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CHLORELLA VULGARIS AND EXTREMOPHILE BACILLUS SPP. GROWTH WITH HYDRAZINE

Abstract

Transforming spacecraft fuel tanks into photobioreactors for microalgae and bacteria cultivation is a promising solution for future space habitats. The challenge would be dealing with the high toxicity properties of the fuels used for space propulsion, such as Hydrazine. Firstly, microbial biodegradation can be used as a preliminary step for decontaminating hydrazine from spent fuel tanks. Secondly, *Chlorella vulgaris*, a freshwater green microalga, can be added and used as a nutrient source and fresh oxygen supplier to the habitat. *C. vulgaris* and seven extremophilic bacteria isolated from the Dead Sea area were submitted to 1-25 ppm hydrazine hydrate, separately. Both reduced hydrazine concentration in situ, extremophilic bacteria averaged 45% reduction, starting from 25 ppm after 120 hours, 37°C, and *C. vulgaris* culture was more effective, with 81% average reduction at 20 ppm, after 24 hours, 25°C. At 1 ppm, algal growth rate was higher compared to control, yet 5-20 ppm decreased algal growth rate. Hydrazine most likely decreased in algae cultures due to oxygen removal via the reaction $N_2H_4 + O_2 \rightarrow N_2 + 2H_2O$. Hydrazine oxidoreductase genes were not detected, and further genetic and chemical analysis is required to identify the hydrazine reduction mechanism in *Bacillus* cultures. All bacterial isolates were related to the *Bacillus* species based on 16S rDNA gene analysis, and taxonomically affiliated to: *B. licheniformis, B. paralicheniformis, B. cereus, B. safensis* and *B. atrophaeus*. Cohabitation experiments in solid and liquid modified media (Bristol 2X and LB) have shown that *C. vulgaris* and ISO-36 (*B. cereus* spp.) can live in symbiosis, without inhibiting each other's growth severely. Flow cytometry analysis identified spores and vegetative *Bacillus* bacteria, alongside the algae cells, during a 16 days cohabitation experiment in

modified broth at the end of which most bacteria were spores. *C. vulgaris* and bacterial isolates from this study are good candidates for a modified photobioreactor with partial capabilities to handle toxic fuel remains.