

Biochemical relationships of *Valonia fastigiata* and *Valoniopsis pachynema* from the tropics

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The amino- and fatty acid compositions of *Valonia fastigiata* and *Valoniopsis pachynema* from Penang coastal waters were investigated and compared from the biochemical viewpoint. It was found that the major amino acids in both species are lysine, asparagine, glycine, alanine, valine and leucine. With respect to fatty acids, the major common acids are 16:0, 16:1 ω 7, 20:1 and 22:1 in both species, 16:3 majorly in *Valonia fastigiata* while 18:1 ω 9, 18:4 ω 3, an unknown component and 20:3 in *Valoniopsis pachynema*. Undoubtedly, while the major biochemical and enzymatic pathways in both species appear to be similar, some enzymatic reaction rates of specific enzymatic systems reflect non-similarity, based on the obtained results.

Key Index Words: Amino acids—biochemical relationships—fatty acids—*Valonia fastigiata*—*Valoniopsis pachynema*.

Phycological research in tropical regions, especially in Asian countries, is extremely limited. In the Malaysian context, some ecological (SIVALINGAM 1977a, b, 1978a) and environmental contamination problems (SIVALINGAM 1978b, 1979, 1981a; SIVALINGAM and KAMARIAH 1979; SIVALINGAM and RODZIAH 1981, 1982) from the bioindicator standpoint have been investigated. Algae as a human consumable food source (SIVALINGAM 1979b), biochemical taxonomy of *Laurencia* and *Gracilaria* spp. (SIVALINGAM 1980a, b) and the production of biofuel-gas (SIVALINGAM 1981b) have also been considered to a certain extent. Under these constraints of fairly limited information, the current study endeavours to evaluate biochemically the difference between *Valonia fastigiata* and *Valoniopsis pachynema* found in Penang tropical waters, with respect to their amino- and fatty acid composition. The results of this evaluation are presented here.

Materials and Methods

Valonia fastigiata and *Valoniopsis pachynema*

employed in the experiments were harvested at the rocky shores of Batu Ferringhi, Miami Beach, Penang, Malaysia, during low tides in February 1987. The specimens were brought back to the laboratory in plastic bags and washed in filtered seawater concomitantly culling-off epiphytes. A final washing was executed with distilled water prior to drying in an air oven at 80°C for a few days. The dried thalli were pulverized separately using a mortar and pestle. In the case of amino acid analyses, known aliquots of the pulverized samples were digested at 110°C *in vacuo* in small amounts of 6N HCl solution which included a drop of phenol. On digestion, the samples were dried over NaOH pellets prior to analyses in a Shimadzu Amino Analyzer according to the methods mentioned previously (SIVALINGAM 1980a). Similarly, for fatty acid analyses, the samples were separately extracted for total lipids for 24 hours with ethyl ether in Soxhlet extractors prior to analyses in a Shimadzu Gaschromatograph according to the methods mentioned previously (SIVALINGAM 1979b).

Results

Table 1 indicates the comparative amino acid composition of both *Valonia fastigiata* and *Valoniopsis pachynema*. It is obvious that the major amino acids in *Valonia fastigiata* and *Valoniopsis pachynema* are lysine, asparagine, glycine, alanine, valine and leucine. In *Valonia fastigiata*, on the other hand, isoleucine is slightly higher as compared to its counterpart. Basically, these results transpire the conclusion of moderately similar patterns in amino acid synthetic pathways.

The results of fatty acid composition are as demonstrated in Table 2. Unlike amino acid composition, while the major common acids are 16:0, 16:1 ω 7, 20:1 and 22:1 in both algal species 16:3 is predominant in *Valonia fastigiata* and 18:1 ω 9, 18:4 ω 3, an unknown component and 20:3 in *Valoniopsis pachynema*. This evidently reflects that the enzymatic activity rates in the fatty acid metabolic pathways of both species appear to be slightly different. Nevertheless, this variation could be attributed to a number of non-specific reasons.

Table 1. Comparison of amino acid composition (%) of *Valonia fastigiata* and *Valoniopsis pachynema*.

Amino Acid	<i>Valonia fastigiata</i>	<i>Valoniopsis pachynema</i>
Lysine	4.41	3.61
Histidine	0.10	0.15
Ammonia	27.3	32.52
Arginine	1.60	1.26
Asparagine	10.15	9.68
Threonine	3.69	2.45
Serine	3.76	4.71
Glutamine	6.82	5.61
Proline	3.22	5.19
Glycine	10.09	13.63
Alanine	8.38	8.45
Valine	6.05	5.91
Methionine	1.23	1.12
Isoleucine	3.65	0.73
Leucine	5.26	3.14
Tyrosine	1.62	0.83
Phenylalanine	2.67	1.01

Table 2. Comparison of the fatty acid composition (%) of *Valonia fastigiata* and *Valoniopsis pachynema*.

Fatty acid	<i>Valonia fastigiata</i>	<i>Valoniopsis pachynema</i>
12:0	4.2	4.3
?	1.3	1.1
14:0	4.0	3.1
14:1	1.0	1.0
15:0	1.6	0.9
?	0.5	0.2
16:0	5.1	5.8
16:1 ω 7*	5.5	4.8
16:2	1.4	1.6
17:0	—	—
16:3	12.4	3.1
?	—	—
16:4	3.8	—
18:0	0.9	1.1
18:1 ω 9*	4.3	6.1
18:2 ω 6	3.0	2.1
18:2 ω 4	—	0.8
18:3 ω 6+?	1.8	—
18:3 ω 3	2.0	1.7
18:4 ω 3	3.8	10.8
?	2.3	5.9
20:1	5.0	5.3
20:2 ω 9?	—	—
20:2 ω 6?	1.0	3.3
20:3?	—	6.3
20:3 ω 6?	4.9	—
20:4 ω 6	—	—
20:3 ω 3	3.7	—
20:4 ω 3	—	—
20:4 ω 3	2.1	1.5
20:5 ω 3	3.3	2.2
22:1	10.4	6.9
22:4?	1.7	1.7
22:5?	1.6	2.9
22:5 ω 3	0.8	—
22:6 ω 3	1.1	1.7
24:1	—	—
?	4.6	—

* Small amounts of other monoenes included.

+? Some unknown peaks which are not listed.

Conclusions

It is evident that the biosynthetic pathways of both *Valonia fastigiata* and *Valoniopsis pachynema* for amino- and fatty acids are relatively identical save for some minor accountable variations. These variations culminating in fluctuations in some fatty acid composition could be due to a number of environmental factors leading to differ-

ences in enzymatic activity rates at specific sites of the system. At times, this might result in some acids being only found in one species while none in the other, viz., 16:4, 18:3 ω 6+?, 20:3 ω 6?, 20:3 ω 3 and 22:5 ω 3 in *Valonia fastigiata* and 18:2 ω 4 and 20:3? in *Valoniopsis pachynema*. States of predominant levels in fatty acid composition could also prevail due to these reasons, i.e. 16:3 in *Valonia fastigiata* and 18:1 ω 9, 18:4 ω 3, an unknown and 20:3 in *Valoniopsis pachynema*.

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P. M. SIVALINGAM : 熱帯産 *Valonia fastigiata* と *Valoniopsis pachynema* の生化学的關係

ベナン沿岸産の *Valonia fastigiata* と *Valoniopsis pachynema* のアミノ酸と脂肪酸組成を生化学的見地から調査・比較した。両種の主アミノ酸はリジン, アスパラギン, グリシン, アラニン, バリンとロイシンであった。脂肪酸に関しては, 両種に共通の酸は, 16:0, 16:1 ω 7, 20:1 であり, また *Valonia fastigiata* では主として 16:3 であり, *Valoniopsis pachynema* では 18:1 ω 9, 18:4 ω 3, 不明物質, 20:3 であった。両種の主要な生化学的, 酵素化学的代謝経路は類似するが, 特定の酵素化学的代謝経路のいくつかの酵素反応速度は非類似性を示した。(School of Biological Sciences, Universiti Sains Malaysia, Minden, 11800 Penang, Malaysia)