Pantry in space

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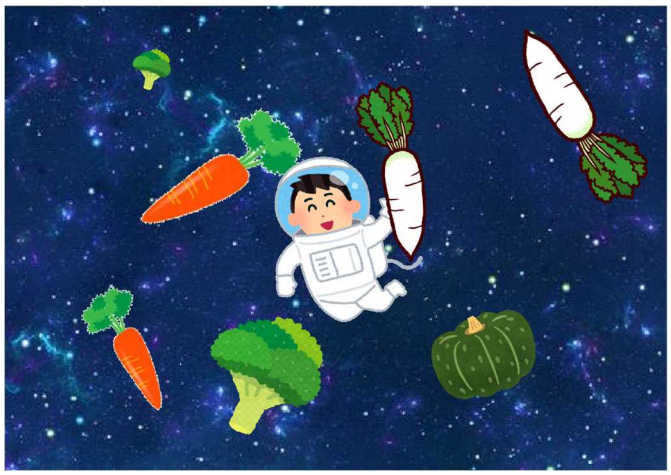

As you know, we human being are facing many difficulties in living on the earth such as global warming, climate change, desertification, population explosion and so on. All of these are issues that need to be addressed immediately. Above all, food crisis has a direct impact on us, and is I think the most serious one.

Do you know how serious the food crisis is? Nowadays about 690 million (one in eleven) people around the world are chronically undernourished, and unfortunately this problem will be getting worse and worse because of other problems. Yes, when we think this problem, we also need to consider problems mentioned above at the same time. During the period from 1987 to 2007, the global population has grown up to 6.7 billion from 5 billion, and it is still now growing. The global population is estimated to reach 9 billion by 2050 and the world food demand will be 1.7 times higher than now. Especially we will need more than three times as much agricultural land as Japan's to secure food for people in developing countries. On the other hand, regarding the global warming, although one says it has a positive aspect on the agricultural production because the increase in the CO2 in the atmosphere make the yield of crop increase, the negative aspect of it also matter. The temperature rise caused by the global warming may causes the decrease in agricultural land area and change the climate, leading to the decreasing in the yield of crop. It is said, in fact, that 5 or 6 million hectares of agricultural land are becoming desert every year. In this way, the problem of food supply is becoming important more and more. Then, is there any solution for it?

As long as we stick to the earth, whose resources are limited, it seems to be impossible to solve the problem of food crisis. Thus, I think space agriculture will become crucial method to address the problem in the future. A lot of research on it has been done actively for a long time such as elucidating the life system, searching for varieties suitable for cultivation in space and develop an agricultural environment. Indeed, there has been some successful cases of plant cultivation in space. Such work mainly focused on the cultivation or growing. Then how about preserving after harvested? In fact, few research has been done on food storage in space so far. However, the food conservation is as important as food production because one of the causes of the food problem is derived from the difficulty to preserve food properly. Actually, it is said that world grain production is over 2.6 billion tons each year, which is enough amount for everyone to eat. However, food problem exists yet because we can't preserve and redistribute these foods properly. What I want to introduce here is the very discovery on the food preserving!

The paper reports that a weak gravity condition may be effective to preserve vegetables fresh[1]. In this research, Makino et al. investigated the effectiveness of a simulated microgravity environment as a novel method for preserving the freshness of vegetables. The main cause of wilting and degradation because of mass loss is moisture loss, which is mainly associated with the process of losing water through the surface of a plant (so-called transpiration). Some studies have reported that the transpiration increases with higher levels of gravity. Therefore, they assumed that the transpiration rates and mass loss of vegetables post-harvest can be reduced by placing the vegetables under a microgravity environment. They prepared the three types of vegetable sample, soybeans, mung bean sprouts and white radish sprouts, and set them into a simulated microgravity device. The machine creates and maintains a microgravity environment on earth by rotating the object 360° slowly to bring the mean value of gravity close to 0 m/s^2. As a result, while the mass retention rates of soybeans were not affected by the difference in gravity levels during the storage period, those of mung bean sprouts and white radish sprouts were significantly higher under the microgravity environment than ordinary gravity environment. The types of sprout vegetables have roots, stems and leaves, and the dissipation of moisture occurs by transporting moisture through the canal from roots to leaves. Under the condition of ordinary gravitation, they sense the

direction of water movement and carry out the transpiration smoothly. On the other hand, under the microgravity conditions, they couldn't detect the direction of water movement, and smooth transpiration was hindered. However, in the case of soybeans, the effect of gravity was not observed because they don't have roots and leaves, and the transpiration occur regardless of gravity sensing. As a conclusion, they confirmed that the microgravity environment is effective in maintaining the freshness of sprout vegetables.

This discovery is a first step to new storage method to conserve and maintain vegetables fresh. It means if you grow and cultivate crops in outer space you don't need to setup equipment nor consume any energy to preserve because outer space is already microgravity environment. You only have to leave it! As mentioned above, much research on the efficient food production is being actively conducted, and this discovery may solve the next problem on how to storage such cultivated food. Someday inexhaustible food is floating in outer space, and every people can take ingredients from sky as needed and cook it. I believe such a future will come.

[1] Yoshino Makino et al. "Efficient preservation of sprouting vegetables under simulated microgravity conditions", PLOS ONE, October 15, 2020