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陸棲シアノバクテリアを用いた生態工学の取り組み

Proposals of Eco-Engineering using terrestrial cyanobacteria

木村駿太 [1, 2]
Shunta KIMURA[1, 2]
1　東大院・農生科，Graduate School of Agricultural and Life Sciences, The University of Tokyo
2　学振 PD，Japan Society for the Promotion of Science,

1. About the Society of Eco-Engineering

The Society of Eco-Engineering promotes wide field of research e.g. food, energy, plant factory, ecosystem, life support systems and remote sensing (Fig. 1) [1]. Those are necessary to human habitation in space. Here I show one of proposals of eco-engineering using terrestrial cyanobacteria.

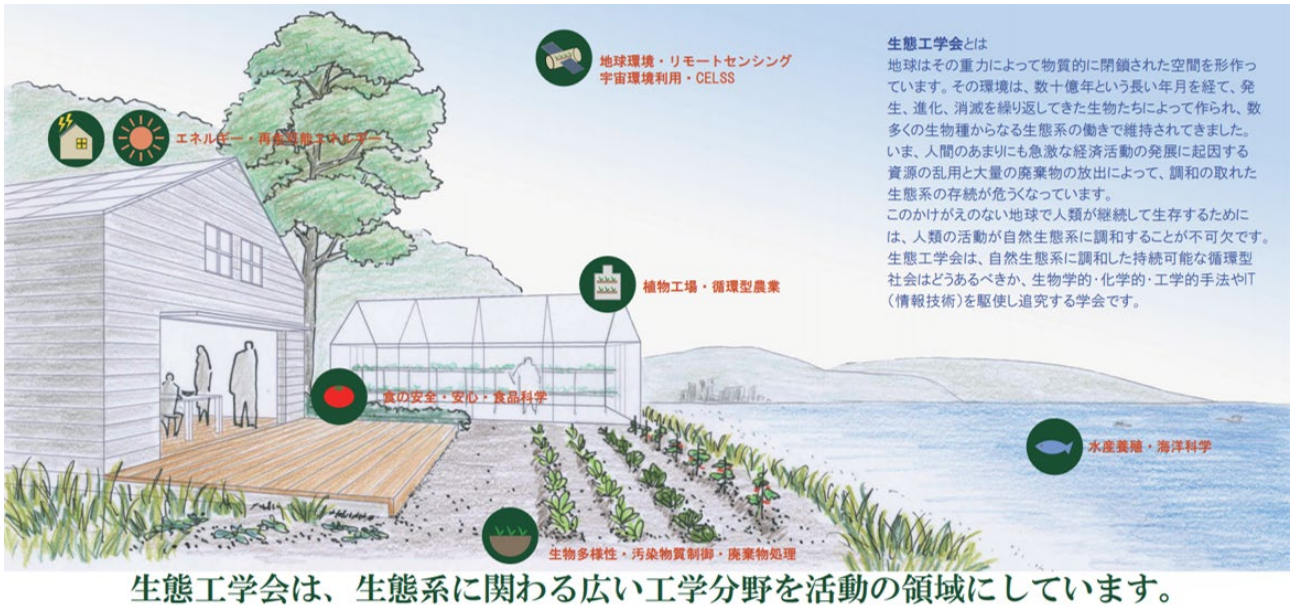

Fig. 1　Introduction of the Society of Eco-Engineering (http://www.see.gr.jp/what/pdf/see_leeflet.pdf)

2. About Terrestrial Cyanobacteria

Cyanobacteria are dominant primary producers in their ecosystems, and are distributed worldwide, not only in the sea and fresh water, but also on land. Terrestrial cyanobacteria (Fig. 2) are useful as initial organisms for environmental preparation for long-term human habitation in space, because of their various abilities; photosynthesis, nitrogen fixation and drought tolerance. Furthermore, cyanobacteria have utilities as food resources.

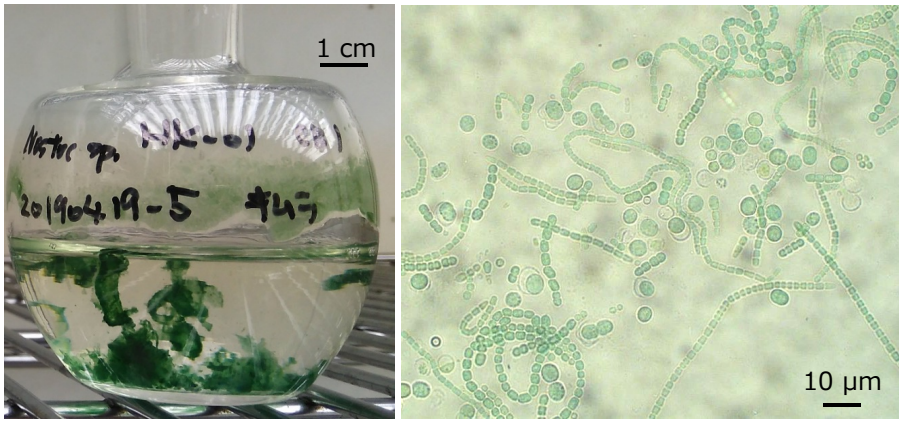

Fig. 2 A terrestrial cyanobacterium, *Nostoc* sp. HK-01.

3. Evaluation of Cyanobacteria as Food Material for Space Agriculture

We have already proposed cyanobacteria as food material. The nutritional energy of 100 g dry weight of a terrestrial cyanobacterium, *Nostoc* sp. HK-01 was estimated to be 358.1±10.9 kcal by the results of protein, sugar and lipids (Table 1). Our results may contribute to the supply of food resources under severe conditions for life-support in closed bio-ecosystems [2), 3)]

Table. 1 Nutritional value per 100 g in *Nostoc* sp. HK-01, three species of cyanobacteria and six food materials [2), 3)]

	State	Energy (kcal)	Water (g)	Protein (g)	Lipid (g)	Sugar (g)
Nostoc sp. HK-01	Dry	358.1 ± 10.9	5.5 ± 1.6	52.9 ± 0.15	10.9 ± 0.7	12.1 ± 1.0
Nostoc commune	Dry	300	16.6	19.6	0.1	55.2
Aphanothece sacrum	Dry	298	11.5	21.8	0.1	52.4
Spirulina platensis	Dry	406	3.6	72.6	7.3	12.4
Rice	Dry	356	15.5	6.1	0.9	77.1
Flour	Dry	368	14.0	8.0	1.7	75.9
Hen‘s egg	Fresh	151	76.1	12.3	10.3	0.3
Pork	Fresh	148	71.2	21.5	6.0	0.2
Horse mackerel	Fresh	121	74.4	20.7	3.5	0.1
Soybean	Dry	417	12.5	35.3	19.0	28.2

4. Future Study: Regulation of Cell Types of Cyanobacteria

Several strains of cyanobacteria can differentiate into vegetative cells with photosynthetic abilities, heterocysts with nitrogen fixation abilities, motile hormogonia, and dormant akinetes (Fig. 3) [4)]. Akinetes are highly resistant to dry conditions and a wide range of temperatures [5)]. We have indicated the phytohormone cytokinins promoted the germination of akinetes [6)]. The results strongly suggest that cyanobacteria have a very similar perception system to plants. We may be able to regulate cell cycle of cyanobacteria, which are useful to life support systems in manned space mission.

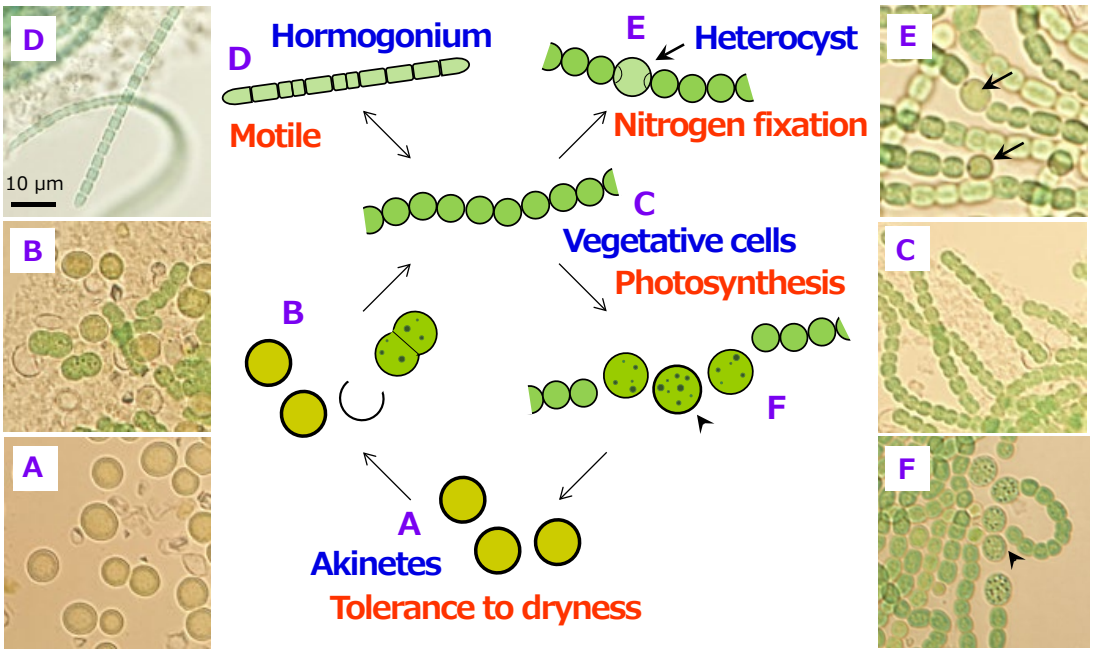

Fig. 3 Cell types and their characteristics of *Nostoc* sp. HK-01 [5].

References

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