MARTIAN PHOTOSYNTHESIS OF THE EARTH PLANTS – INDUCED BIOCHEMICAL ADAPTATIONS

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ABSTRACT

Human Mars missions and long-term settlements followed by the Terraformation of the Planet are those of the most important challenges for 21st century scientists. Invention of the practical methods for the possible bioremediation of Martian ground and atmosphere seems prospective and is of great scientific interest.

Normal functioning of the photosynthesizing organisms is very important for the long-term sustainability of human Mars settlements as there are no other alternatives for the stable oxygen/food supply for such stations. It is certain that plants will play the crucial role in the Terraformation of the Red planet.

We have simulated the possible environmental conditions of the human Mars settlements and studied various adaptations of the optically active organisms to it. Specific biochemical aspects of the Martian photosynthesis during Terraformation have been investigated.

Although many organisms have been used, only the results obtained from the experiments on the vascular plants are presented in this particular work.

METHODS AND MATERIALS

Greenhouse conditions of the human Mars settlement have been simulated within MCSC – Mars Climate Simulation Chamber (Figure 1).

Sweet basil (O. Basilicum) and its cultivar Dark “Opal” basil (O. Basilicum L.) have been chosen for these experiments as they are closely related taxonomically and contain the significant variety of the substances known to act as anti-oxidant and radiation-screening agents.

Seedlings have been grown for two weeks under the dim light to prevent the formation of the starch grains inside chloroplasts.

RESULTS

Results show the significant changes of the pigment and anti-oxidant content within the plants placed in the lab and MCSC conditions. These data are also highly dependent on the illumination intensity and temperature variation during daily cycle. Presented data show the results obtained at maximum irradiation intensity (Figure 3).

Under the MCSC “Martian” conditions Chl a concentration decreases sharply unlike that of Chl b, amount of which increases almost twice of the initial number. Content of the anti-oxidants, such as Carotenoids and Tocopherols rises significantly in both species, however, based on the preliminary data from the measured Hill Reaction, photo-reduction system of the “Opal” basil more likely relies on anthocyanin-based scavenging of the free radicals, whereas Sweet basil responds with the intensified synthesis of anti-oxidant oils (Figure 4).

One of the noticeable effects (during experiment) is the strong odor followed by the depositions of the oil-like compounds on the walls of the container. Biochemical and spectral analysis of these compounds reveals various types of the Arenes and PAH – Polycyclic Aromatic Hydrocarbons.

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REFERENCES