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MAJOR STEROL COMPOSITION OF SOME ALGAE FROM QATAR

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Abstract—Thirteen macroscopic algae belonging to the three main divisions Chlorophyceae, Rhodophyceae and Phaeophyceae from the coast of Qatar (Arabian Gulf) were investigated for their sterol composition by using GC-MS coupling experiments. Our results show the sterol composition for these three major divisions of algae growing in this unusual condition of the sea water (salty, warm and shallow).

INTRODUCTION

Very little is known about the chemistry of marine organisms for the Arabian Gulf. However, some papers were published concerning the distribution and the ecology of macroscopic algae from different parts of the Arabian Gulf [1–6] and, to the best of our knowledge, three papers deal with phytochemical studies, fatty acids and amino acids composition of some macroalgae from Qatar coasts [7–9]. In this study, we deal with the sterol composition of 13 marine algae collected from the coast of Qatar (seven red, five brown and one green algae). The literature data showed that sterol profiles present distinguishing features for the chemotaxonomic classification of these algal divisions [10]. Cholesterol is dominant in almost all Rhodophyceae, and the distribution of the sterols among red algae varies a great deal between the different species [10, 11]. Fucosterol is usually dominant in most of the Phaeophyceae species, and cholesterol also occurs but the proportions of both sterols vary during the life cycle of the algae [10, 12, 13]. The sterol composition of Chlorophyceae differs from the previously mentioned divisions, and the dominant sterol seems to vary within the order or, for the same order, within the family [10, 14]. The results of our study are in agreement with those reported in literature.

RESULTS AND DISCUSSION

The sterols were isolated from the unsaponifiable matter by two experimental procedures: as the digitonides using a large excess of digitonin and preparative TLC on silica gel. Sterols were then acetylated and analysed by GC-MS on a capillary column coated with DB1 phase. The identification of steryl acetates was based upon their GC retention time and comparison of their mass spectra with those of previously described mixtures [11, 13, 14]. The configuration at C-24 of the steryl acetates was not yet determined. Table 1 lists all the identified compounds and indicates the presence of 13 known sterols. Five unidentified minor sterols in the red algae are still under investigation.

All the studied members of the red algae, especially *Laurencia paniculata*, contained cholesterol in a fairly high percentage of dry weight, which agrees with that reported in literature [10]. 24-Methylenecholesterol was only encountered in one species (*Chondria collinsiana*) and it is also considered rare for red algae. Cholestanol, (*E*)- and (*Z*)-22-dehydrocholesterol, desmosterol, ergosterol and poriferasterol occurred in almost all species. Brassicasterol, campesterol, 24-methylcholesterol and 24-nor-cholesta-5,22-dien-3β-ol were found in low percentage in a few species of this group.

Fucosterol was found to be the dominant sterol in the studied species of the brown algae, and was associated with 24-methylenecholesterol in Fucales which is in agreement with literature [10]. On the other hand, all the brown species were found to contain a fairly good percentage of cholesterol [12]. Brassicasterol, (*E*)- and (*Z*)-22-dehydrocholesterol, ergosterol and poriferasterol all occurred in various species of this division.

The only studied species of green algae was *Dictyosphaeria cavernosa* (Siphonocladale). Ergosterol was found to be the major sterol in this species (27.5%) and there was no dominant sterol reported for Chlorophyceae in literature [10]. The other isolated sterols were 24-methylenecholesterol (19.7%), 24-methylcholesterol (16.3) and poriferasterol (11.7%). It is interesting that this species did not contain isofucosterol or 24-ethylcholesterol which is common for other species of this family [10, 15, 16].

Five unidentified sterols in the red algae are reported in this paper, all accounting for less than 5%. These are: sterol A (4.1% in *Polysiphonia ferulavea*), sterol B (4.7% in *Diginea simplex*), sterol C (3.3% in *Polysiphonia ferulavea*) sterol D (4.2%, 1.6%, 2.3%, 3.1% in *Spyridia*

Table 1.

Species	Yield (%)	Sterol composition (%)												
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Chondria collinsiana	0.60	—	—	—	72.9	12.7	1.8	1.0	—	—	—	4.1	2.9	4.6
Digenia simplex	0.38	11.1	3.8	25.7	30.2	11.9	8.0	—	—	—	—	—	—	9.3
Laurencia paniculata	0.45	—	—	—	100.0	—	—	—	—	—	—	—	—	—
Laurencia papillosa	0.55	—	—	—	68.7	—	—	—	—	—	—	—	—	31.3
Polysiphonia brodiae	0.67	—	—	5.0	32.0	14.0	5.1	11.6	13.7	9.3	—	—	—	9.3
Polysiphonia ferulavea	0.35	8.9	—	1.9	47.5	9.7	1.9	2.8	16.3	4.0	—	—	—	7.0
Spyridia filamentosa	0.58	—	—	—	23.8	30.5	4.7	5.1	6.9	8.2	—	7.1	—	13.7
Cystoseira trinodes	1.36	—	—	—	5.4	—	—	—	—	5.4	78.7	10.5	—	—
Hormophysa triquetra	1.17	—	—	—	3.2	—	—	—	—	—	86.7	10.1	—	—
Padina gymnospora	0.41	2.8	—	—	14.4	—	—	—	—	—	72.4	10.4	—	—
Sargassum boveanum	0.51	9.6	—	—	43.2	—	0.6	5.7	—	2.9	28.1	7.4	—	2.5
Sargassum denticulatum	0.39	10.6	—	—	21.3	—	3.4	7.3	—	—	38.4	15.5	—	3.5
Dictyosphaeria cavernosa	0.87	6.8	16.3	—	—	—	8.9	9.1	—	27.5	—	19.7	—	11.7

1 Brassicasterol (crinosterol); **2** campesterol (dihydrobrassicasterol); **3** cholestanol; **4** cholesterol; **5** clionasterol (sitosterol); **6** (*Z*)-22-dehydrocholesterol; **7** (*E*)-22-dehydrocholesterol; **8** desmosterol; **9** ergosterol; **10** fucosterol; **11** 24-methylenecholesterol; **12** 24-nor-cholesta-5,22-dien-3β-ol; **13** poriferasterol (stigmasterol).

filamentosa, *Polysiphonia brodiae*, *P. ferulavea* and *Chondria collinsiana*, respectively) and sterol E (0.7% in *Chondria collinsiana*). Research is in progress in our laboratories to isolate more of these compounds in a pure form to confirm their structures by spectroscopic methods.

EXPERIMENTAL

The 13 algal samples were collected from the coastal waters of Qatar (Arabian Gulf) in March 1987. The algae were washed with distilled water and air dried. The lipids were extracted continuously with MeOH–$CHCl_3$ (1:2) in a Soxhlet extraction apparatus. The unsaponifiable material was recovered by extraction with diisopropylether and the sterols were extracted by prep. TLC silica gel plates (0.5 mm thickness) with hexane–diethyl ether–acetic acid (7:3:1) as eluent, or as digitonides using a large excess of digitonin. The free sterols were then acetylated using Ac_2O–Py (1:2) at room temp. overnight. They were submitted to GC-MS analysis using a HP-5890 series II chromatograph, DB1 column (30 m × 0.32 mm i.d.) with phase thickness of 0.25 μm; split 1/40 and injecting at 240° and the interface temperature for GC-MS 250°. The linear temp. programming conditions were from 180 to 300°, at a rate of 5° min^{-1}. The total duration of analysis was 40 min per injection. The GC was coupled with an HP-5989-A Mass Spectrometer (70 eV) equipped with a HP-9000/345 integrator.

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