

Free Amino Acids in Greek Marine Algae*

by

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The quantity of free amino acids present in a cell is very small and constitutes the so-called amino acid pool. By means of this pool occurs the supply of particular amino acids, which are necessary for the metabolism of the cell [1]. Such an amino acid pool constitutes a mere functional and by no means a morphological unity [2, 3]. It must be emphasized, that the intracellular amino acid pool does not contain a necessary intermediate product for the protein synthesis; it should more or less represent a reservoir [1].

Investigations of the free amino acids composition of marine algae have been made by several workers [4, 5, 6, 7, 8, 9, 10].

Isolation, chemical identification and quantitative determination of 17 free amino acids was carried out, by use of ion-exchange resins technique [11] combined with Technic on Auto-Analyser [see also 9], in 39 marine plants organisms of the Greek coasts. The studied samples were the following :

a. CHLOROPHYCEAE : *Enteromorpha linza*, *Ulva lactuca*, *Cladophora albida*, *Cladophora vagabunda*, *Cladophora lehmanniana*, *Valonia macrophysa*, *Acetabularia mediterranea*, *Bryopsis disticha*, *Caulerpa prolifera*, *Nalimeda tuna*.

b. PHAEOPHYCEAE : *Chaetopteris plumosa*, *Colpomenia sinuosa*, *Scytosiphon lomentaria*, *Sphacelaria cirrosa*, *Halopteris scoparia*, *Dictyopteris membranacea*, *Padina pavonia*, *Cystoseira barbata*, *Cystoseira discors*, *Sargassum hornschurchii*.

c. RHODOPHYCEAE : *Liagora viscida*, *Pterocladia capillacea*, *Gorallina mediterranea*, *Schizymenia dubyi*, *Gracilaria verrucosa*, *Hypnaea musciformis*, *Antithamnion cruciatum* f. *fragilissima*, *Ceramium rubrum*, *Neomonospora furcellata*, *Spyridia filamentosa*, *Griffithsia barbata*, *Wrangelia penicillata*, *Nitophyllum punctatum*, *Polysiphonia sanguinea*, *Polysiphonia* sp., *Acanthophora delilei*, *Laurencia papillosa*.

d. MARINE PHANEROGAMS : *Halophila stipulacea*, *Posidonia oceanica*.

The recorded free amino acids were the following : aspartic acid, asparagine, glutamic acid, glutamine, alanine, glycine, valine, cysteine, leucine, isoleucine, tyrosine, threonine, serine, phenylalanine, lysine, histidine and arginine.

A great fluctuation in the total amino acid content is observed, i e. from 19** (*Nitophyllum punctatum*) to 795 (*Chaetopteris plumosa*) $\mu\text{g/g}$ fresh weight. A high proportion always greater than 80 % with the exception of *Corallina mediterranea* (63 %) and *Sphacelaria cirrosa* (79 %), is due to the amino acids aspartic acid, asparagine, glutamic acid, glutamine, glycine, alanine, threonine and serine, whereas the remaining amino acids valine, cysteine, leucine, isoleucine, tyrosine, phenylalanine, lysine, histidine

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** The obtained data were estimated in μg of free amino acids per 1 g of fresh weight and the percentage of each amino acid was given, considering the total amino acid content as 100 %.

and arginine are completely absent or exist in low proportions except for arginine in *Corallina mediterranea* (17 %, see also 9), for valine in *Scytosiphon lomentaria* (12 %), *Corallina mediterranea* (9 %), and *Antithamnion cruciatum* f. *fragilissima* (8 %), for phenylalanine in *Cladophora albida* (7 %) and for lysine in *Sphacelaria cirrosa* (9 %). The amino acid methionine is completely absent in all the samples studied. These results are consistent with previous works [4, 5, 6, 7, 8, 9, 10, 12].

The characteristic feature of the distribution of these free amino compounds is the similarity of certain quantitative groupings between phyla.

In agreement with other algal studies [7, 8, 9, 12, 13, 14, 15, 16, 17] glutamic acid, aspartic acid and alanine were consistently the highest representative in the first group. It was unusual to find that aspartic acid was absent in *Dictyopteris membranacea*. The high content of dicarboxylic acids and alanine was probably the result of a close relationship with tricarboxylic acid cycle metabolism. The group of the amino acids threonine-serine-glutamine-asparagine was constantly represented in significant amounts in most algae examined. According to MADGWICK and RALPH [8], and MARGARIS and MITRAKOS [9] glutamic acid is the major representative in all the species studied except in *Halimeda tuna*, *Dictyopteris membranacea*, *Pterocladia capillacea* and *Antithamnion cruciatum* f. *fragilissima*, and in the marine phanerogam *Halophila stipulacea*. There was a trend for more alanine in the browns compared with the green and red algae.

The second prominent group of free amino acids included glycine, leucine, isoleucine, valine, phenylalanine, lysine and arginine. The aforesaid amino acids are present to about the same degrees in most species but are usually considerably less than the first group. In contrast to MADGWICK and RALPH [8] and in agreement with LANDSBERGER *et al.* [7], MARGARIS & MITRAKOS [9], CITHAREL & GAUTHERET [16] and OGINO [18] arginine was present in significant amounts in these analyses.

The third group comprises the amino acids cysteine, tyrosine and histidine, which are sparsely represented, whereas methionine, as we have already emphasized, is absent from all the algae investigated.

The comparison of the free amino acid patterns for each species does not provide sound evidence for its use in taxonomic studies of the naturally occurring marine algae.

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