How Dunaliella sp. can survive the high salt lake of Antarctica ?

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Summary

The genus Dunaliella do not have a rigid cell wall. The cell is enclosed by a thin elastic plasma membrance and therefore can responds rapidly to changes in osmotic stress by changing its cell volme. The response of the cell to changes in the extracellular osmotic stress occurs in two distance steps. In first step the cells rapidly shrik or swell under hypertonic or dilute stress. The seconde step of adaptation is slower than the first step and involves metabolic adjustment, by synthesis or elimination of glycerol in hypertonic or dilute stress. The Antarctic Dunaliella sp. had a large amount of glycerol content than D.primolecta. The alga is one of the ecological pecliarities of the Antarctic high salt lake. The Dunaliella sp. has many interesting characters in ecology and biochemistry as well becase it was fond to be halotolerant, cryotolerant and light-shield tolerant. We herein report the result obtained by the use of ^{1}H- and ^{13}C-NMR to characterize the intracellular glycerol metabolim in living Dunaliella sp. during adaptations to such stresses as salt, cryo and light-shielding.

In vivo ^{1}H- and ^{13}C-NMR domonstrated that signal observed was assigned to be glycerol. The glycerol has been known as one of marcker substance for osmoregulutors in a adaption experiment to salt stress.

In hypertonic salt stress shifting from 6% to 12% sodium chloride content, intracellular glycerol content increased, whereas in the hypotonic stress shifting from 3% to 1.5% sodium chloride intracellular glycerol decreased. In those stress experiments, in vivo ^{1}H-NMR detected choline, alanine, lactate other than glycerol in Dunaliella sp.. ^{13}C-NMR demonstrated that glucose can be stored as glycogen. When Dunaliella sp. labeled with enriched ^{13}C-labeled glucose was exposed to salt stress, changes such as degradation of glycogen were demonstrated. The reslts strongly suggest that biochemical change in cell membrance of Dunaliella sp. was occurred. Thus, in vivo NMR combined with stable isotope is extremely useful in a measurement for real time change in such metabolites as glycerol. And this approach is applicable not only to salt stress but also to cryostress or light-shielding stress.