

HCG035-P01

Room:Convention Hall

Time:May 22 14:00-16:30

Study of effective utilization of the Nitrogen-fixing terrestrial cyanobacterium based on the desiccation-related genes.

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Using DNA microarray from a terrestrial cyanobacterium *Anabaena* sp. PCC7120, the typical desiccation-responsible genes were selected and the gene-disruptants were characterized. All of typical gene-disruptants showed low viability under desiccation using cells grown in N₂-free medium. These results may suggest that desiccation-tolerant genes contain nitrogen fixation relating genes, are expressed irrespective of nitrogen content to protect desiccation sensitive N₂-fixing heterocyst and express to stabilize intra-and outer-cellular condition under desiccation in N₂-rich condition. We were also shown that the no-inducible photosynthesis gene, *psb28*, was related to desiccation tolerant. Psb28 protein associates with photosystem II but function of Psb28 is not enough to understand.

Desiccation tolerant N₂-fixing cyanobacterium, *Nostoc commune* is related to the *Anabaena*. The *Nostoc* has ability to use scientific research for desiccation tolerance system, food and soil for plantation. These abilities expect to improve devastating soil to nutrient-rich soil including space agriculture. So it was tried to isolate the *Nostoc* and succeeded to cultivate the *Nostoc* axenically. To confirm ability of the *Nostoc* soil, the *Nostoc* was used plantation as nutrient containing plate. The result of difference plant growth between N₂-deficient plate and cyanobacterial mat is now in progress.

Keywords: desiccation, tolerance, cyanobacteria, gene analysis, bioremediation, agriculture

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The small ecosystems using cyanobacteria and a Martian regolith simulant

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The detailed verification of the space-environment tolerance of the creature on the earth has the merit of a lot of new results and the possibility about the development related to them. Specifically, the appearance of the cyanobacteria, one of photosynthetic creatures, on the earth had a great influence on the material recycling and the oxidation of the atmosphere in the earth in the past period. Arai et al.(2008, 2010) have reported that *Nostoc* sp. of the cyanobacteria showed the high tolerance to vacuum. It has been also proved that cyanobacteria could grow in the Martian regolith simulant. Their results lead the possibility that the dried cyanobacteria can be carried in the outer planet from earth, in future, too. Here, we design small scale of bio-ecosystem using the Martian regolith simulant and the cyanobacteria. The designed small ecosystems are variously changed in the environmental conditions. We will review the utilization for teaching materials in the designed system which examines the process of the change and also discuss the possibility that the small ecosystems are able to use in the several research fields after our investigation.

Keywords: cyanobacteria, Martian regolith simulant, small ecosystems, teaching materials

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Symbiosis among two plants and their related fungus (Rhizoctonia).

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Spiranthes sinensis var. *amoena* is a orchid with a typical orchid mycorrhizal association. A tripartite symbiotic association is reported among *Abies firma*, *Chamaegastrodia sikokiana* and mycorrhizal fungus which forms mycorrhiza in both plants. Recently, we reported that isolates which were isolated from the roots of *Zoysia tenuifolia*, were able to promote the germination of seeds of *Spiranthes sinensis* var. *amoena*. In this study, we demonstrated a tripartite symbiotic association among *Spiranthes sinensis* var. *amoena*, *Zoysia tenuifolia* and a symbiotic fungus which forms mycorrhiza in *Spiranthes sinensis* and promotes the germination and growth of *Zoysia tenuifolia*. We have already found some property in the isolated fungus and functions. We have also investigated the functional substances extracted from the isolated fungus which affect the plant seed germination or growth. The results from our study, symbiosis among several species of creatures, will lead the important information at the selection of creatures into the artificial bio-ecosystems.

Keywords: Symbiosis, *Spiranthes sinensis* var. *amoena*, *Rhizoctonia*

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Microbial response to the applied magnetic field

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Biological reactions under magnetic fields should be considered in closed-ecology on planets because the Earth's magnetic field (geomagnetic field). For example, magnetotactic bacteria are oriented along the magnetic field lines of geomagnetic field.

Magnetic fields may induce multiple effects in biological systems, including change in DNA replication or RNA transcription and modification of ion and protein flow across membranes. In recent years, influences of various electromagnetic fields on cell and organisms have been investigated by many researchers. However, the detailed mechanisms in the effects of magnetic field on organisms are still controversial.

In this study, we had focused on influences of the magnetic field (the hundreds of mT range of magnetic flux density) on environmental microbes. Some microbes susceptible to the applied magnetic field have been isolated from the soil. To reveal the species or strain of these microbes and these mechanisms, we investigated changes of these microbial metabolisms by the applied magnetic field individually.

Keywords: environmental microbe, magnetic field

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Method for the measurement of bacterial cell growth using Quarts Crystal Microbalance

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Rapid methods for bacterial detection are significant for food, industrial, clinical diagnostics, and environmental monitoring.

Recently, a quartz crystal has been used as a mass detector and has been applied to determine gases, ions, and some biomolecule (e.g., immuno-compounds). These studies are based on the fact that the resonant frequency change of the quartz crystal corresponds to mass change on the crystal surface.

In this study, we used a quartz crystal microbalance (QCM) as a transducer for the measurement of bacterial cell growth. As a result of the current experiment, both the dry cell weight and the living cell weight were linearly proportional to the frequency change in the range of 10^{-8} to 10^{-5} when our QCM sensor was used for the measurement. Namely, the measurement of bacterial cell weight is possible within this range using the sensor.

The aim of this study is to develop the device and method to monitor in real time cell growth of in situ environmental cultivation. This method will also be variable to analyze the behavior of microbes in the closed-ecosystem.

Keywords: Quartz Crystal Microbalance, Biosensor

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Several applied utilizations of tree allelopathic function in artificial closed bio-ecosystems.

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It has been well known that allelopathy is a phenomenon that an action of natural bioactive chemicals produced by plants to other life. Many allelopathy researches have reported and accumulated the results, identification of the candidate substances which cause the phenomenon and its functions, using many species of plants as materials. When designing the closed-ecosystem in outer planet or severe environmental place, the tree has a lot of utility values. Tree produce excess oxygen, woody materials for living cabin, and provide biomass by cultivating crops and other species of creatures, in addition to the material recycling in the atmosphere. The study of allelopathy evaluation becomes necessary sufficiently when trees cultivate in the artificial ecosystems. We have found a tree, one of Prunus tree line, which had a high medicinal utility value in the study of an allelopathy. When we establish an artificial ecosystem design, there will be several utility matters in the one field of study developed from the allelopathy research. We will show the result as one of the example study and discuss them.

Keywords: tree, functional substaces

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Rice BRITTLE CULM 6 gene is required for cellulose synthesis in secondary cell walls

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Cell wall polysaccharide are synthesized by actions of glycosyltransferases including cellulose synthases in plants. Brittle culm 6 (Bc6) is a semi-dominant rice mutant with easily breakable plant bodies, and expected to have defects in the formation of secondary cell walls. In this study, Bc6 gene was isolated, and appeared to encode a cellulose synthase catalytic subunit, OsCesA9. Bc6 mutation reduced the cellulose content by 31%, while it increases the hemicellulose content by 48%. Introduction of the mutant Bc6 gene into wild-type rice significantly reduced cellulose content, causing brittle phenotypes. Expression of BC6 gene was observed in the culms, nodes, and flowers, and related to that of BC1, which encodes a COBRA-like protein involved in cellulose synthesis in secondary cell walls in rice. We might regulate the cellulose synthesis using BC1 and BC6 genes.

Keywords: cell wall, rice, cellulose, polysaccharide

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The response to gravity and light in tilapia *Oreochromis niloticus* in closed recirculating fish rearing system

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Living organism adapts to their habitat environment and lives depend on it. Fish is especially dependent on environmental water and thrives in it. In artificial closed ecosystem, fish adaptation to gravity and light based on water environment is grasped and the environmental factors are needed to control for sustainable operation of the artificial ecosystem. This presentation introduces the response to gravity and light in tilapia *Oreochromis niloticus* and explains environment control in closed recirculating fish culture system that can be used in artificial closed ecosystem.

Keywords: artificial closed ecosystem, closed recirculating fish culture system, tilapia, gravity, light, rearing water

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Human reproduction in bioecology systems in the space environment

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Since 2004, when we first presented a paper entitled Prospects for reproductive medicine in space at the 20th Space Utilization Symposium, we have continuously studied and discussed together with our colleagues the topics of the human reproduction in the space environment. For example, we have investigated the effect of gravity on the fetus development in the uterus on the earth, or discussed face to face feeding behavior for mother milk in the space environment. During the past half a century development of space exploitation and utilization greatly progressed. It is not a surprise that astronauts or cosmonauts stay for several months and even one year on a space station, and now space tourism is commercially planned and promoted extensively. There will be more opportunities that much more people will visit or contact with the space environment, and it will become realistic and definite that housing structures for human being will be constructed on the moon, Mars or orbits of the earth. In the present meeting we summarize a series of our previous studies and discuss the necessity of a systematic approach to the study of space reproductive medicine for the coming human society that will be built in complex bioecology systems in the space environment. We also presented most of this discussion at the 27th Space Utilization Symposium, January, 2011, Sagamihara.

Keywords: reproduction, sexuality, space, fetus, gravity, microgravity