

Cytoplasmic electrolyte fluctuations in *Valonia fastigiata* and *Valoniopsis pachynema* with regard to the external environmental medium

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SIVALINGAM, P. M. 1989. Cytoplasmic electrolyte fluctuations in *Valonia fastigiata* and *Valoniopsis pachynema* with regard to the external environmental medium. Jpn. J. Phycol. 37: 4–6.

Cytoplasmic electrolyte fluctuations of Ca, Cl, K, Mg and Na with regard to external medium concentrations were investigated in *Valonia fastigiata* and *Valoniopsis pachynema* from the tropics. Interestingly, the levels of the electrolytes of Cl, Mg and Na were fairly identical in both species as compared to the external medium. Cl and Na in comparison to that in the external medium were lower by ca. 30 and 90%, respectively, while Mg greater by ca. 52,700% in both species. The electrolytes of Ca and K were also higher in concentration in both species, but at varying levels, i.e. Ca, by 124% for *Valonia fastigiata* and 92% for *Valoniopsis pachynema*; while K, by 78% for *Valonia fastigiata* and 971% for *Valoniopsis pachynema*.

Key Index Words: Cytoplasmic electrolyte—*Valonia fastigiata*—*Valoniopsis pachynema*.

Studies on the accumulation of electrolytes in *Valonia* spp. had began as early as the 1930's (OSTERHOUT 1930) leading to a number of postulative suggestions. GROSS and ZEATHEN (1948) with an identical inclination illustrated the functional role of SO_4^- in the buoyancy of planktonic diatoms. The relationship of ion concentrations in the vacuole of *Nitella* and *Valonia* spp. to that of the outer medium was further indicated by HOAGLAND (1948). In this regard, SCOTT and HAYWOOD (1955) had also demonstrated that cation exchange capacity in *Ulva lactuca* and *Valonia macrophysa* is absolutely a physiological process directly dependent upon light intensity and temperature conditions. Notwithstanding the foregoing, scarcity in this area of research had spurred the author currently to delve on the electrolyte relationship of *Valonia fastigiata* and *Valoniopsis pachynema* from the tropics with that in the external medium. The results of this investigation are reported here.

Materials and Methods

Fresh thalli of *Valonia fastigiata* and *Valoniopsis*

pachynema were harvested daily during the early hours of the day at low tides from Batu Ferringhi, Miami Beach, Penang, Malaysia. These were immediately washed with triple distilled water and the cytoplasmic fluid of the cells was individually siphoned out with micro-syringes and collected in micro-centrifuge tubes. The cytoplasmic fluid (=sap) was brought back to the laboratory and cell fragments along with contaminating chloroplast were centrifuged-off prior to analyses of the electrolytes, viz. Ca, Cl, K, Mg and Na, employing a Varian Techtron 120 atomic absorption spectrophotometer. Similarly, in the case of the external medium, i.e. seawater, after collection at the growing site of the algal species it was filtered through a 0.25 Millipore filter prior to subjecting to similar analyses. In all cases, appropriate dilutions were carried out when necessary, while analytical work performed in triplicates.

Results

Table 1 shows the results of the present investigation. It should be noted that all

Table 1. Percentage of cytoplasmic electrolytes in *Valonia fastigiata* and *Valoniopsis pachynema* in comparison to that in the external medium.

Sample	Electrolytes (%)				
	Ca	Cl	K	Mg	Na
Seawater	100	100	100	100	100
<i>Valonia fastigiata</i>	224	70.1	178.6	52,742.8	2.8
<i>Valoniopsis pachynema</i>	192	70.1	1071.4	52,742.8	2.7

electrolytes present in the seawater medium are designated with a percentage value of 100, in which Ca, 520.8 ppm; Cl, 19,400 ppm; K, 373.3 ppm; Mg, 190 ppb; and Na, 5,937.5 ppm. Against these concentrations the electrolytes present in the cytoplasmic fluid of both *Valonia fastigiata* and *Valoniopsis pachynema* are compared.

The percentages of Cl, Mg and Na in the cytoplasmic fluid of both species are fairly identical although values of Cl and Na are lower as compared to the external medium while Mg comparatively higher. Regarding the electrolytes of Ca and K they both are higher than that existent in the external medium de facto Ca being higher in *Valonia fastigiata* and vice versa for K.

Discussions

Studies by OSTERHOUT (1930) had indicated that in the cytoplasmic fluid of *Valonia macrophysa* and *Halicystis osterhout* the electrolyte of Cl is similar in level to that in the external medium, i.e. equivalent to 100 percent, while Ca lower by 1.77 and 0.7%, K higher by 84.1 and lower by 0.45%, Mg undetectable and lower by 6.8% and Na lower by 70 and higher by 6.5%, respectively. HOAGLAND (1948), on the other hand, demonstrated that in the *Valonia* spp. the electrolyte of Cl was identical in percentage, Ca lower by ca. 11%, K higher by ca. 76%, Mg lower by ca. 24% and Na lower by ca. 95% with regard to comparative concentrations in the external medium. In contrast, his studies on a freshwater *Nitella* species interestingly reflected higher percentages for all the electrolytes in the cytoplasmic fluid in the following category: Ca by 14%, Cl by 80%,

K by 45%, Mg by 28% and Na by 4%. At this juncture, the conclusion by SCOTT and HAYWOOD (1955) that cation exchange in *Ulva lactuca* and *Valonia macrophysa* is a physiological process dependent upon light and temperature conditions transpires to be a validated statement to a certain degree.

In contrast, the results from those of tropical *Valonia fastigiata* and *Valoniopsis pachynema* illustrated a completely different picture. Here, it is appropriate to mention that the levels of the electrolytes Cl and Na are lower in equi-percentages while Mg higher on a relative basis. Ca and K electrolytes, on the other hand, are higher by 124 and 92% for *Valonia fastigiata* and *Valoniopsis pachynema* and 78.6 and 971% for *Valonia fastigiata* and *Valoniopsis pachynema*, respectively. Evidently, this reflects the extent of complications in electrolyte transport/pump systems in tropical *Valonia* and *Valoniopsis*. It is postulated that the electrolyte transport system across the membrane system of both algal species has a close relationship with the related enzymes, especially ATPases, and their photosynthetic pathways. Hence, this phenomenon might have a close relationship with such environmental factors as mentioned by SCOTT and HAYWOOD (1955), but would differ drastically within the species due to a number of factors.

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**P. M. SIVALINGAM : 外液に関連する *Valonia fastigiata* と *Valoniopsis pachynema* の
細胞質内電解質変動**

熱帯産 *Valonia fastigiata* と *Valoniopsis pachynema* の外液濃度に関する Ca, Cl, K, Mg, Na の細胞質内電解質変動を調査した。Cl, Mg, Na の電解質の濃度水準は外液との比較において両種とも同一であった。外液の濃度水準と比較して、Cl と Na はそれぞれ 30% と 90% と低く、Mg は 52,700% と高かった。Ca と K の電解質は両種とも高濃度であったが、Ca は *Valonia fastigiata* で 124%, *Valoniopsis pachynema* で 92%, K は *Valonia fastigiata* で 78%, *Valoniopsis pachynema* で 971% と変化にとむ濃度水準であった。(School of Biological Sciences, Universiti Sains Malaysia, Minden, 11800 Penang, Malaysia)