 \pm 0.87	0.13 \pm 0.04	2.31 \pm 0.52	3.98 \pm 0.92	0.19 \pm 0.04
	DL	1.46 \pm 0.57	2.53 \pm 0.99	0.12 \pm 0.04	2.41 \pm 0.33	4.16 \pm 0.57	0.20 \pm 0.03
	Control	0.92 \pm 0.35	2.18 \pm 0.74	0.18 \pm 0.05	2.65 \pm 0.31	0.61 \pm 0.23	0.04 \pm 0.02

Total Nitrogen (TN):

FF, NL and DL values were significantly ($P<0.025$) higher than the control sides for soil TN% of the entire study areas suggesting significant influence of fish farms on its nearby agricultural lands except for the concentration of TN% in water (Table 1).

Conclusion:

Similar to the presented results, other mean values of soil (6) and water parameters (8) (results not shown) in the studied areas were also in the range suitable for fish culture in Greater Noakhali district as described by other reports (results are not shown) but not significantly higher than the control sides. However, water and soil parameters such as organic carbon (%), organic matter (%) and total nitrogen (%) in FF, NL and DL were significantly ($P<0.025$) higher than the control side of the entire study areas suggesting significant influence of fish farms on its nearby agricultural land.

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Species Diversity and Occurrence Patterns of Planktonic Copepods from Korean Coastal Waters

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The Korean coast is divided into the West Sea (Yellow Sea), the South Sea (northeastern area of the East China Sea), and the East Sea (Japan Sea), and each coastal area has different marine environment characteristics. This study analyzed zooplankton data of KOEM (Korea Environment Management Corporation) collected in Korean coastal waters in spring and summer of 2015 and 2016. In spring water temperature was lowest in Jeju coastal area (JCA), and gradually increased toward the eastern coastal area (ECA), the southern coastal area (SCA), and the western coastal area (WCA), while in summer lowest in WCA and increased in the order of ECA, SCA, and JCA. Salinity was lowest in WCA with many rivers flowing inland, and increased in the order of SCA, ECA and JCA in spring. In summer it was lowest in JCA and increased toward WCA, SCA, and ECA. Chlorophyll-a concentration was lowest in JCA in spring and relatively low in ECA in summer. In Korean coastal areas 50 species of copepods occurred in spring and 64 species did in summer. The number of species was lowest in JCA and highest in SCA in spring and summer.

Paracalanus parvus s. l. showed different ecological status as the most dominant species or the second dominant species in Korean coastal areas in spring, but it was predominant in summer. In addition, in spring *Acartia hongii*, *Calanus sinicus*, *Oithona similis* were predominant in WCA, *Oithona similis* and *Corycaeus affinis* in SCA, *Oithona similis* and *Corycaeus* sp. in ECA, *Corycaeus affinis* and *Oithona setigera* in JCA. In summer *Corycaeus* spp., *Oithona similis*, *Acartia hongii*, *Tortanus forcipatus* were predominant in WCA, *Corycaeus affinis*, *Pseudodiaptomus marinus* in SCA, *Oithona similis*, *Acartia omorii*, *Corycaeus* sp. in ECA, and *Acartia steueri*, *Acartia pacifica*, *Oithona* sp., *Calanus sinicus* in JCA. The copepod community in the Korean coastal areas were clearly classified into four areas, WCA-western SCA, eastern SCA, ECA and JCA according to differences of environmental factors such as water temperature, salinity, Chl-a concentration, and suspended matter concentration of each coastal area.

Effects of Water Temperature, Irradiance and Nitrate on the Growth of Sporelings of the Nongeniculate Coralline Alga *Lithophyllum okamurae* Foslie (Corallinales, Rhodophyceae)

Sakie Yoshioka

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Coralline algae are one of the largest groups of calcifying macroalgae and are important components of benthic marine communities worldwide, playing pivotal roles as reef-building organisms and morphogenetic inducers for the larvae of marine invertebrates. Recently, degradation of seaweed beds and expansion of barren grounds have been reported along the Japanese coasts against a background of rising coastal water temperature. Coralline algae are dominant on barren grounds, whereas they form an understory beneath canopy-forming brown algae. Although coralline algae have recently been the subjects of numerous studies related to global warming and ocean acidification, few have examined the optimal growth conditions and range of viable conditions for individual species. Therefore, we investigated the effects of water temperature, irradiance, and nitrate on the growth of sporelings of *Lithophyllum okamurae* commonly found in the temperate Western Pacific. Mature plants of *L. okamurae* were collected from the lower intertidal zone in Hiroshima, Japan, and sporelings were established from released spores in the laboratory. The relative growth rate (RGR) was then evaluated by measuring the area occupied by the sporelings. We found that the optimal growth temperature of the sporelings was 20°C, which is similar to that of temperate brown algae. However, RGR of the sporelings was saturated at an irradiance of approximately 106.8 $\mu\text{mol photon m}^{-2}\text{s}^{-1}$, with photoinhibition observed at a greater intensity, indicating that sporelings of *L. okamurae* cannot tolerate a higher intensity of irradiance than temperate brown algae. This saturation irradiance level was similar to that of other coralline algae grown in shade conditions, indicating that *L. okamurae*, or at least the examined samples, had adapted to such conditions. The saturating nitrate concentration was 25 $\mu\text{mol/L}$ and the half-saturation constant (K_s) was 1.5 $\mu\text{mol/L}$, both of which are at least three times higher than those for other coralline species but are similar to values for other macroalgae, refuting the previous belief that coralline algae are more adaptable to a lower nitrate concentration than other macroalgae. These results indicate that *L. okamurae* is not advantageous than other macroalgae in the mentioned growth conditions; hence, this species also suffer from the effects of rising water temperature.

Marine Ecosystem Protection

SEONGMIN CHO, **YOUNG HUI LIM**

*Environmental Oceanography, Faculty of Marine Technology,
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In the Republic of Korea, the protected areas have been organized and maintained by the nation for marine ecological preservation since 2010. Nowadays, not only 14 Wetland protective areas, 13 Marine ecology protective areas, but also marine life protective area, totally 28 of them are designated by our country.

Wetland conservation zones are designated as areas where natural conditions are primitive or rich in biodiversity, areas where rare or endangered wildlife is designated, and areas with unique landscape or geological values. Up to now, Songdo mudflats, Siheung mudflats, Woongin jangbongdo mudflats, Seocheon mudflats, Gochang mudflats, etc. have been designated as wetlands, and 7 of them are designated as the Ramsar wetlands.

Marine ecological protection zones are designated as based on maintaining primitive state or rich in marine biodiversity, being with conservation and academic value, The geographical, geological, and the state of the ocean which are unique and valuable in scientific research, as well as, the ocean that are recognized as either having high basis production or as habitat for protected marine products. The areas where is the scenery of the ocean is so beautiful that we need to protect them. So far, around area of Yijakdo, Sinduri dune, Oryuk island, etc. is designated as the protective zones. In marine biodiversity a protected zone is based on being rich in marine biodiversity, for example, there is Garolim bay. It guarantees growth and spawn activity, resulting with the protection of marine lives and tourist attraction regardless of fishery in nearby.

Current Status of the Indonesian Aquaculture Sector: Approach to Shrimp Culture

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Abstract

Recent study shows that world per capita supply of fish for food has increased steadily by years from an average of 9.9 kg in the 1960s to 20.4 kg in 2016. The aquaculture sector was responsible to this fact, considering on the decrement of the capture fishery production which is affected 64% of the 25 top producer countries, including Indonesia. As one of the biggest archipelago countries, Indonesia has about 54,720 km (34,000 mil) of coastline which makes Indonesia as a strategic place for aquaculture development to fulfill the needs of human-being for the fish consumption. Therefore, the potential for brackish water aquaculture ponds in Indonesian coastal areas comprises an area of 1.3 million ha, with developments that still continue to grow. This vast and watery area resources in Indonesia has a great potential for cultivation of aquatic organisms to support human life especially shrimps. Shrimp is categorized by FAO as one of four highly valuable fishery productions along with tuna, lobster, and cephalopods. Shrimp contains omega 3, mineral, fat, chitin, carotenoids (astaxanthin) and vitamin. Besides consuming the meat of shrimp, some important by-products are utilized as well, such as chitosan which is utilized in water treatments, cosmetics, etc. In tropical and subtropical coastal areas, including Indonesia, shrimp cultures have developed the most among other economical activities along the coast. With vast potential of watery area, it is possible to cultivate shrimp with the extensive, semi-intensive, intensive, also the super intensive. Therefore, the shrimp production of Indonesia becoming one of the top market suppliers in the world. Some loyal importers of Indonesian shrimp production including USA and Japan, accounted for about 20% of total imports in 2016 respectively. Indonesian fisheries sector grew rapidly throughout 2015 with total production increase from 20.44 million tons in 2014 to 23.99 million tons in 2015. Wherein the wild-capture production in Indonesia has been depressed, aquaculture play a big role to contribute on the fisheries production to meet the global demand. Also, aquaculture will provide a sustainable fish supply for general. Ministry of Marine and Fisheries (MMAF) Republic of Indonesia emphasizes the importance of aquaculture industry for the whole fisheries sector. This study review further describes the status of aquaculture development in Indonesia and proposes the characteristic that must be considered for shrimp cultures in Indonesia, especially to the environmental effect.

Protected Culture, the Appropriate Agri-Technology for Ensuring Food and Nutritional Security in the Tropical Region

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Many developed as well as developing nations in the world accepted globalization as a timely concept in the mid nineties and reformed their developmental strategies to match with the mainstream economic policies. As a result the national capital markets were pumped with direct foreign investments in most under developed countries in the region. Most of these investments were on non-agriculture sector productions and services such as industries, education, transportation and health. Higher revenues and merits generated by these new production ventures and service provisions brought extra remunerations for the workers and beneficiaries, transforming the labour as well as consumer markets to different orientations over the years. Expanded education opportunities as a consequence of globalization leads into demography of educated rural youths outward from the rural agricultural setup. As a result, the traditional agriculture which has been feeding the nation for centuries was in crossroads due to diminishing returns, lack of labour and subsequent loss of social acceptance. Meanwhile the population growth in developing nations in the region has been relatively high, compared to that of the developed nations as well as the global averages in last two decades. Some of the current global trends and various anthropogenic activities amass with the growing population have been fast diminishing the arable lands in these nations as a consequence of deforestation, land erosion, environmental pollution etc. Meanwhile the nearly three decades long economic and trade reforms appeared to be unable to bring a lasting solution for food security through imports. Therefore most developing nations are at a stake with respect to national food security which closely addresses “zero hunger” in the SDGs. Moreover, driven by the awareness and affordability issues, partially globalized rural communities in these nations are fast moving out of their nutritious food rations, endangering the nutritional security. Therefore more remunerative and highly productive high-tech agriculture must be developed to find answers to this grave situation. Appropriate technology and sustainable use of natural resources must be the key issues when high-tech solutions such as protected culture (greenhouse agriculture) will be applied to establish national food and nutritional security through future developmental programs. Last 25 years of research and developments on protected culture in Sri Lanka would provide a good platform for this task, as summarized below.

Unlike in the temperate region, the main climatic factor that needs to be controlled through protected culture technologies in the tropical region is the severity of rainfall. The direct mechanical damages of rainfall and its indirect disturbances of on plant physiology and health can be counteracted by growing indoors. However, complete partitioning of the plant growing space (micro climate) is impracticable due to the build up of high temperature inside especially during peak sunshine hours of the day. Meanwhile

highly energy-intensive cooling strategies are impracticable due to low investment power and lack of cost-effectiveness under low productivity and less accessibility to high-value markets. Relatively inexpensive ventilation strategies adopted by temperate countries for the summer crops such as the use of retractable greenhouses are also not practicable due to heavy pest and disease incidences in the tropics. Therefore a large part of the greenhouse research program of the university of Peradeniya was devoted to testing of the effectiveness of natural and forced air ventilation of insect-screened plastic houses with or without evaporative cooling and thermal screening options.

Meanwhile protection from the adverse soil conditions receives almost 50% of the attention in protected culture in general. Hydroponics or soilless culture is the technological solution in this regard. Further, it makes all the plant nutrients available and allows the roots to grow vigorously. The selection of media and type of circulation in hydroponics are crucial factors that are usually determined based on the availability of materials and their compatibility with the plant and environmental factors. In Sri Lanka, coco-peat based drip fertigation is widely adoptable for greenhouse vegetable crops. Therefore maintaining the rate of plant nutrient uptake through proper selection and management of media and fertilizers were subjected to research through university research programs during last ten years, making progressive outcome towards yield and quality improvements and the development of cost-effective and environment-friendly production strategies.

Characterization of LaMATE-PI1, a Candidate of Citrate Transporter Isolated from Cluster Roots of White Lupin

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White lupin (*Lupinus albus* L.) has developed strategies to adopt low phosphate (P) condition in soils by forming cluster roots. The cluster roots secrete a large amount of citrate to solubilize P in soils under P deficiency (Gardner et al. 1983). Some exudations such as isoflavonoids are secreted to decrease microbial consumptions of carboxylates by modification of microbial community structures. It has been proposed that citrate channel plays an important role to release citrate from cluster roots (Zhang et al. 2004), although the citrate transporter/channel has not been isolated yet. This study aimed to characterize a candidate of citrate transporter isolated from cluster roots of white lupin.

It was shown that both P-deficiency and Al stress stimulated citrate exudation from whole roots of white lupin, suggesting that the pathway of citrate exudation is different between these stresses. We isolated a cDNA for a homolog of MATE (multidrug and toxin extrusion) type transporter, designated as *LaMATE-PI1*, from cluster roots of white lupin. The deduced amino acid sequence of LaMATE-PI1 has highest similarity to RHC1, which is involved in bicarbonate transport, and shows different clade which includes citrate transporters induced by Al stress or Fe deficiency (HvAACT1, OsFRD1, and AtMATE). SOSUI program presumed that LaMATE-PI1 contained 12 transmembrane domains. mRNA for LaMATE-PI1 was increased under P deficiency at cluster root specifically, and not altered by Al stress. Also, *LaMATE-PI1* transformed *A. thaliana* showed better growth than WT in soil cultivation, but they showed smaller growth in gel culture without P application. On the other hand, larger secretion of citrate was determined in gel cultivation. These results are consistent with a hypothesis that LaMATE-PI1 plays an important role in releasing abundant amount of exudation from cluster roots of white lupin under P-deficiency.

Enhancing Production Stability of Tropical Fruits through Variety Selection and Propagation

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Abstract

As the global population grows with time the demand for food becomes critically important. For example the projected increase of global population from 7.6 billion in 2017 to 9.8 billion in 2050. Out of these 55% lives in cities today but it will increase to 68% in 2050. This will definitely increase the demand for food. In the meantime the rapid increase in anthropogenic activities along with the growing population have been fast diminishing arable lands and contaminating the environment, endangering the food security as well as the food safety. One of the best examples is large masses of none/less arable lands in dryer areas in South Asia (i.e. India, Sri Lanka). As a result, less privileged people in these regions have already been subjected to non-communicable diseases due to low quality drinking water and lack of variety in their food. At this backdrop, drought tolerant and highly nutritious tropical fruit crops such as mango (*Mangifera indica*), cashew (*Anacardium occidentale*), wood apple (*Limonia acidissima*), pomegranate (*Punica grantum*), tamarind (*Tamarindus indica*), bale (*Aegle marmelos*) etc. have shown potential to be successfully grown in dry and barren lands with appropriate agronomic interventions. Hence they can be considered to be a savior for lack of variety and nutrition in vital diets, coming from less arable lands. And also they are a rich source of bioactive compounds (nutaceutical properties) which ensures human health against non-communicable diseases. Hence tropical fruit crops can be considered to be a good answer to shortage of food (prevention of hunger), rural poverty (economic well-being) and lack of variety in diets (health safety). However, these crops have not been subjected to proper crop improvement programs when compared their counterparts like field crops and vegetables. As a result they constantly suffer from lack of improved varieties and lack of remedial measures for some critical agronomic issues. Taking this situation in to consideration, variety and agronomic improvements of mango, cashew, bale and pomegranate have been conducted in various tropical countries in Central and South Asia during last several decades. Collaborative research groups in Sri Lanka have documented the nutraceutical properties (i.e. antioxidant activity) of a range of popular and underutilized fruit crops and found the highest antioxidant activity in tamarind and pomegranate. The geographical distribution of pomegranate and Mango (var. *Karthakolomban*) and tamarind have been assessed for yield and quality parameters. These basic information has been very useful in developing new varieties (i.e. for Pomegranate).

Mango variety, *Karthakolomban* is the most popular and largely cultivated mango variety in Sri Lanka because of its' unique taste and flavor qualities. Elite mango varieties are propagated by grafting to stock plants from relatively tolerant wild type mango varieties. However, recently a high degree of stock-scion incompatibility has been reported for *Karthakolomban* mango. This was revealed through yield and quality parameters and irregular fruit bearing. In order to investigate the role of plant growth hormones and other phytochemicals on the stock-scion inter-relationship, recently university of Peradeniya conducted a series of experiments on the grafting of mango. In this research program it was aimed to develop a compatible stock-scion combination with the help of morphological, anatomical and biochemical indicators. In the first experiment 6 month old variety *Kohuamba* root stocks were grafted with variety *Karthakolomban* scions. The resultant grafted seedlings were categorized into three vigour groups and their grafting compatibilities were tested in terms of different aspects at 60 and 90 days after grafting. The results revealed that grafting success, survival of seedlings and rootstock vigour after grafting were positively correlated with each other. Moreover, anatomical observations at the graft union supported the biochemical and morphological evidences made on the graft union formation. The intensity of biochemical interactions during the recovery process at the graft union could be detected with the use of the enzyme, peroxidase which could be identified as an early detection indicator of the graft union formation.

The second step of the series dealt with the influence of the genetic or varietal diversity of root stock on grafting where four different rootstock varieties, *Kohuamba*, *Velleikolomban*, *Wal amba* and *Gira amba* were selected for the experiment. Peroxidase activity was increased over the time after grafting (2 and 6 months), and the highest peroxidase content in the graft union was reported in rootstock varieties, *Gira amba* and *Wal amba* followed by *kohuamba* and *Velleikolomban*. In addition, entirely different peroxidase activities could be detected in different parts of the growing seedlings. Overall results could be used to develop anatomical, morphological and biochemical indicators for early detection of stock-scion compatibility in grafting, a useful guide for the production sector to increase resource use efficiency and sustainability of the industry.

Finally the research output of both pomegranate crop improvement and mango propagation programs upgraded their potential cultivation in less arable lands, providing useful information for growers and consumers on their agronomy, food value and nutritional/nutraceutical properties.

Fight Hunger and Poverty with Goats: Developing Nutritional Supplements from Farm By-Products for Increased Survival and Performance of Pre-Weaning Kids

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EXTENDED ABSTRACT

INTRODUCTION

Goat production is one of the most important enterprises of farming households in the Philippines as 98% of the total goat population is raised in the backyard. One great problem in raising goats is the high mortality rate (50-60%) at pre-weaning stage, and if the kids are able to surpass this critical period and reach weaning age, body weights tend to be lower and mortality rates higher at the ensuing grower stage. Late pregnancy and lactation serve as critical stages for kid survival at birth until weaning (Khan and Ludri, 2002). At late pregnancy, carbohydrate needs are high because most of the fetal development occurs at this stage, but the doe is not fed well as farmers regard this dry-off period of a milk-producing system as non-productive. Consequently, kids are born underweight and die in the first two weeks of age, especially twins and triplets, unless supplemented.

The use of farm by-products such as seaweed-fortified coconut water (Quilicot and Bestil, 2011) and locally-grown forages such as “madre de agua” (*Trichanthera gigantea* Nees) plus dextrose (Maglinte and Bestil, 2010) provides a great potential for kid supplementation. Another potential by-product is jackfruit (*Artocarpus heterophyllus* Lin.) wastes, constituting of rags and peelings (70% of the fruit yield), readily available after processing vacuum-fried or dehydrated jackfruit. This project, therefore, focused on the development of supplements, utilizing farm by-products and local feed ingredients, for increased pre-weaning survival and performance of newborn kids.

MATERIALS AND METHODS

The development of supplemental “Cocowater-based Nutritional Drench (CND)” included shelf-life assessment, nutrient analysis, and feeding trial with pre-weaning kids. The freshly collected coconut water was strained, chilled, pasteurized, and kept refrigerated. Glucose powder, liquid seaweed, and water-soluble mineral-vitamin premix were added, and the mixture was again pasteurized and cooled down to 50°C to stabilize the product. It was then added with citric acid to have a pH of 6.0 to 6.5 similar to that of goat’s milk, and sodium benzoate as preservative, then chilled.

Shelf-life was assessed in terms of microbiological load and physico-chemical characteristics such as pH, total soluble solids (TSS) and total titratable acidity (TTA) at ambient and chilling temperatures. Feeding trial was conducted at amounts of 0, 0.65, 0.80, 1.00 and 1.25% BW of pre-wean kids in their first 28 days of age at three times weekly. The lactating does were fed with fresh grass, legume forages, and/or tree leaves twice daily, and a concentrate mix composed of copra meal, rice bran, limestone, and salt given as supplement at 11:00 AM, while CND was given to suckling kids at 7:00 AM.

The “**Forage-based, Jackfruit waste and Seaweed-fortified (FJS) pellets**” contained “madre de agua” and “madre de cacao” (*Gliricidia sepium*) leaf meals as basal ingredients, jackfruit waste meal, fish meal, dicalcium phosphate, and seaweed powder. The mixture was pelletized using molasses as binder, and the FJS pellets were then sun-dried to at least 86% dry matter (DM) for optimum storage. The pellets were then tested with pre-weaning kids at age 61-90 days considering different **levels** (0, 0.75, and 1.00% BW) and **frequencies** (daily, 3 times weekly) of supplementation.

RESULTS AND DISCUSSION

The “CND” appeared to be low in protein but high in glucose, minerals and vitamins. Storage under chilled conditions had a rate of increase in microbial population 6 times slower, and would take 13.3 weeks before the microbial load equated that of ambient temperature. The rate of increase in acidity under chilled was 15 times slower, while decline in pH under ambient condition was 7.5 times faster. Sugar content rapidly declined after 3 weeks under ambient condition, and lost 40% of its sugar content after 4 weeks of storage while that under chilled lost only 6%. When fed to suckling kids, CND prevented pre-weaning mortalities and promoted faster weight gains than those without, significantly with 1.25% BW level. There were no significant differences in blood glucose level, showing that supplemental CND must have been rapidly absorbed and utilized.

With “FJS” pellets, supplementation at 1.00% of BW, DM basis, showed significantly higher weight gains than those without, and pre-weaning kids performed better at daily supplementation of 0.75% to 1.00% BW, DM basis, although giving at 1.00% BW at three times weekly (MWF) can save on supplement cost as performance was not significantly different. Differences in blood glucose levels were not significant, and “daily” supplementation maintained a positive level of blood glucose even with faster weight gains. When fed to weanlings at 1% BW level, intakes of DM, energy and protein of Napier grass were improved, and total diet digestibility was high. This is critical as newly-weaned kids usually go off-feed right after weaning.

CONCLUSION AND RECOMMENDATION

The CND, being high in glucose, vitamins and minerals, has great potential for increased survival and weight gain, with stable blood glucose levels of pre-weaning kids. Storage under chilled condition, and supplementation at 1.25% BW level, even at three times weekly, are therefore highly recommended.

Pre-weaning kids perform better with supplementation of FJS pellets at 61-90 days of age. Supplementation of FJS pellets to weanlings improves intake and overall digestibility of diet based on Napier grass. The amount of 1.00% BW, DM basis, at three times weekly is highly recommended

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Use of Green Forage : Phytol from Plant Chlorophyll for Ruminant Nutrition

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Forages are major feed resources for ruminant animals. Especially, green forages are rich in nutrients and abundantly contain chlorophylls. When forage is ingested by ruminants, phytanic acid is produced from chlorophyll, phytol in the rumen (Patton & Benson, 1966). Phytol and phytanic acid have an effect stimulating hepatic fatty acid oxidation (Hellgren, 2010). This effect of chlorophyll metabolites might be useful to solve the perinatal diseases of dairy cow, such as fatty liver. However, there are little researches for the effect of phytol and phytanic acid on lipid metabolism in ruminants and quantitative information for ruminal phytanic acid production is lacking. Thus, we investigated the extent of phytol that can be converted to phytanic acid in the rumen and whether phytol and phytanic acid affect lipid metabolism in sheep.

We used four sheep (average body weight, 54 kg) fitted with ruminal and duodenal cannula in a 4 × 4 Latin square design. The experimental treatment included infusion with phytol (mixture of trans/cis isomers; Sigma-Aldrich) into the rumen at 0, 4, 8, and 12 g/kg dry matter (DM) intake in two equal portions at feeding (0900 and 2100 h). Sheep were fed a mixed diet composed of oat hay and barley grain in a ratio of 2:3 on a DM basis at maintenance energy level. Feces and duodenal digesta were collected to measure the duodenal flow and fecal output of DM, phytol, and phytanic acid. Sample of jugular venous blood was collected to analyze for plasma concentrations of metabolites related to lipid metabolism and insulin.

Phytol infusion did not affect DM intake and digestibility in the rumen and intestine as well as ruminal volatile fatty acid concentrations. The ruminal production rate of phytanic acid from phytol was 0.36 ± 0.040 , while 0.37 ± 0.073 of infused phytol entered the duodenum. Plasma concentrations of glucose, non-esterified fatty acid, ketone body, and insulin were not affected by phytol infusion. However, plasma triglyceride level for the 8 and 12 g/kg infusion was higher ($P < 0.01$) than that for the 0 g/kg infusion. Conversely, plasma HDL-cholesterol for the 12 g/kg infusion was lower ($P < 0.01$) than that for the other treatments. These results indicates that excess phytol infusion to sheep stimulates the synthesis of triglyceride in the liver.

Fight Hunger and Poverty with Goats: Improving Animal Health using Ginger (*Zingiber officinale* Roscoe) Pulp as Dewormer

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EXTENDED ABSTRACT

Introduction

Goat production in the Philippines is an integral part of small-hold farming systems, and is becoming a popular livelihood option offered by local government units to their constituent rural farmers because of its growing demand and it offers several opportunities for increasing household income and improving family nutrition. Backyard goat production in the country accounts 98% of the total goat inventory (Bersales *et al.*, 2017) as many small-scale farming families raise goats because it requires a simple management and little investment as compared to other livestock. They are considered valuable asset in providing supplementary income to poor farmers and animal protein for the family in the form of meat and milk.

Goat rearing can be a powerful vehicle to alleviate poverty and sustainable food security in the country. However, parasitism is one of the major husbandry challenges among small-hold goat farmers. Prophylactic treatment with synthetic anthelmintic is the primary control measure, but these are expensive and are often unavailable to goat farmers in rural areas. There are also sporadic incidences of anthelmintic resistance reported, thus, a shift towards medicinal plants may provide a more accessible and profitable solution. The use of ginger (*Zingiber officinale* Roscoe) pulp, the by-product of ginger tea production, may have a great potential in deworming as shown in the preliminary studies of Iqbal *et al.* (2001) and Iqbal *et al.* (2003) in addition to its anti-microbial and methane-reducing properties. Being produced in large quantities in the Province of Leyte, Philippines, its use in animal feeding can provide a low cost anthelmintic alternative to improve animal health and serve as an economical yet environmentally-sound way of managing farm wastes.

Materials and Methods

The experimental animals were fed with Napier grass at *ad libitum* as basal diet and a concentrate supplement containing ginger pulp at levels of 1% and 2% of the mixture. Supplementation of ginger pulp was conducted for seven (7) days to nine (9) goats naturally-infected with gastrointestinal nematodes arranged in completely randomized design replicated three (3) times. Fecal samples were examined using the flotation technique (MAFF, 1979 as cited by Hussain, 2008) to identify

gastrointestinal nematodes. The Modified McMaster Technique (Soulsby, 1982 as cited by Hussain et al., 2008) was used to obtain the total fecal egg count.

Results and Discussion

When experimental animals were tested for the presence of gastro-intestinal nematodes, noting that nematodes are considered as the main pathogens that cause severe damage to their hosts, only *Haemonchus contortus* eggs were recovered in the fecal samples collected. This nematode is of major concern because of its blood-sucking characteristic which causes anemia that can be so severe as to result in death (Bizimenyera, 2008). This nematode has also been documented to be resistant to all three broad spectrum anthelmintics: Benzimidazole, Imidazothiazole, and Ivermectin (Seigh *et al.* 2011).

There was a significant effect of ginger pulp feeding on the egg per gram (EPG) count both at 1% and 2% level in the concentrate supplement; ginger pulp significantly decreased the EPG count in feces compared to those without (T₀) where EPG count even increased. This indicates that ginger pulp in the diet can have significant anthelmintic efficacy against *Haemonchus contortus* in goats. As reported by Iqbal *et al.* (2001) and Iqbal *et al.* (2003), ginger has considerable anthelmintic activity against gastrointestinal nematodes, both *in vivo* and *in vitro* study which lend support to the results of this study.

Conclusion and Recommendation

Ginger pulp feeding on goats, either at 1% or 2% level in the concentrate mix given at 1% BW on DM basis can effectively control gastrointestinal nematodes such as *Haemonchus contortus* in growing kids. Such level, given in short-term supplementation, is recommended so as not to affect voluntary intake of the diet or other production measures. Using a plant-derived anthelmintic such as ginger pulp may offer great opportunities for an effective and economical control of parasitic diseases in goats.

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A Mathematical Model for the Influences of Intrinsic Fruit Juice Properties on the Ultraviolet-C Inactivation Energy of a Resistant Reference Spoilage Yeast Species

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ABSTRACT

For the first time, a model for the influences of intrinsic fruit juice properties on the ultraviolet-C decimal reduction energy (D_{UV-C} , mJ/cm^2) of a resistant spoilage yeast strain is being reported. Prior to model building, a suitable reference yeast strain was determined. The D_{UV-C} values of 17 mid-stationary phase (Yeast Extract Peptone Glucose Broth, 25 °C) yeast species and their composited inoculum were determined and compared in coconut water and orange juice. Two mathematical methods were employed and evaluated in the determination of the inactivation kinetic parameters of the test yeast species. Despite the variability in the UV-C opacity, *Cryptococcus albidus* (LJY1) exhibited the greatest resistance to UV-C in both suspending media. Survivor population fitting on the Baranyi and Roberts (1994) model was deemed more appropriate in the determination of D_{UV-C} . A predictive model for the D_{UV-C} of *C. albidus* was thereafter established in simulated fruit juices (SFJs) with varying pH (2.00-8.00), soluble solids (SS, 0.00-70.00 °Brix from sucrose), insoluble solids (IS, 0.00-3.00 % wt/vol cellulose), and ascorbic acid content (AA, 0-1000 mg/L, mg/L) using a rotatable composite design of experiment and response surface methodology. Model building showed that the individual linear effects of all intrinsic properties, and only the individual quadratic effect of AA (AA^2) significantly ($P < 0.05$) influenced D_{UV-C} . The interactive effects $\text{pH} \times \text{IS}$ and $\text{SS} \times \text{AA}$ were also significant. Analyses of coefficient of determination (R^2) and its modified forms namely adjusted R^2 and predicted R^2 suggested the use of a reduced model. Validation of the full and reduced models also showed that the latter had better predictive efficacies.

Effects of diluents, temperature and pH on the enumeration and growth kinetics of *Alicyclobacillus acidoterrestris* in standard growth media

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This study reports on the comparison of the effects of dilutions in DW (distilled water), 0.85% SS (saline solution), 0.10% PW (peptone water) and PBS (phosphate-buffered saline) solutions on the enumeration and viability of *Alicyclobacillus acidoterrestris* (ATCC 49025) vegetative cells and spores by direct plating. Only PW caused a significant underestimation of viable populations of vegetative cells, while no significant effect was observed among diluents for the enumeration of spore cells. This study also further characterized the effects of temperature and pH on the growth rate kinetics of *A. acidoterrestris* in standard yeast-starch-glucose media. A two-factored Central Composite Rotatable Design of Experiment (CCRD) was used to determine combinations of the test variables (temperature 35-55 °C; pH 2.20-5.80) before applying Response Surface Methodology to quantify their influences on the growth kinetic parameters such as lag time, growth rate, and population change. The growth kinetic parameters for each combination were determined and fitted into the Baranyi-Roberts equation. Lag times were observed for a few combinations while others did not exhibit a lag phase. Rates ranged from -0.37 (inactivating) to 1.07 (growth), while population change varied from -3.11 to 2.89 log. Enumerated population values significantly fitted into a linear model for the growth rate response and a quadratic model for the population change response. Only pH was observed to be the significant factor affecting the response variables, having linear effects for both models. Significant quadratic effects of pH were also observed for population change. Model validation studies of combinations not included in the CCRD showed that predictions were all within acceptable error margins for the population change model, while the growth rate model exhibited limited success rate. The results obtained in this study nonetheless provide information on growth behaviors of *A. acidoterrestris* in standard media and can be further used in researches dealing with its maintenance and propagation.

Keywords: *Alicyclobacillus acidoterrestris*; diluent; RSM; growth kinetics

Inactivation of Pathogens in Human Breast Milk, Infant Formula Milk, and Cow's Milk during Holder Pasteurization

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ABSTRACT

This study determined the inactivation patterns of pathogens in human breast milk, infant formula milk, and cow's milk Holder pasteurization. The pathogens *Salmonella enterica*, *Escherichia* O157:H7, *Listeria monocytogenes*, *Staphylococcus aureus*, and *Pseudomonas aeruginosa* were propagated to mid-stationary phase (23 h) and were inactivated by heat in various suspending medium following the Holder pasteurization protocol (62.5°C for 30 min then rapidly cooled to 10°C). Survivor cells were enumerated at predetermined exposure times; and results were expressed in terms of total log reduction. All organisms except for *L. monocytogenes* in breast milk exhibited a biphasic inactivation pattern composed of a fast initial log linear reduction followed by a slow inactivation tailing. *L. monocytogenes* in breast milk exhibited a monophasic, log linear pattern. The formation of tailing in thermal inactivation poses a concern in the food industry particularly in breast milk pasteurization as it shows resistance of microorganisms during inactivation. The log reductions at 30 min exposure time ranged from 2.18 ±0.18 to 3.93 ±0.27, 3.35 ±0.24 to 3.77 ±0.44, and 1.91 ±0.24 to 6.00 ±0.53 in BM, IM, and CM samples respectively. The most resistant microorganism was *L. monocytogenes* for all milk samples while the least resistant was *S. aureus*.

Use of Natural and Naturally Derived Compounds in Preserving Meat, Seafood and Agricultural Products in Vietnam

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Vietnam has the advantage of long delta and coastline, many rivers and temperate climate so it is very convenient for farming and exploiting meat, seafood and agricultural products. These resources have opened up great prospects for supplying these products to people's livelihoods, for export and for the livestock industry. According to FAO statistics, these meat, seafood and agricultural products resources are providing more than 20% of the total plant and animal protein in food, and up to 50% in many countries.

Exploiting and harvesting good sources of meat, seafood and agricultural products for human consumption is an extremely important issue, but the process of catching, processing and preserving is limited which affects the quality. Special post-harvest losses result in enormous economic losses. Vietnam mainly exports meat, seafood products and agricultural products in cold or semi-processed form. Therefore, the value of economic is low due to the freshness of raw materials. Meat, seafood and agricultural products have a loose structure, enzymes and organisms in the product are very diverse, very active so very fast damage, especially in hot climate conditions, conditions for preserving harvesting and scattered farming as in our country. The methods used in preserving meat, seafood and agricultural products are now mainly exported to cold storage or preliminary treatment ...etc. Most of these methods have a short shelf life, costly least. Particularly for the sake of profit, some people use toxic chemicals, and the high salts in these products cause a serious impact on consumer health and affect export.

Therefore, the study of appropriate storage methods, ensuring the preservation time, quality of raw materials and food safety is an urgent requirement of the benefits from Vietnam's agriculture. However, today, the world's food safety is of prime concern, so the use of chemicals for preservation is very cautious and limited. Therefore, the current research focus on the exploitation of raw materials, natural preservatives and biologically active ingredients with the desire to extend the longest preservation time, but still keep the nutritional value and sensory value of the above products, ensuring food hygiene and safety, safety for consumer health and raising surplus value for agriculture of Vietnam.

In Vietnam, plants such as Ginger, Lesser Galangal, Garlic and some essential oils (such as Cinnamon) are very rich and especially contain many biologically active substances and contain many compounds themselves and it is safe for human health. Based on this fact, we conducted a number of studies on preservation methods using ingredients from these natural sources to provide the longest, safe for these consumers, keep the nutritional value of meat, seafood and agricultural products. This research is highly practical to meet the needs of producers and those growers of meat, seafood and agricultural products, that are most effective in Vietnam.

Effect of Trehalose on the Physical Stability of Deep-fried Food Characterized by Glass Transition Temperature

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Abstract

Deep frying is a versatile and rapid process for preparing various food products and become very popular throughout the world due to its appealing flavor, appearance, and texture. The brittle or crisp texture is a unique parameter for deep-fried food. But, crispiness is lost during storage, because glass transition is caused by water sorption. Therefore, it is practically important to understand glass transition temperature (T_g) to improve physical stability of deep-fried food. The purpose of this study was to investigate the effect of trehalose on the T_g of deep-fried models using Thermal rheological analysis (TRA) and to discover the effect of glass transition on the texture properties of it. Moisture content of the sample was adjusted in numerous water activity conditions, and the mechanical glass transition temperature T_g was investigated using TRA as a function of water content. The T_g decreased with increase in water content because of water plasticizing. The oil free sample and trehalose-added sample had a higher T_g than the normal sample at each water content. Synergistic action of Trehalose are suggested that retain water by hindering the interaction among water molecules, gluten and starch thus increase T_g . The fracturing properties of the all model samples changed from brittle to ductile at the critical water contents (i.e., those at $T_g = 25$ °C). This suggested that the change in the crispness of deep-fried foods can be characterized by the glass transition. These findings reveal that trehalose could be a flavor to improve and control the physical stability of deep-fried foods.

Research on Ingredients and Biological Activity of Polyphenol from Green Tea of Vietnam

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From the research of the polyphenol compounds are found in *Camellia sinensis*-green tea-a popular drink in the world, we find a lot of benefits from green tea brought to people, especially in health. Green tea is a kind of greenery throughout the year, mainly in the tropics. Currently, this tea is grown in many countries, the tea output in the world is 2.5 million tons of tea annually, of which 80% are of Asian origin, especially in Vietnam, green tea cultivation is developed in 6 large areas, and the area of tea growing every year also partly shows that the value and production of tea in Vietnam is very high. Not only that, tea is a popular drink in the world. Drinking tea is not only a cultural heritage, but many scientific studies also prove that tea is effective in preventing and treating many different diseases. These studies are based on green tea polyphenols derived from the tea leaves of the Middle West cultivar, the winter crop (PP1) and the crushed green tea (PP2) and found to have antioxidant and inhibitory properties of process creates peroxidase in human blood in green tea leaves. Specially, the study of these criteria with PP2 formulation is the crushed green tea, will make full use of raw materials green tea, from raw tea leaves to small leaves, which will increase profits of green tea in Vietnam. Using *C.G.Blagodrov* method and *E.C.Xavron* is based on two scientists of the same name with mouse liver to determine the ability to inhibit lipid peroxidation of mouse hepatocellular membrane, the ability to suppress human blood peroxidase to achieve fast and effective results and antioxidant protection by 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging in green tea leaves, we have tried our best to complete the test objectively and accurately to determine these criteria of leaf green tea, and from the results of the analysis showed that the ability to inhibit peroxidation lipid membranes of rat liver cells, PP1 is more effective than PP2, while the ability inhibition of peroxidase in human blood, both preparations vary in type of blood type, but also demonstrate the ability suppresses peroxidase. It can be said, all three analyzes have shown the important effect of green tea in the anti-oxidation for humans. Three analyzes showed antioxidant capacity through DPPH radical scavenging ability, lipid peroxidation capacity of rat liver cell membrane, and inhibitory properties of process creates peroxidase in human blood and the inhibitory activity increases with the concentration of inoculants that humans use. From this, it can be concluded that green tea has many health benefits because of the polyphenol compounds found in green tea if used regularly and at dosages.

New Value-Added Products from Thai Sweet Cassava

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Cassava is one of Thailand's most important economic crops with supplying more than 70% of the global market. In 2017, Thailand was ranked as the world's largest cassava products exporter. Exported forms of cassava include chips, pellets, and starch. Cassava chips and pellets are mainly exported as raw materials for feed and ethanol production while cassava starch is exported for various industries including sweeteners, monosodium glutamate (MSG), modified starch and acid-based products. Cassava cultivars are classified as "sweet" or "bitter" depending on their cyanide content. Exported cassava products from Thailand are derived from "Bitter varieties", which are especially suited for industrial and feed purposes, because of their higher starch content, while "sweet varieties" are generally preferred if the root is to be consumed as food. Consumption of "sweet" cassava in Thailand is very minimal. Only a few traditional desserts are made from sweet cassava and they are not popular, especially among young generation. Recently, the Department of Internal Trade (DIT), Ministry of Commerce, has been promoted the production and utilization of sweet cassava in order to increase bitter cassava growers' income during cassava crisis (low price according to global trade). Three new value-added products have been developed through the support of DIT with objectives to increase utilization of sweet cassava for food production in Thai rural community as well as persuade farmer to cultivate sweet cassava as an alternative to the bitter one. They were sweet cassava chips, sweet cassava ice-cream and sweet cassava ball. Sweet cassava chips were developed with a concept of gluten-free and healthy bake snack and glazing with chocolate, strawberry and green tea. Sweet cassava ice cream (milk, chocolate and green tea flavor) was also developed using sweet cassava as natural stabilizer. The product had high yield, slow melting and unique flavor. Sweet cassava ball was low cost desserts with modern appearance similar to fine confectionery products. This dessert was simply a chocolate compound coated cassava filling. All three products were acceptable to farmer and consumer during exhibition of sweet cassava. Production methods of these new value-added products from sweet cassava were transferred to farmers and small-scale cooperation.

Effects of Tripalmitin and Tristearin on Crystallization of Coconut Oil

Busakorn Mahisanunt

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Triacylglycerides (TAGs) of coconut oil (CO) consist of medium-chain fatty acids promoting human health. Many researchers have blended CO with other fats to expand its specific uses. In order to basically understand the CO crystallization, we must clarify how to control the CO crystallization affected by TAG additives. Therefore, this study aimed to investigate of the crystallization behavior of CO at different cooling rates with tripalmitin (PPP) and tristearin (StStSt) additives. The effects of cooling rate (2, 5 and 10°C/min) and TAG concentrations (0.3-10 wt%) on crystallization and melting behaviors of CO were studied by differential scanning calorimetry (DSC) and optical microscopy. The polymorph was also determined by synchrotron radiation X-ray diffraction (SR-XRD). From the DSC results, two exothermic peaks of CO crystallization indicated two compositions in CO. From SR-XRD result, α form firstly crystallized at high crystallization temperature (HTc) followed by β' form at low crystallization temperature (LTc) and then both HTc- α and LTc- β' transformed into β' form of CO (CO- β') during heating. Although, the addition of PPP increased a crystallization temperature of CO, it did not change a polymorphic pattern of CO. However, the StStSt additives at slow cooling induced CO crystallization into CO- β' from melt. Moreover, the crystallized StStSt spherulites at isothermal condition could induce a nucleation of CO more than PPP. It is thus clear that PPP increased the crystallization temperature of CO in both HTc-peak and LTc-peak without changing the polymorph of CO, while StStSt could promote CO to crystallize directly into CO- β' . Therefore, the high melting StStSt could induce a nucleation of CO more than PPP. It is thus clear that the StStSt or PPP additives can promote the crystallization of CO, which will in turn affect the application uses in food systems.

Edible Insect in Thailand: New Alternative High Protein Source

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According to FAO, edible insect has recently become a new alternative food to overcome food security. Edible insect usually provides 100-250 calories/100 g and contains high nutrients, especially protein (9-25 %). In Thailand, there are 8 types of edible insects, which are usually consumed by consumer. They are short-tail cricket, cricket, silk worm pupae, bombay locust, larva wasps, scorpion, bamboo caterpillar, and cockchafer. These edible insects could be found easily on street vendor, supermarket or sophisticated restaurant and they could also be used as ingredients for industry. Examples of edible insect products available in the market are crispy roasted snack, ingredients for main courses, edible insect biscuit, and etc. Not only for domestic consumption, now Thai entrepreneurs are exporting the products oversea and expect to have income more than 30 million Baht per year.

Poster Presentations by HU Students

Time: 14:20-

Venue: Second floor lobby of Building C, Graduate School of Biosphere Science

	NAME
1	ISLAM MD ARIFUL
2	KANG YE
3	AYU LANA NAFISYAH
4	SHINYA MORISHIMA 森島 慎也
5	ELHAMOULY, MOUSTAFA MOHAMMED
6	KOTA KUBO 久保 海太
7	YOSHIHISA ISHIMOTO 石本 佳久
8	WAHYUDIN
9	ALVINO GRANADOS ALEX EDUARDO
10	HIROAKI FURUTANI 古谷 浩章
11	TADASHI OKAMURA 岡村 惟史
12	ERI TANIGUCHI 谷口 恵理
13	WEI GUO-REN 魏 国任
14	MIO AOKI 青木 美緒
15	TAKUMI MOCHIZUKI 望月 匠峰
16	SHIZUKA OHARA 小原 静夏
17	KAYIRA,TABITHA MLOWOKA