Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

HCG36-01 Room:101B Time:May 24 14:18-14:33

Utilization of a terrestrial cyanobacterium, *Nostoc* sp. HK-01, in closed bio-ecosystems

KIMURA, Shunta[1*] ; KIMURA, Yasuko[2] ; KATOH, Hiroshi[3] ; ARAI, Mayumi[4] ; SATO, Seigo[1] ; TOMITA-YOKOTANI, Kaori[1]

[1]University of Tsukuba, [2]University of Tsukuba and Jumonji University, [3]Mie University, [4]National Museum of Emerging Science and Innovation

Cyanobacteria has been used as a traditional food resource in many parts of the world. Food production under severe conditions is important for life-support in closed bio-ecosystems.

A terrestrial cyanobacterium, *Nostoc* sp. HK-01 may be utilized for bio-chemical circulation in closed bio-ecosystems, including Mars. *Nostoc* sp. HK-01, has several ability; photosynthesis, nitrogen fixation and space environmental tolerance to drought, vacuum, heat, UV, gamma-ray and heavy particle beams. We propose the utilization of a terrestrial cyanobacterium, *Nostoc* sp. HK-01, as food in closed bio-ecosystems.

In this study, we verified the utilization of terrestrial cyanobacterium *Nostoc* sp. HK-01 as a food resource on Mars, and will discuss technology for recycling this strain as a food resource in a closed bio-ecosystem.

Keywords: closed bio-ecosystems, cyanobacteria, food resources, *Nostoc* sp. HK-01

Japan Geoscience Union Meeting 2015
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HCG36-02 Room:101B Time:May 24 14:33-14:48

Current Status on CELSS for Human Space Activities - An Introduction of ECLSS on board ISS -

OHNISHI, Mitsuru[1*]

[1]Japan Aerospace Exploration Agency

It is called ECLSS (Environmental Control and Life Support System) that provides suitable environment for human space activities. The smallest ECLSS is a space suit. On the other hand, ISS (International Space Station) has one of the largest ECLSS for long term stay. It looks like a very complicated chemical plant composed of several functions. Still, this ECLSS is a subset of fully CELSS (Controlled Ecological Life Support System). CELSS consists of air revitalization, food production, thermal control, waste disposal, and water recovery functions. The most important and difficult function is the food production. Current ECLSS on board ISS racks this. However we can’t have achieved this CELSS even on the ground yet. Anyway this ECLSS can keep the environment inside ISS comfortable, provide material requirement from human body, and process exhausting material from that. Let’s introduce the ECLSS on board ISS as a step to the fully CELSS.

Keywords: CELSS, ECLSS

Japan Geoscience Union Meeting 2015
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HCG36-03 Room:101B Time:May 24 14:48-15:03

Utilization of the terrestrial cyanobacteria

KATOH, Hiroshi[1*] ; KIMURA, Shunta[2] ; YOKOSHIMA, Mika[2] ; FURUKAWA, Jun[2] ; TOMITA-YOKOTANI, Kaori[2]

[1]Mie University, [2]University of Tsukuba

The terrestrial, N_2 -fixing cyanobacterium, *Nostoc commune* has expected to utilize for agriculture, food and terraforming cause of its extracellular polysaccharide, desiccation tolerance and nitrogen fixation. For isolation, many of bacteria, fungi, algae and cyanobacteria were obtained from natural *Nostoc commune* crusts. It may be suggesting that *Nostoc commune* has potential of ”Cradle of Life”. In this report, we suggest possibility of agriculture, using the cyanobacterium. Further, we also found radioactive compounds accumulated *Nostoc commune* (cyanobacterium) in Fukushima, Japan after nuclear accident. Thus, it is investigated to remove radioactive compounds from soil by the cyanobacterium and showed to accumulate radioactive compounds using the cyanobacterium. We will discuss utilization of terrestrial cyanobacteria under closed environment.

Keywords: desiccation, terrestrial cyanobacteria, bioremediation, agriculture, space agriculture

Japan Geoscience Union Meeting 2015
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HCG36-04 Room:101B Time:May 24 15:03-15:18

Evaluation of nutritional utilization of Nostoc sp. HK-01, as a food resource in closed bio-ecosystems

KIMURA, Yasuko[1*] ; KIMURA, Shunta[2] ; KATOH, Hiroshi[3] ; ARAI, Mayumi[4] ; SATO, Seigo[2] ; TOMITA-YOKOTANI, Kaori[2]

[1]University of Tsukuba and Jumonji University, [2]University of Tsukuba, [3]Mie University, [4]National Museum of Emerging Science and Innovation

We study life-support in closed bio-ecosystems to provide food and oxygen for habitation in severe environments. We propose several species of organisms as candidate species. A terrestrial cyanobacterium, *Nostoc* sp. HK-01 has several unique abilities, photosynthesis, nitrogen fixation and tolerance to a space environment. Here, we propose to utilize *Nostoc* sp. HK-01 as a food resource in space environments such as Mars. *Nostoc* sp. HK-01 appears to have high nutritional values for humans. We will discuss the nutritional utilization of *Nostoc* sp. HK-01 in closed bio-ecosystems. Our results may contribute to the supply of food resources under severe conditions for life-support in closed bio-ecosystems.

Keywords: closed bio-ecosystems, cyanobacteria, food resource, Nostoc sp.HK-01, nutritional utilization

Japan Geoscience Union Meeting 2015
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HCG36-05 Room:101B Time:May 24 15:18-15:33

Possibility of tree utilization in closed bio-ecosystems - Proposal research in model tree *Prunus* sp.

TOMITA-YOKOTANI, Kaori[1*] ; BABA, Kei'ichi[2] ; KATOH, Hiroshi[3] ; SUZUKI, Toshisada[4] ; KATAYAMA, Takeshi[4] ; COSMO, Bon[1]

[1]University of Tsukuba, [2]Kyoto University, [3]Mie University, [4]kagawa University

Living creatures on the earth have evolved since their origin. They are equipped with several important functions affecting each other. Knowledge about these functions and interactions with the ecological factors is essential for secure design of a closed-ecosystem with a limited number of living species under severe environments, such as space and deep sea or desert. We have studied trees for using their materials in such environment. There are various utilizations of trees on the earth. Trees have numerous abilities such as materials for several tools in a closed bio-ecosystem. Japanese flowering cherry trees, *Prunus* sp., have been studied as one woody plants in our research group. We carry out experiments to show actual usage in a closed bio-ecosystem by using a small bonsai, CosmoBon, that is easy to use physiological experiments after the selection of suitable and perfect strains of the tree. We will discuss the biological and technical systems for the establishment of closed systems.

Keywords: Closed bio-ecosystem, CosmoBon, Space experiment, Severe environment, Tree utilization

Japan Geoscience Union Meeting 2015
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HCG36-P01 Room:Convention Hall Time:May 24 18:15-19:30

Closed bio-ecosystems by the systems of organisms

TOMITA-YOKOTANI, Kaori[1*]

[1]University of Tsukuba

Various species of living organisms on the earth have evolved for a long time. They are equipped with several important functions affecting each other. Knowledge on these functions and interactions with ecological factors is essential to secure a design of a closed-ecosystem with a limited number of living species under severe environments, such as space and deep sea or desert. This session will discuss biological and technical systems for the establishment of closed systems shown in several research reports. I will introduce this research.

Keywords: Closed bio-ecosystem, Severe environment, Space experiment

Japan Geoscience Union Meeting 2015
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HCG36-P02 Room:Convention Hall Time:May 24 18:15-19:30

Proteins involved in desiccation tolerance of Nostoc sp. HK-01

ABE, Tomoko[1*] ; IIMURO, Rurika[1] ; KIMURA, Shunnta[2] ; KATHO, Hiroshi[4] ; KIMURA, Yasuko[3] ; TOMITA-YOKOTANI, Kaori[2]

[1]Tokyo Denki University, [2]University of Tsukuba, [3]Mie University, [4]Jumonji University

Nostoc sp. HK-01 is one of terrestrial cyanobacterium having a tolerance to desiccation stress and it has several ability, photosynthesis, nitrogen fixation and usefulness as a food, it is thought that it can be used for bio-chemical circulation in a closed ecosystem, including space.

In this study, we searched for the proteins that play an important role in the desiccation stress response. A study on desiccation tolerance predicted at the time of introduction to a closed bio-ecosystem is necessary. To investigate expression changes of the proteins in *Nostoc* sp. HK-01 cells, the proteins were analyzed by SDS-polyacrylamide gel electrophoresis. In the course of desiccation, an increased level of expression of a certain was detected.

Keywords: cyanobacteria, Nostoc sp., desiccation tolerance, stress protein

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HCG36-P03 Room:Convention Hall Time:May 24 18:15-19:30

Production and maintenance of the most useful tree in a closed environment

ABE, Yusuke[1*] ; KIMURA, Shunta[1] ; KATOGI, Hitomi[1] ; SATO, Seigo[1] ; BABA, Kei'ichi[2] ; KATOH, Hiroshi[3] ; SUZUKI, Toshisada[4] ; KATAYAMA, Takeshi[4] ; MATSUMOTO, Asako[5] ; TOMITA-YOKOTANI, Kaori[1]

[1]University of Tsukuba, [2]Kyoto University, [3]Mie University, [4]Kagawa University, [5]Forestry and Forest Products Research Institute

Trees can have several important roles; oxygen supply, carbon fixation, materials and functional substances for human especially in closed bio-ecosystems. In general, the genetic background of all productive trees are basically different because of cross ? pollination. We are now screening useful trees and their maintenance techniques using several traditional methods of trees planting. Species of Sakura are originally grown in the Mt. Fuji area, oligotrophic location. We are trying to create the best useful woody plant under closed bio-ecosystems with "Mamezakura", *Prunus* incisa , as a model tree.

Keywords: Closed bio-ecosystems, Tree planting, *Prunus* sp., useful tree

Japan Geoscience Union Meeting 2015
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HCG36-P04 Room:Convention Hall Time:May 24 18:15-19:30

Analysis of filamentous fungal cell wall components to study the existence of endophytes

KATOGI, Hitomi[1*] ; YOKOSHIMA, Mika[1] ; FUJIMORI, Shohei[1] ; KIMURA, Shunta[1] ; SATO, Seigo[1] ; TOMITA-YOKOTANI, Kaori[1]

[1]University of Tsukuba

Endophyte is an organism that lives inside a plant. Endophytes of the ergot fungus family *Neotyphodium* reproduce by producing seeds, although the life cycle of the endophyte remains unclear. Tall fescue (*Festuca arundinacea*) non-infected and infected with *Neotyphodium* sp. Fe-047 were used as materials in this study. Chitin is a component of the filamentous fungal cell wall. Chitin is decomposed to $(GlcNAc)_2$ by an enzyme and we analyzed the amount of $(GlcNAc)_2$ that can be produced. This analysis has advantages compared to the already investigated methods using proteins or genes.

There are 80-90 % of land plants living together with filamentous fungi. The symbiotic relationships change between the plant and endophyte under microgravity conditions. We will discuss the value of this research method for symbiotic relationships between plants and endophytes in an artificial closed bio-ecosystem.

Keywords: endophyte, symbiosis, closed bio-ecosystem

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Developing a water source forest conserved in a suburban park into an educational space

TAKEDA, Mie[1*]

[1]Aichi Institute of Technology

People who still use spring water for paddy fields and daily living know how to cherish the blessings of nature. In contrast, it is difficult for people in the modern age to learn that water from nature is a precious resource, while water resources are of serious global concern.

The aim of the project was to conduct investigations on soil, water quality, aquatic organisms, and vegetation in the water source forest by researchers in respective disciplines and develop it into an educational space to facilitate education for sustainable development. The forest, which is now a source of spring water used for paddy fields, serves as a field to pass on how to grow the soil sustainably in a suburban area to the next generation.

Keywords: Environmental Education