P. M. シバリンガム*・M. W. R. N. デ シルバ*・K. ラジャゴパラン*・西澤一俊**: マレーシア熱帯海域における海藻中の紫外線吸収物質334の含量の比較研究

P. M. SIVALINGAM*, M. W. R. N. DE SILVA*, K. RAJAGOPALAN* and K. NISIZAWA**: Comparative studies on the content of UV-absorbing substance 334 of marine algae from the tropical zone (Malaysian waters)

It is well known that radiant solar energy showered on the tropical climatic zone of the world is much higher than that on the temperate climatic zone. Hence, the UV-absorbing substance 334 of marine algae, whose physiological roles have been proposed by SIVALINGAM et al.[1-4] to serve as a feed-back energy carrier of UV-irradiation to the chlorophylls in the form of a filtering effect and also as a photophosphorylation enhancing factor at the irradiation of wavelengths in the vicinity of 334 nm, could be expected to be higher in the content in marine algae of the tropical zone than those of the temperate zone. Against this assumption, however, investigations on 2 species of the Cyanophyta, 9 species of the Rhodophyta, 5 species of the Phaeophyta and 3 species of the Chlorophyta from Malaysian waters showed much lower contents of this substance than those from the temparate Japanese waters. In this paper, the results of this investigation and some discussion on it will be presented.

Materials and Methods

Algae employed for this study were harvested mostly from 0.5 to 1m in depth at Batu Ferringgi, Sungai Dua and Batu Maung shores of Penang Island, West Malaysia, in the season between February and April, 1975. The sea water temperature was around 28°C. After careful elimination of the microscopic epiphytes and other contaminating material, the algal thalli were homogenized in

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Bull. Jap. Soc. Phycol., **24**: 8-12, March 1976.

80% aqueous ethanol in a mortar and centrifuged at 4,000 x g for 20 min. The supernatant was analyzed for the UV-absorbing substance 334 using an automatic Beckman ACTA III spectrophotometer, as had been made in the previous paper[1-5]. Concurrently, the length and width of the experimental algal thalli were recorded. The results so obtained were compared with those for the temperate Japanese algae which had been reported by Sivalingam et al.[5].

Results and Discussion

The contents of the UV-absorbing substance 334 in the marine algae from tropical Malaysian waters are given in Table 1. It is clear that the contents of this substance in 2 species of the Cyanophyta were 0.98 and 1.08 as the optical density per 100 mg wet weight of each thallus, those in 9 species of the Rhodophyta were between 0.2 and 2.82, and those in 5 species of the Phaeophyta fluctuated between 0.25 and 0.92. In contrast, the values reported for Japanese algae were 8.14, 2.02 to 12.0 and 0.87 to 2.49 in the Cyanophyta, Rhodophyta and Phaeophyta, respectively, under the comparable experimental conditions.[5] The optical densities for 3 species of the tropical Chlorophyta were between 0.13 and 0.42 while those for 7 species at the temperate zone fluctuated from 0.18 to 2.05. Thus, the contents of the UV-absorbing substance 334 in all species of marine algae from the tropical zone were found in general to be far smaller than those for the temperate zone. Due to scantiness of the species of the Phaeophyta and the Chlorophyta from the low tidal levels of the tropical Malaysian shores, however, no comparative studies could be made at this region.

In view of the above comparison of the contents of UV-absorbing substance 334 between marine algae from tropical and those from temperate zones, it become clear that contrary to the first expection its contents were generally much lower in Malaysia than those in Japan. The fact may possibly due to a high turbidity of the waters throughout the year around Penang Island which is attributed to a high degree of sediments and a high phyto- and zoo-plankton population in this area. For example, an ordinary transparency of the rough waters surrounding Penang Island has been measured to be 2 to 2.5 feets by the Sacchi's disk method. These factors may effectively reduce the solar radiant energy as well as the natural UV-irradiation available for the marine algae. There is a possibility that the element tin which occurs in relative abundance around the coastal water of Penang Island would cause a deleterious effect on

Table 1 Content of the UV-absorbing substance 334 in marine algae from tropical Malaysian waters

	UV Maxima (mm)	OD Substs./100 mg wet weight	Size (L(cm)×W(cm))
CYANOPHYTA			
Species growing at high tidal level			
Lyngbya sp.	330	0.98	—
Oscillatoria sp.	330	1.08	—
RHODOPHYTA			
Species growing at high tidal level			
Gracilaria sp.	329	0.81	8—9; 0.4
Species growing at intermediate tidal level			
Jania sp.	331	0.30	3; 0.6—0.7
Acanthophora specifera (VAHL) BOERGS.	325	0.44	3—5; 0.25
Gracilaria sp.	323	1.20	8—9; 1—1.5
Laurencia sp.	325—330	0.2	2—3; 0.5
Laurencia sp.	333	0.36	3—8; 0.5
Gelidiopsis sp.	316	2.82	1.5—2.5; 0.3—0.5
Gracilaria sp.	331	1.98	4.5; 1.5
Species growing at low tidal level			
Laurencia sp.	328	0.18	4—5; 1—1.5
PHAEOPHYTA			
Species growing at high tidal level			
Chnoospora minima (HERING) PAPENFUSS (?)	331	0.92	2—3; 0.7
Species growing at intermediate tidal level			
Dictyota bartayresii LAMOUROUX	331	0.54	6—8; 0.3
Sargassum sp.	325	0.25	15; 3
Sphacelaria furcigera KÜTZING	321	0.90	1.5—1.7; 0.1
Padina sp.	316	0.28	8—9; 6—7
CHLOROPHYTA			
Species growing at high tidal level			
Enteromorpha flexuosa (WULFEN) J. AGARDH	332	0.42	2—2.5; 0.3
Species growing at intermediate tidal level			
Valoniopsis pachynema (MARTENS) BOERGS.	331	0.22	1.5; 0.5
Cladophora sp.	330	0.13	3.5—4; 0.6

the general algal biochemical tasks. The factor like the latter cannot really be ignored, although it is under study how high concentration of the tin in sea water affects the algal metabolism, particularly on the physiological function of the UV-absorbing substance 334.

It is very striking on the other hand that the marine algae studied in the present work were extremely small size even with the mature plants (Table 1) as compared with the related species recorded by SEGAWA[6] and CHIHARA[7] in Japan. Further, they were limited in the number of species available in Penang Island. If at all this is related to the content of tin in sea water, it should be a serious problem for algal growth in this tropical zone.

Abstract

A general survey of the content of the UV-absorbing substance 334 was carried out on the marine algae including 2 species of the Cyanophyta, 9 species of the Rhodophyta, 5 species of the Phaeophyta and 3 species of the Chlorophyta which were harvested from the tropical Malaysian sea waters. It was found that their contents were conspicuously lower than those of the related species from the temperate waters of Japan. This result might be due to some disturbance in penetration of light into sea water as a consequence of much sediments and a high population of plankton or due to the possible effects of the tin on the algal metabolism.

Acknowledgment

The authors wish to express their gratitude to Professor C. P. RAMACHANDRAN, the Dean, School of Biological Sciences, Universiti Sains Malaysia, for his encouragement and aid.

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要　　約

1975年2–4月に，マレーシア ペナン島周辺海岸において，水温約28°C，深さ 0.5–1.0m の潮間帯から採集した藍藻2種，褐藻5種，紅藻9種につき，UV-吸収物質 334 の含有量をその抽出液の吸光度により測定し，既報の下田海岸で採集した海藻の場合と比較検討した。その含有量は，予期に反して日本産海藻のものの 1/3—1/10 に過ぎなかった。これは，太陽照射エネルギーの強いマレーシア海岸の試料とは裏腹の結果であった。その理由として，この海域における水の透明度 (Sacchi 円板法で 2–2.5 フィート) の低いことや錫イオン含量が高いと考えられることに何らかの関連性があるものと推測された。

て，系統，生理，遺伝などの観点から考察を試み，西沢・猪川両氏は藻類一般の光合成をまとめている。

生態学分野は片田・里見（池ノ上）氏のもののみであるが，海藻の生活形，遷移，生産力など日本では比較的未開な分野を詳細にとりまとめている。

分布関係は，岡村先生が 1931 年にまとめられた，日本とその周辺の地理分布を基本として，その後の諸知見を加えるとともに，地域により異なる垂直分布図を挿入したものを千原氏が執筆している。

応用・利用の分野では，渡辺氏が窒素固定藍藻の種類，意義，水田肥料としての実際の応用例を述べ，三浦氏，斎藤氏は海苔養殖とワカメ養殖の実態につきそれぞれ蘊蓄を傾けており，高木氏は駆虫剤となる海藻やプロビタミン類が海藻類に広範囲に存在することを紹介し，医薬品源としての海藻にスポットをあてている。

以上のように本書には，海藻養殖の実情を含め，日本における藻類学進展の多くの分野と，それらに関連する文献が収載しているため，研究者には絶好の伴侶となろう。本書出版のため長年月にわたってご苦労をされた時田先生，広瀬先生をはじめ執筆者各位に敬意を表する次第です。　　（岩 本 康 三）