November 2018 to November 2019

Project title

Development of a small scale and efficient protein production platform utilizing edible microalga, Spirulina

Institutions：Chitose Laboratory Corporation, Taberumo, IHI Aerospace Co., Ltd., Fujimori Kogyo Co., Ltd.

Project outline

Objective

This project aims to develop a space-saving and highly efficient device that is capable of producing Spirulina (Arthrospira platensis; earlier classified under genus Spirulina) and apply it to the greenhouse agricultural system on earth as well as to self-supplied protein production during stay on the moon. Among other nutrients, Spirulina has especially high protein content accounting for approximately 70% of its dry weight. As a result, the annual protein productivity per unit area of Spirulina is overwhelming, and over 15 times greater than that of soy. Another feature of Spirulina is that it allows for resource-saving production. Using these features of Spirulina, we propose to develop a protein self-supplied device for astronauts during their stay on the moon. This technology is applicable on earth too, and we will seek to expand it to greenhouse agriculture in future.

Contents

In this study, we will address the following:

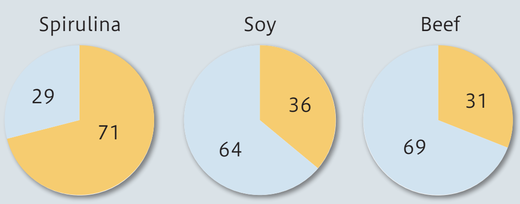
(1) Optimization of culture conditions for the cultivation of Spirulina using artificial light and standard medium. We will assess the adequacy of materials with various characteristics as the supporting material, on which algal cells are attached and immobilized, using primarily materials that were used for alga culture in the past.

(2) Manufacture and testing of several small-sized demonstrators equipped with LED light sources. Using the supporting material selected in (1), we will conduct a culture assay using small-sized demonstrators.

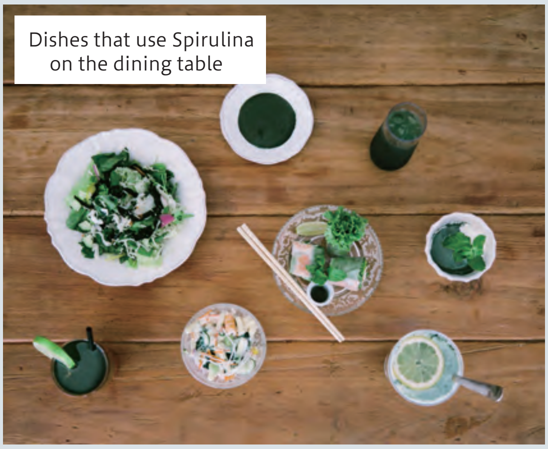
(3) Production of a liquid fertilizer from non-edible plant remnants using nitrification bacteria.
We will use greens as a model of non-edible plant remnants and artificial urine to perform fermentation via nitrification bacteria that are adequate for fermenting the model case.

(4) Culture Spirulina using the liquid fertilizer obtained from non-edible plant remnants and artificial urine (see point 3).

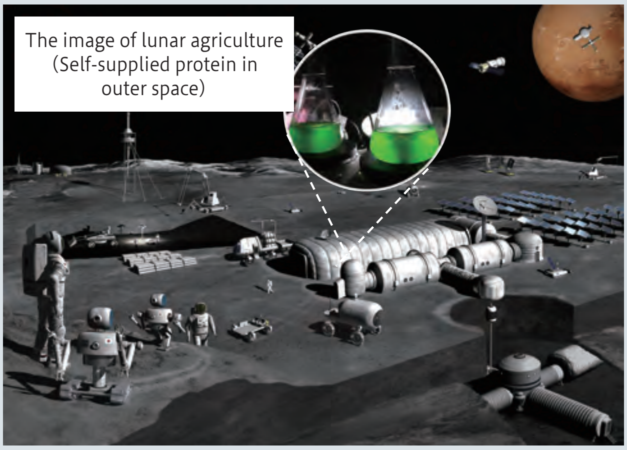
(5) Discuss a system that can be used in outer space. We will design a concept of a system that assumes use in outer space, by examining items necessary for culture in outer space environments, including low gravity environment, and by considering the maximization of culture efficiency.



Percentage of protein contained in Spirulina, Soy, and Beef
Compared to that in soy and beef, Spirulina has approximately twice the protein content, and is expected to serve as an abundant source of protein supply.



Spirulina has been appreciated from old times as an invaluable dietary source due to its high nutrient value. Today, it is appreciated in various forms, such as smoothies, salads and yogurts, and has become increasingly recognized as a new ingredient.



In outer space, Spirulina can be cultured as a nutrient-rich raw diet with high protein content in the International Space Station and on the moon, by using a resource-saving and space-saving device that can culture Spirulina. Thus, even during a long-term mission, astronauts are expected to be able to keep in good shape by eating Spirulina on a daily basis.