98. Raspailynes, Novel Long-Chain Acetylenic Enol Ethers of Glycerol from the Marine Sponges *Raspailia pumila* and *Raspailia ramosa*

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The sponges *Raspailia pumila* and *R. ramosa* (Demospongiae, Tetractinomorpha, Axinellida) from the North-East Atlantic are shown to contain a series of novel long-chain enol ethers of glycerol where the enol ether C=C bond is conjugated, in sequence, to both an acetylenic and an olefinic bond. Polar extracts give raspailynes hydroxylated at their (1*Z*,5*Z*)-1,5-alkadien-3-ynyl chain, like raspailyne A1 (= (+)-(*S*)-3-[((1*Z*,5*Z*)-16-hydroxy-hexadeca-1,5-dien-3-ynyl)oxy]-1,2-propanediol; (+)-**2**) and isoraspailyne A (= (+)-3-[((1*Z*,5*Z*)-17-hydroxyocta-deca-1,5-dien-3-ynyl)oxy]-1,2-propanediol; (+)-**3**). Less polar extracts give 3 different types of raspailynes not hydroxylated at the chain. Raspailynes of the first type have either the (1*Z*,5*Z*)-configuration in a linear chain such as raspailyne B2 (= (−)-(*S*)-3-[((1*Z*,5*Z*)-trideca-1,5-dien-3-ynyl)oxy]-1,2-propanediol; (−)-**4**), raspailyne B1 (= (−)-3-[((1*Z*,5*Z*)-tetradeca-1,5-dien-3-ynyl)oxy]-1,2-propanediol; (−)-**5**), and raspailyne B (= 3-[((1*Z*,5*Z*)-pentadeca-1,5-dien-3-ynyl)oxy]-1,2-propanediol; **6**) or the (1*Z*,5*Z*)-configuration in a chain ending with an isopropyl group, like isoraspailyne B1 (= 3-[((1*Z*,5*Z*)-12-methyltrideca-1,5-dien-3-ynyl)oxy]-1,2-propanediol; **7**) and isoraspailyne B (= 3-[((1*Z*,5*Z*)-13-methyltetradeca-1,5-dien-3-ynyl)oxy]-1,2-propanediol; **8**). Raspailynes of the second type have the (1*Z*,5*E*)-configuration, like isoraspailyne B1a (= 3-[((1*Z*,5*E*)-tetradeca-1,5-dien-3-ynyl)oxy]-1,2-propanediol; **9**) and isoraspailyne Ba (= 3-[((1*Z*,5*E*)-13-methyltetradeca-1,5-dien-3-ynyl)oxy]-1,2-propanediol; **10**). Raspailynes of the third type have the (1*E*,5*Z*)-configuration, like isoraspailyne B1b (= 3-[((1*E*,5*Z*)-tetradeca-1,5-dien-3-ynyl)oxy]-1,2-propanediol; **11**). The (*S*)-configuration for (+)-**1**, (+)-**2**, and (−)-**4** is derived from chemical correlations.

Introduction. – Saturated, long-chain alkyl ethers of glycerol have widespread occurrence in the marine environment. In fact, both (*S*)-3-hexadecyloxy-1,2-propanediol (= chimyl alcohol; (+)-**13a**) and (*S*)-3-octadecyloxy-1,2-propanediol (= batyl alcohol; (+)-**12a**) occur in shark-liver oil [1] and have also been found in the zoanthid *Palythoa liscia* [2a], in the gorgonian *Plexaurella dichotoma* [2b], and in the eggs of the opisthobranch mollusc *Aplysia kurodai* [2c]. Batyl alcohol was also found, without reporting chiroptical data, in the sponge *Ulosa ruetzleri* [2d] (Demospongiae, Ceractinomorpha, Halichondrida) whilst chimyl alcohol was found in the nudibranch mollusc *Archidoris montereyensis* [2e]. Moreover, (*S*)-3-tridecyloxy-1,2-propanediol ((+)-**14**) has been isolated from an undetermined sponge [3].

Archaebacteria are peculiar for containing isoprenyl ethers of glycerol in place of ordinary lipids [4]. This is the case of the thermophilic, deep-sea hydrothermal vent species *Methanococcus jannaschii* [5a] which, in common with other Archaebacteria [5b], contains a tetraphytanyl ether of diglycerol whose absolute configuration at the asymmetric centers of the glycerol moiety [5c] and at the isoprenyl moiety has been defined, the latter *via* total synthesis [5b].

Olefinic long-chain glyceryl monoethers have also been isolated from marine organisms. Thus, 3-*O*-[(17*Z*)-17-tetracosenyl]glycerol, for which no chiroptical data have

been provided, was obtained from the sponges *U. ruetzleri* and *Cinachyra alloclada* [2c] (Demospongiae, Tetractinomorpha, Spirophorida), and 2-{[3-icosadi(and tetra)enoyl-oxy-2-hydroxypropyloxy]methyl}-2-propenoic acids whose absolute configuration is still unknown from the marine *Sargassum fulvellum* [6] (Chromophyta, Fucales).

Relying merely on the degradation of lipids with $LiAlH_4$ followed by oxidation of the (reportedly) freed 1-glyceryl monoether to formaldehyde and determination of the latter, it has been reported that 1-glyceryl monoethers are lipidic components of a wide variety of marine invertebrates [7].

Recently, we have described a new type of enol ether of glycerol, raspailyne A ((+)-**1**), isolated from the North-East-Atlantic sponge *Raspailia pumila* [8], where the enol C=C bond is conjugated, in sequence, to an acetylenic and an olefinic bond. We are now concerned with new natural raspailynes isolated from both the same source and the closely related species *R. ramosa*.
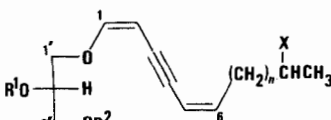
Isolation and Structural Elucidation. – From extracts of similar polarity[1]) to those giving (+)-**1** (*i.e.* at slightly higher polarity than ordinary monoglycerides), we have now
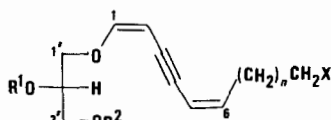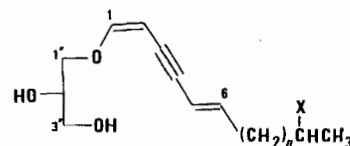

(+)-**1**[2]) (*S*); *n* = 11; R^1 = R^2 = H; X = OH
(−)-**1a** (*S*); *n* = 11; R^1, R^2 = Me_2C=; X = OH
(−)-**1b** (*S*); *n* = 11; R^1, R^2 = Me_2C=; X = OSO_2Me
(−)-**1c** (*S*); *n* = 11; R^1, R^2 = Me_2C=; X = H
1d (*S*); *n* = 11; R^1 = R^2 = Ac; X = OAc
(+)-**2** (*S*); *n* = 9; R^1 = R^2 = H; X = OH
(−)-**2a** (*S*); *n* = 9; R^1, R^2 = Me_2C=; X = OH
(−)-**2b** (*S*); *n* = 9; R^1, R^2 = Me_2C=; X = OSO_2Me
(−)-**2c** (*S*); *n* = 9; R^1, R^2 = Me_2C=; X = H
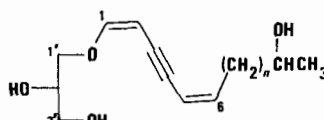
(+)-**3**; *n* = 10

(−)-**4** (*S*); *n* = 5; R^1 = R^2 = X = H
(−)-**5** *n* = 6; R^1 = R^2 = X = H
(−)-**5a** *n* = 6; R^1 = R^2 = Ac; X = H
6 *n* = 7; R^1 = R^2 = X = H
7 *n* = 5; R^1 = R^2 = H; X = Me
8 *n* = 6; R^1 = R^2 = H; X = Me

9 *n* = 6; X = H
10 *n* = 6; X = Me
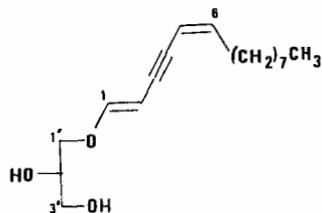
11
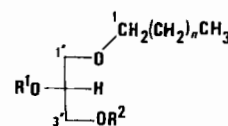
12 (*S*); *n* = 16; R^1 = R^2 = Me_2C=
(+)-**12a** (*S*); *n* = 16; R^1 = R^2 = H
13 (*S*); *n* = 14; R^1 = R^2 = Me_2C=
(+)-**13a** (*S*); *n* = 14; R^1 = R^2 = H
(+)-**14** (*S*); *n* = 11; R^1 = R^2 = H

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[1]) We loosely use here the term 'higher polarity' to mean a higher retention time on silica-gel chromatography.
[2]) For convenience, all raspailynes and derivatives thereof are numbered as shown in the *Formulae* **1–14**. Systematic names are given in the *Summary* and *Exper. Part*.

isolated from *R. pumila* two additional raspailynes hydroxylated at the alkadienynyl chain, raspailyne A1 ((+)-**2**) and isoraspailyne A ((+)-**3**). From less polar extracts (*i.e.* at only slightly higher polarity than cholesterol) which give a single band on silica-gel chromatography, though the compounds can be nicely separated by reverse-phase chromatography, we have now isolated a series of new raspailynes. They bear the same 1,6-disubstituted (*Z,Z*)-dienyne moiety[2] or (*E,Z*)-stereoisomers of it as (+)-**1**, (+)-**2**, and (+)-**3**, with the substituent at C(6) being an alkyl chain. They can be usefully grouped together as follows. First those maintaining the (1*Z*,5*Z*)-configuration[2] of **1**–**3** with either an unbranched chain such as raspailyne B2 ((−)-**4**), raspailyne B1 ((−)-**5**), and raspailyne B (**6**) or with a branched chain such as isoraspailyne B1 (**7**) and isoraspailyne B (**8**). Then, those having different configurations at the side chain than **1**–**3**, *i.e.* either (1*Z*,5*E*) like isoraspailyne B1a (**9**) and isoraspailyne Ba (**10**) or (1*E*,5*Z*) like isoraspailyne B1b (**11**).

All new natural raspailynes have practically superimposable UV (λ_{max} (CHCl₃): 292 (ε 15000), 277 (18300), 266 (sh, 14200) nm) and IR spectra ($\tilde{\nu}_{max}$ (neat): 3350vs (OH), 2160w (C≡C), 1650m (C=C) cm⁻¹) with those previously reported for (+)-**1** [8]. Taking the previous discussion for (+)-**1** [8] as a pattern, the structures for the new natural raspailynes can be easily grasped from the examination of the NMR data in *Tables 1* and 2 and the MS data *(Exper. Part)*. Conspicuous differences which constitute the clue to the new structures are given below. In addition, several chemical transformations serve to confirm the structures, allowing us also to assign absolute configurations.

Thus, the spectral data for (+)-**2** are much the same as for (+)-**1** [8], except for showing that the chain has two CH₂ groups more *(Table 1* and *2)*. With (+)-**3**, the penultimate position for the OH group is based both on the ¹H-NMR observations of a *d* for a terminal CH₃ group coupled with an OH-deshielded H–C(17) *(Table 1)* and the ¹³C-NMR observation of an OH-deshielded C(17) (*d*), which has been assigned by heterodecoupling *(Table 2)*[2]. Further support is given by the strong signal at *m/z* 45 in the MS which does not appear with the raspailynes bearing an OH group at the chain end; it can be interpreted as the loss of the two terminal C-atoms of the chain as the CH₃CH=OH⁺ ion.

Structural evidences for compounds (−)-**4**, (−)-**5**, and **6** lie in the loss of only 1 H₂O molecule from the molecular ion (*vs.* the loss of 2 H₂O molecules with the above raspailynes bearing an OH group on the chain) and the related lack of OH-deshielded signals in both the ¹H- and the ¹³C-NMR spectra, except for those belonging to the glycerol moiety *(Tables 1* and *2)*. In further support, the MS also shows the loss of the CH₂CH(OH)CH₂OH fragment deriving from C(1′)–O breaking with protonation, followed by allylic assisted breaking at the C(7)–C(8) bond. In accordance, (−)-**5** can be only diacetylated, to give (−)-**5a**, whereas (+)-**1** can be triacetylated to give **1d** [8]. Finally, a terminal CH₃ group is seen at a normal (0.90 ppm) position for an unbranched, saturated hydrocarbon *(Table 1)*.

Structures **7** and **8** are based on similar evidences, except for the fact that signals for a terminal i-Pr group are seen in the place of those for the CH₃ group of (−)-**4**, (−)-**5**, and **6** *(Tables 1* and *2)*.

The clue to structures **9** and **10** is a coupling constant *J*(5,6) = 16.0 Hz in the ¹H-NMR spectrum *(Table 1)*, which is just that calculated [8] for the (*E*)-configuration at C(5)=C(6) (*vs.* the value *J*(5,6) = 10.8 Hz for the (6*Z*)-configuration in **1** [8]) on the basis of either the differential coupling constant treatment [9a] or the empirical relationship between *J* and the substituent electronegativity [9b]. The (*E*)-configuration at C(5)=C(6) of **9** and **10** is further supported by the ¹³C-NMR signal for C(7) at 34.09 and 34.07 ppm, respectively *(Table 2)*, whereas all natural raspailynes having the C(5)=C(6) (*Z*)-configuration show this signal at *ca.* 31 ppm. This can be interpreted in terms of less steric compression at C(7) of both **9** and **10** [10].

The (*E*)-configuration at C(1)=C(2) of **11** can be easily inferred from the fact that the ¹H-NMR spectrum shows a coupling constant *J*(1,2) = 12.8 Hz which is twice that observed with all natural raspailynes having the (*Z*)-configuration at C(1)=C(2) *(Table 1)*.

Table 1. ¹H-NMR Data (CD₃OD) of Natural Raspailynes (+)-2, (+)-3, (−)-4, (−)-5, and 6–11[2]). δ in ppm, J in Hz.

Proton[a] at	(+)-2	(+)-3	(−)-4	(−)-5	6
C(1')	4.00, 3.92 (AB of ABX, J_{AB} = 10.7, J_{AX} = 4.8, J_{BX} = 5.7)	4.00, 3.92 (AB of ABX, J_{AB} = 10.7, J_{BX} = 5.7)	4.01, 3.90 (AB of ABX, J_{AB} = 10.8, J_{AX} = 5.0, J_{BX} = 5.5)	4.00, 3.92 (AB of ABX, J_{AB} = 10.7, J_{AX} = 5.0, J_{BX} = 5.1)	4.00, 3.92 (AB of ABX, J_{AB} = 10.9, J_{AX} = 4.6, J_{BX} = 6.0)
C(2')	3.82 (X of ABX and A'B'X, pseudo-quint., J = 5.5)	3.82 (X of ABX and A'B'X, pseudo-quint., J = 5.5)	3.87 (X of ABX and A'B'X, pseudo-quint., J = 5.4)	3.82 (X of ABX and A'B'X, pseudo-quint., J = 5.5)	3.82 (X of ABX and A'B'X, pseudo-quint., J = 5.4)
C(3')	3.61, 3.57 (A'B' of A'B'X, $J_{A'B'}$ = 11.3, $J_{A'X}$ = $J_{B'X}$ = 5.3)	3.61, 3.57 (A'B' of A'B'X, $J_{A'B'}$ = 11.3, $J_{A'X}$ = $J_{B'X}$ = 5.3)	3.59 (m)	3.61, 3.57 (A'B' of A'B'X, $J_{A'B'}$ = 11.3, $J_{A'X}$ = $J_{B'X}$ = 5.3)	3.61, 3.57 (A'B' of A'B'X, $J_{A'B'}$ = 11.4, $J_{A'X}$ = 4.9, $J_{B'X}$ = 5.7)
C(1)	6.46 (d, J(1,2) = 6.4)	6.46 (d, J(1,2) = 6.4)	6.46 (d, J(1,2) = 6.4)	6.46 (d, J(1,2) = 6.4)	6.46 (d, J(1,2) = 6.4)
C(2)	4.63 (dd, J(2,1) = 6.4, J(2,5) = 2.5)	4.62 (dd, J(2,1) = 6.4, J(2,5) = 2.5)	4.62 (dd, J(2,1) = 6.1, J(2,5) = 2.1)	4.63 (dd, J(2,1) = 6.4, J(2,5) = 2.5)	4.62 (dd, J(2,1) = 6.4, J(2,5) = 2.5)
C(5)	5.56 (ddd, J(5,6) = 10.8, J(5,2) = 2.5, J(5,7) = 1.1)	5.56 (ddd, J(5,6) = 10.8, J(5,2) = 2.5, J(5,7) = 1.1)	5.58 (ddd, J(5,6) = 10.8, J(5,2) = 2.1, J(5,7) = 1.4)	5.56 (ddd, J(5,6) = 10.8, J(5,2) = 2.5, J(5,7) = 1.1)	5.56 (ddd, J(5,6) = 10.7, J(5,2) = 2.5, J(5,7) = 1.3)
C(6)	5.83 (dt, J(6,5) = 10.8, J(6,7) = 7.5)	5.83 (dt, J(6,5) = 10.8, J(6,7) = 7.5)	5.83 (dt, J(6,5) = 10.8, J(6,7) = 7.5)	5.83 (dt, J(6,5) = 10.8, J(6,7) = 7.5)	5.83 (dt, J(6,5) = 10.7, J(6,7) = 7.4)
C(7)	2.31 (tdd, J(7,6) ≈ J(7,8) ≈ 7.5, J(7,5) = 1.1)	2.31 (tdd, J(7,6) ≈ J(7,8) ≈ 7.5, J(7,5) = 1.1)	2.31 (tdd, J(7,6) ≈ J(7,8) ≈ 7.0, J(7,5) = 1.1)	2.31 (tdd, J(7,6) ≈ J(7,8) ≈ 7.5, J(7,5) = 1.1)	2.31 (dd, J(7,6) ≈ J(7,8) ≈ 7.5)
C(8)	1.40 (m)	1.41 (m)	1.40 (m)	1.41 (m)	1.40 (m)
C(12)	b)	b)	b)	b)	b)
C(13)	b)	b)	b)	b)	b)
C(14)	b)	b)	0.90 (t, J(13,14) = 6.5)	0.90 (t, J(14,13) = 6.7)	b)
C(15)	1.53 (m)	b)	—	—	0.90 (t, J(15,14) = 6.8)
C(16)	3.54 (t, J(16,15) = 6.4)	3.70 (qt, J(17,18) = 6.0, J(17,16) = 4.6)	—	—	—
C(17)	—	—	—	—	—
C(18)	—	1.14 (d, J(18,17) = 6.0)	—	—	—

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Table 1 (cont.)

Proton[a]	7[c]	8	9	10	11
C(1')	4.00, 3.92 (AB of ABX, $J_{AB} = 11.0$, $J_{AX} = 5.1$, $J_{BX} = 4.2$)	3.99, 3.92 (AB of ABX, $J_{AB} = 10.8$, $J_{AX} = 5.0$, $J_{BX} = 5.7$)	4.01, 3.89 (AB of ABX, $J_{AB} = 10.8$, $J_{AX} = 4.4$, $J_{BX} = 5.9$)	4.03, 3.90 (AB of ABX, $J_{AB} = 10.8$, $J_{AX} = 5.0$, $J_{BX} = 5.5$)	4.15, 4.06 (AB of ABX, $J_{AB} = 11.4$, $J_{AX} = 4.6$, $J_{BX} = 6.0$)
C(2')	3.82 (X of ABX and $A'B'X$, pseudo-quint., $J = 5.0$)	3.82 (X of ABX and $A'B'X$, pseudo-quint., $J = 5.2$)	3.82 (X of ABX and $A'B'X$, pseudo-quint., $J = 5.3$)	3.82 (m)	3.82 (X of ABX and $A'B'X$, m)
C(3')	3.61, 3.57 ($A'B'$ of $A'B'X$, $J_{AB} = 11.3$, $J_{AX} = 4.6$, $J_{BX} = 5.6$)	3.60, 3.58 ($A'B'$ of $A'B'X$, $J_{A'X} = J_{B'X} = 5.2$)	3.58 (m)	3.57 (m)	3.58 (m)
C(1)	6.46 (d, $J(1,2) = 6.4$)	6.46 (d, $J(1,2) = 6.4$)	6.43 (d, $J(1,2) = 6.4$)	6.43 (d, $J(1,2) = 6.5$)	6.86 (d, $J(1,2) = 12.8$)
C(2)	4.62 (dd, $J(2,1) = 6.4$, $J(2,5) = 2.41$)	4.62 (dd, $J(2,1) = 6.4$, $J(2,5) = 2.5$)	4.57 (dd, $J(2,1) = 6.4$, $J(2,5) = 2.5$)	4.56 (dd, $J(2,1) = 6.5$, $J(2,5) = 2.5$)	5.11 (dd, $J(2,1) = 12.8$, $J(2,5) = 2.2$)
C(5)	5.56 (ddd, $J(5,6) = 10.8$, $J(5,2) = 2.4$, $J(5,7) = 1.2$)	5.56 (ddd, $J(5,6) = 10.6$, $J(5,2) = 2.5$, $J(5,7) = 1.1$)	5.58 (ddd, $J(5,6) = 16.0$, $J(5,2) = 2.5$, $J(5,7) = 1.4$)	5.58 (ddd, $J(5,6) = 15.4$, $J(5,2) = 2.5$, $J(5,7) = 1.3$)	5.52 (br. dd, $J(5,6) = 10.8$, $J(5,2) = 2.1$)
C(6)	5.83 (dt, $J(6,5) = 10.8$, $J(6,7) = 7.5$)	5.83 (dt, $J(6,5) = 10.6$, $J(6,7) = 7.2$)	6.01 (dt, $J(6,5) = 16.0$, $J(6,7) = 7.1$)	6.01 (dt, $J(6,5) = 15.4$, $J(6,7) = 6.6$)	5.79 (dt, $J(6,5) = 10.8$, $J(6,7) = 7.5$)
C(7)	2.31 (tdd, $J(7,6) \approx J(7,8) \approx 7.3$, $J(7,5) = 1.1$)	2.31 (tdd, $J(7,6) \approx J(7,8) \approx 7.2$, $J(7,5) = 1.1$)	2.10 (tdd, $J(7,6) \approx J(7,8) \approx 7.1$, $J(7,5) = 1.4$)	2.09 (tdd, $J(7,6) \approx J(7,8) \approx 7.4$, $J(7,5) = 1.3$)	2.26 (pseudo-q, $J(7,6) \approx J(7,8) \approx 6.9$)
C(8)	1.40 (m)	1.40 (m)[b]	d)	d)	1.40 (m)
C(12)	1.53 (m)	1.53 (m)	d)	d)	d)
C(13)	0.88 (d, $J(13,12) = 6.5$)	0.88 (d, $J(14,13) = 6.7$)	d)	1.55 (m)	d)
C(14)	0.88 (d, $J(13,12) = 6.5$)	0.88 (d, $J(14,13) = 6.7$)	0.90 (t, $J(14,13) = 7.0$)	0.88 (d, $J(14,13) = 6.5$)	0.90 (t, $J(14,13) = 7.2$)
C(15)	–	–	–	0.88 (d, $J(14,13) = 6.5$)	–
C(16)	–	–	–	–	–
C(17)	–	–	–	–	–
C(18)	–	–	–	–	–

a) The number of protons is defined by the appropriate structural formula.
b) These protons and those at C(9) to C(11) appear as a m at 1.3 ppm.
c) Protons at C(9) to C(11) appear as a m at 1.3 ppm.
d) These protons and those at C(8) to C(11) appear as a m at 1.3 ppm.

Table 2. ^{13}C-NMR Data (CD_3OD) of Natural Raspailynes (+)-2, (+)-3, (−)-4, (−)-5, and 6-10[2]). δ in ppm, J in Hz.

C-Atom	(+)-2	(+)-3[b]	(−)-4	(−)-5[b]	6	7	8	9	10[l]
C(1')	75.46 (t)	75.42 (t, $J(C,H)$ = 143.6)	75.47 (t)	75.42 (t, $J(C,H)$ = 145.2)	75.41 (t)	75.39 (t)	75.41 (t)	75.50 (t)	[k]
C(2')	72.16 (d)	72.11 (d, $J(C,H)$ = 143.0)	72.17 (d)	72.14 (d, $J(C,H)$ = 142.7)	72.11 (d)	72.10 (d)	72.10 (d)	72.10 (d)	[k]
C(3')	63.95 (t)	63.92 (t, $J(C,H)$ = 143.1)	63.96 (t)	63.96 (t, $J(C,H)$ = 142.1)	63.93 (t)	63.89 (t)	63.90 (t)	63.86 (t)	[k]
C(1)	156.61 (d)	156.58 (d, $J(C,H)$ = 184.2)	156.58 (d)	156.55 (d, $J(C,H)$ = 182.7)	156.56 (d)	156.60 (d)	156.59 (d)	156.44 (d)	156.38 (d)
C(2)	86.34 (d)	86.33 (dd, $J(C,H)$ = 166.7, $J(C(2),H-C(5))$ = 12.5)	86.37 (d)	86.34 (dd, $J(C,H)$ = 167.3, $J(C(2),H-C(5))$ = 12.2)	86.32 (d)	86.28 (d)	86.32 (d)	86.31 (d)	86.32 (d)
C(3)	90.40 (s)	90.37 (s)	90.40 (s)	90.37 (br. s)	90.37 (s)	90.37 (s)	90.37 (s)	[h]	[k]
C(4)	89.58 (s)	89.56 (br. s)	89.51 (s)	89.55 (br. s)	89.54 (s)	89.58 (s)	[h]	[h]	[k]
C(5)	110.73 (d)	110.72 (br. d, $J(C,H)$ = 163.7)	110.74 (d)	110.72 (br. d, $J(C,H)$ = 165.8)	110.69 (d)	110.73 (d)	110.72 (d)	111.41 (d)	111.39 (d)
C(6)	143.07 (d)	141.05 (br. d, $J(C,H)$ = 160.1)	143.09 (d)	143.05 (br. d, $J(C,H)$ = 155.7)	143.03 (d)	143.02 (d)	143.02 (d)	144.00 (d)	144.98 (d)
C(7)	31.09 (t)	31.09 (t, $J(C,H)$ = 125.0)	31.12 (t)	31.08 (t, $J(C,H)$ = 125.0)	31.07 (t)	31.09 (t)	31.08 (t)	34.09 (t)	34.07 (t)
C(8)	30.75[a] (t)	30.86[d] (t)	30.76[d] (t)	30.54[e] (t)	30.69[f] (t)	30.78[g] (t)	30.84[i] (t)	30.53 (t)	[k]
C(9)	30.24[a] (t)	30.59[d] (t)	30.26[d] (t)	30.42[e] (t)	30.69[f] (t)	30.03[g] (t)	30.29[i] (t)	30.42[j] (t)	[k]
C(10)	30.55[a] (t)	30.26[d] (t)	30.06[d] (t)	30.26[e] (t)	30.57[f] (t)	28.36[g] (t)	30.01[i] (t)	30.26[j] (t)	[k]
C(11)	30.61[a] (t)	30.74[d] (t)	33.05 (t)	30.02[e] (t)	30.24[f] (t)	40.18 (t)	28.50 (t)	30.10[j] (t)	[k]
C(12)	30.65[a] (t)	30.74[d] (t)	23.75 (t)	33.05 (t, $J(C,H)$ = 125.0)	30.01[f] (t)	29.16 (d)	40.24 (t)	33.04 (t)	[k]
C(13)	30.68[a] (t)	30.74[d] (t)	14.45 (q)	23.72 (t, $J(C,H)$ = 125.0)	33.07 (t)	23.08 (q)	29.17 (d)	23.72 (t)	23.02 (q)
C(14)	26.97[a] (t)	30.03 (t)	–	14.43 (q, $J(C,H)$ = 125.0)	23.74 (t)	23.08 (q)	23.05 (q)	14.42 (q)	23.02 (q)
C(15)	33.69 (t)	26.93 (t)	–	–	14.43 (q)	–	23.05 (q)	–	–
C(16)	63.05 (t)	40.24 (t, $J(C,H)$ = 125.2)	–	–	–	–	–	–	–
C(17)	–	68.61 (d, $J(C,H)$ = 143.6)	–	–	–	–	–	–	–
C(18)	–	23.50 (q, $J(C,H)$ = 125.0)	–	–	–	–	–	–	–

[a]) [c]) [d]) [e]) [f]) [i]) [j]) [k]) These resonances could not be assigned to specific CH_2 groups and may be interchanged.
[b]) Fully coupled spectrum with NOE enhancement.
[h]) These resonances could not be detected.
[l]) These resonances are derived from a 4:1 mixture of 6/10 (signals of 10 could not be assigned when overwhelmed by those of 6).

Table 3. *Polarimetric Data* (CHCl₃) *of Natural Raspailynes and their Derivatives*

Compound	c [mol/l]	$[\alpha]^{22}$ at				
		589 nm	577 nm	546 nm	435 nm	365 nm
(−)-1a	0.20	−25.0°	−26.5°	−28.5°	−57.0°	−115.0°
(−)-1b	0.53	−13.0°	−14.1°	−16.1°	−33.0°	−66.1°
(−)-1c	0.36	−13.6°	−14.2°	−16.1°	−33.0°	−61.1°
(+)-2	0.29	+1.0°	+2.4°	+4.1°	+6.2°	
(−)-2a	0.60	−36.6°	−38.2°	−40.0°		
(−)-2b	0.68	−18.8°	−20.3°	−22.5°	−46.0°	
(−)-2c	0.50	−18.0°	−19.8°	−23.2°	−44.0°	−85.8°
(+)-3	0.24	+2.1°	+5.0°	+7.9°	+22.8°	
(−)-4	0.065	−10.8°	−13.8°	−18.5°	−46.2°	
(−)-5	0.47	−4.9°	−5.0°	−5.3°		
(−)-5a	0.23	−4.3°	−4.9°	−6.3°	−10.2°	−19.5°
(+)-12a	0.15	+2.6°	+3.3°	+5.3°	+9.3°	+11.3°
(+)-13a	0.24	+2.1°	+2.9°	+4.2°	+7.9°	+10.0°
(+)-14	0.07	+3.1°	+3.6°	+4.6°	+13.8°	+24.6°

Scheme 1

(+)-1 $n=11$
(+)-2 $n=9$

(−)-1c $n=11$
(−)-2c $n=9$

(+)-12a $n=11$
(+)-13a $n=9$

(*i*)   Acetone, CuSO₄, reflux, 1 h.
(*ii*) CH₃SO₂Cl, pyridine, Et₂O, r.t., overnight.
(*iii*) LiAlH₄, Et₂O, reflux, 15 min.
(*iv*) H₂, 10% Pd/C, AcOEt, r.t., 30 min.
(*v*)   AcOH/H₂O 8:2, reflux, 3 h.

The existence of batyl alcohol ((+)-12a), chimyl alcohol ((+)-13a) [11], and 3-tridecyloxy-1,2-propanediol ((+)-14) [3] of known absolute configuration (S) allows us to determine the absolute configuration for (+)-1, (+)-2, and (−)-4³) referring to the optical-rotation data for the natural raspailynes in *Table 3*. The cases of both (+)-1 and (+)-2 are illustrated in *Scheme 1*. Thus, either (+)-1 or (+)-2 are protected as acetonides (→(−)-1a and (−)-2a, resp.) in order to obtain the mesylates (−)-1b and (−)-2b, respectively, at the end of the chain. The mesylates are then reduced with LiAlH₄ to (−)-1c and (−)-2c, respectively, which are fully reduced in AcOEt with H₂ over Pd/C. Finally, (S)-batyl alcohol ((+)-12a) and (S)-chimyl alcohol ((+)-13a) are liberated from their acetonides, thus establishing the (S)-configuration for both (+)-1 and (+)-2, respectively. The structures for the derivatives of the raspailynes are supported by the ¹H- and ¹³C-NMR data in *Tables 4* and *5* as well as by the MS data *(Exper. Part)*.

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³)   Likely, the absolute configuration of the raspailynes could have otherwise been determined by *Snatzke*'s circular dichroic method in the presence of the Mo₂(O₂CCH₃)₄ complex [12]. We thank Prof. *G. Snatzke* for suggesting us this possibility.

Table 4. *¹H-NMR Data* (CDCl₃, unless otherwise stated) of Raspailyne Derivatives (−)-**1a**, (−)-**1b**, (−)-**1c**, (−)-**2a**, (−)-**2b**, (−)-**2c**, (−)-**5a**, **12**, (+)-**12a**, **13**, (+)-**13a**, and (+)-**14**²), δ in ppm, J in Hz.

Proton[a] at	(−)-**1a**[b]	(−)-**1b**[c]	(−)-**1c**[d]	(−)-**2a**[e]
C(1′)	3.98, 3.95 (AB of ABX, $J_{AB} = 11.1$, $J_{AX} = 4.9$, $J_{BX} = 5.4$)	3.98, 3.95 (AB of ABX, $J_{AB} = 11.2$, $J_{AX} = 4.9$, $J_{BX} = 5.4$)	3.98, 3.95 (AB of ABX, $J_{AB} = 11.0$, $J_{AX} = 5.0$, $J_{BX} = 5.5$)	3.98, 3.95 (AB of ABX, $J_{AB} = 11.1$, $J_{AX} = 4.9$, $J_{BX} = 5.4$)
C(2′)	4.30 (X of ABX and A′B′X, pseudo-quint., $J = 6.3$)	4.30 (X of ABX and A′B′X, pseudo-quint., $J = 6.1$)	4.30 (X of ABX and A′B′X, pseudo-quint., $J = 6.2$)	4.30 (X of ABX and A′B′X, pseudo-quint., $J = 6.3$)
C(3′)	4.08, 3.86 (A′B′ of A′B′X, $J_{A′B′} = 8.5$, $J_{A′X} \approx J_{BX} \approx 6.3$)	4.08, 3.86 (A′B′ of A′B′X, $J_{A′B′} = 8.5$, $J_{A′X} \approx J_{BX} \approx 6.3$)	4.07, 3.87 (A′B′ of A′B′X, $J_{A′B′} = 8.6$, $J_{A′X} \approx J_{BX} \approx 6.3$)	4.08, 3.86 (A′B′ of A′B′X, $J_{A′B′} = 8.5$, $J_{A′X} \approx J_{BX} \approx 6.3$)
C(1)	6.35 (d, $J(1,2) = 6.4$)	6.35 (d, $J(1,2) = 6.4$)	6.35 (d, $J(1,2) = 6.4$)	6.35 (d, $J(1,2) = 6.2$)
C(2)	4.67 (dd, $J(2,1) = 6.4$, $J(2,5) = 2.5$)	4.67 (dd, $J(2,1) = 6.4$, $J(2,5) = 2.4$)	4.67 (dd, $J(2,1) = 6.4$, $J(2,5) = 2.5$)	4.67 (dd, $J(2,1) = 6.4$, $J(2,5) = 2.3$)
C(5)	5.58 (br. d, $J(5,6) = 11.1$)	5.58 (br. d, $J(5,6) = 10.8$)	5.58 (br. d, $J(5,6) = 11.2$)	5.58 (br. d, $J(5,6) = 11.2$)
C(6)	5.83 (dt, $J(6,5) = 11.1$, $J(6,7) = 7.2$)	5.84 (dt, $J(6,5) = 10.8$, $J(6,7) = 7.3$)	5.83 (dt, $J(6,5) = 11.2$, $J(6,7) = 7.2$)	5.83 (dt, $J(6,5) = 11.2$, $J(6,7) = 7.2$)
C(7)	2.29 (pseudo-q, $J(7,6) \approx J(7,8) \approx 7.2$)	2.30 (pseudo-q, $J(7,6) \approx J(7,8) \approx 7.3$)	2.30 (pseudo-q, $J(7,6) \approx J(7,8) \approx 7.3$)	2.29 (pseudo-q, $J(7,6) \approx J(7,8) \approx 7.4$)
C(8)	1.40 (m)	1.40 (m)	1.40 (m)	1.40 (m)
C(15)	[c]	[c]	[d]	1.55 (quint., $J(15,16) = J(15,14) = 7.2$)
C(16)	[c]	[c]	[d]	3.62 (t, $J(16,15) = 6.7$)
C(17)	1.73 (pseudo-quint., $J(17,18) \approx J(17,16) \approx 7.2$)	1.73 (pseudo-quint., $J(17,18) \approx J(17,16) \approx 7.3$)	—	—
C(18)	3.62 (t, $J(18,17) = 6.7$)	4.21 (t, $J(18,17) = 6.7$)	0.87 (t, $J(18,17) = 6.7$)	—

Proton[a] at	(−)-**2b**[f]	(−)-**2c**[g]	(−)-**5a**[h]	**12**[i]
C(1′)	3.98, 3.95 (AB of ABX, $J_{AB} = 11.1$, $J_{AX} \approx J_{BX} \approx 6.0$)	3.98, 3.95 (AB of ABX, $J_{AB} = 11.0$, $J_{AX} = 5.0$, $J_{BX} = 5.5$)	4.08, 4.05 (AB of ABX, $J_{AB} = 10.2$, $J_{AX} \approx J_{BX} \approx 4.5$)	3.47 (m)
C(2′)	4.30 (X of ABX and A′B′X, pseudo-quint., $J = 6.3$)	4.30 (X of ABX and A′B′X, pseudo-quint., $J = 6.0$)	5.21 (X of ABX and A′B′X, pseudo-quint., $J = 4.8$)	4.25 (pseudo-quint., $J = 5.5$)
C(3′)	4.07, 3.85 (A′B′ of A′B′X, $J_{A′B′} = 8.1$, $J_{A′X} \approx 6.3$, $J_{BX} \approx 6.4$)	4.07, 3.87 (A′B′ of A′B′X, $J_{A′B′} = 8.6$, $J_{A′X} \approx J_{BX} \approx 6.3$)	4.38, 4.15 (A′B′ of A′B′X, $J_{A′B′} = 12.3$,	4.05, 3.72 (A′B′ of A′B′X, $J_{A′B′} = 8.3$, $J_{A′X} = J_{BX} = 6.1$)
C(1)	6.35 (d, $J(1,2) = 6.4$)	6.35 (d, $J(1,2) = 6.4$)	6.26 (d, $J(1,2) = 6.8$)	3.44 (m)
C(2)	4.67 (dd, $J(2,1) = 6.4$, $J(2,5) = 2.5$)	4.68 (dd, $J(2,1) = 6.4$, $J(2,5) = 2.5$)	4.72 (dd, $J(2,1) = 6.8$, $J(2,5) = 2.5$)	1.55 (m)
C(5)	5.58 (br. d, $J(5,6) = 11.1$)	5.58 (br. d, $J(5,6) = 10.8$)	5.58 (br. d, $J(5,6) = 11.0$)	}
C(6)	5.83 (dt, $J(6,5) = 11.2$, $J(6,7) = 7.2$)	5.83 (dt, $J(6,5) = 10.8$, $J(6,7) = 7.3$)	5.83 (dt, $J(6,5) = 11.1$, $J(6,7) = 6.8$)	}
C(7)	2.29 (pseudo-q, $J(7,6) \approx J(7,8) \approx 7.1$)	2.30 (pseudo-q, $J(7,6) \approx J(7,8) \approx 7.3$)	2.30 (pseudo-q, $J(7,6) \approx J(7,8) \approx 7.2$)	}
C(8)	1.40 (m)	1.40 (m)	1.40 (m)	}
C(15)	1.72 (quint., $J(15,16) = J(15,14) = 6.7$)[g]	—	—	}
C(16)	4.21 (t, $J(16,15) = 6.7$)	0.87 (t, $J(16,15) = 6.7$)	—	}
C(17)	—	—	—	}
C(18)	—	—	—	0.86 (t, $J(18,17) = 6.7$)

Table 4 (cont.)

Proton[a] at	(+)-12a[j]	13[k]	(+)-13a	(+)-14[i]
C(1')	3.70, 3.63 (AB of ABX, $J_{AB} = 11.3$, $J_{AX} = 4.0$, $J_{BX} = 4.8$)	3.47 (m)	3.71, 3.74 (AB of ABX, $J_{AB} = 11.3$, $J_{AX} = 4.0$, $J_{BX} = 4.7$)	3.51, 3.41 (AB of ABX, $J_{AB} = 11.2$, $J_{AX} = 4.1$, $J_{BX} = 5.2$)
C(2')	3.87 (X of ABX, pseudo-$quint.$, $J = 4.7$)	4.25 (pseudo-$quint.$, $J = 5.5$)	3.86 (X of ABX, pseudo-$quint.$, $J = 5.4$)	3.64 (X of ABX and $A'B'X$, pseudo-$quint.$, $J = 4.7$)
C(3')	3.50 (m)	4.04, 3.71 (AB of ABX, $J_{AB} = 8.2$, $J_{AX} = J_{BX} = 6.1$)	3.50 (m)	3.24, 3.20 ($A'B'$ of $A'B'X$, $J_{A'B'} = 10.8$, $J_{A'X} = J_{B'X} = 5.0$)
C(1)	3.44 (br. t, $J(1,2) = 6.1$)	3.47 (m)	3.46 (br. t, $J(1,2) = 6.3$)	3.16 (td, $J(1,2) = 5.5$, 2.0)
C(2)	1.55 (m)	1.55 (m)	1.55 (m)	1.45 (m)
C(5)	[f]	[k]	1.24 (m)	1.30 (m)
C(6)	[f]	[k]	1.24 (m)	1.30 (m)
C(7)	[f]	[k]	1.24 (m)	1.30 (m)
C(8)	[f]	[k]	1.24 (m)	1.30 (m)
C(15)	[f]	[k]	1.24 (m)	–
C(16)	[f]	0.85 (t, $J(16,15) = 6.7$)	0.85 (t, $J(16,15) = 6.7$)	–
C(17)	[f]	–	–	–
C(18)	0.86 (t, $J(18,17) = 6.7$)	–	–	–

[a] The number of protons is defined by the appropriate structural formula.
[b] Protons at C(9) to C(16): 1.26 (m); Me_2C=: 1.35 (s), 1.41 (s).
[c] Protons at C(9) to C(16): 1.24 (m); Me_2C=: 1.35 (s), 1.41 (s); OSO_2Me: 2.99 (s).
[d] Protons at C(9) to C(17): 1.24 (m); Me_2C=: 1.35 (s), 1.41 (s).
[e] Protons at C(9) to C(14): 1.26 (m); Me_2C=: 1.35 (s), 1.41 (s).
[f] Protons at C(9) to C(14): 1.26 (m); Me_2C=: 1.35 (s), 1.41 (s); OSO_2Me: 2.99 (s).
[g] Protons at C(9) to C(15): 1.24 (m); Me_2C=: 1.35 (s), 1.41 (s).
[h] Protons at C(9) to C(13): 1.24 (m); $CH_3(14)$: 0.87 (t, $J(14,13) = 6.7$); 2 Ac: 2.06 (s), 2.08 (s).
[i] Protons at C(3) to C(17): 1.24 (m); Me_2C=: 1.35 (s), 1.41 (s).
[j] Protons at C(3) to C(17): 1.24 (m).
[k] Protons at C(3) to C(15): 1.24 (m).
[l] ^1H-NMR in C_6D_6; protons at C(3) to C(12): 1.30 (m); $CH_3(13)$: 0.91 (q, $J(14,13) = 6.0$).

Table 5. ^{13}C-NMR Data (CDCl$_3$) of Derivatives of the Raspailynes $(-)$-1a, $(-)$-1b, $(-)$-1c, $(-)$-2a, $(-)$-2b^2), $(-)$-2c, $(-)$-5a, and 13. δ in ppm.

C-Atom	$(-)$-1a[a])	$(-)$-1b[c])	$(-)$-1c[e])	$(-)$-2a[g])	$(-)$-2b[i])	$(-)$-2c[k])	$(-)$-5a[m])	13[p])
C(1')	73.00 (t)	73.06 (t)	73.01 (t)	73.00 (t)	72.99 (t)	73.00 (t)	69.71 (t)	71.82 (t)
C(2')	74.37 (d)	74.37 (d)	74.58 (d)	74.36 (d)	74.34 (d)	74.35 (d)	70.90 (d)	74.78 (d)
C(3')	66.28 (t)	66.28 (t)	66.26 (t)	66.24 (t)	66.22 (t)	66.28 (t)	62.15 (t)	66.96 (t)
C(1)	154.57 (d)	154.60 (d)	154.56 (d)	154.60 (d)	154.62 (d)	154.58 (d)	153.75 (d)	71.90 (t)
C(2)	86.42 (d)	86.41 (d)	86.40 (d)	86.38 (d)	86.31 (d)	86.40 (d)	87.30 (d)	30.34 (t)
C(3)	90.26 (s)	90.28 (s)	90.27 (s)	90.25 (s)	90.28 (s)	90.27 (s)	90.53 (s)	26.06 (t)
C(4)	87.81 (s)	87.85 (s)	87.82 (s)	87.80 (s)	87.85 (s)	87.92 (s)	87.40 (s)	29.70°) (t)
C(5)	109.39 (d)	109.41 (d)	109.37 (d)	109.39 (d)	109.41 (d)	109.35 (d)	109.26 (d)	29.70°) (t)
C(6)	142.93 (d)	142.91 (d)	142.94 (d)	142.91 (d)	142.87 (d)	142.95 (d)	143.25 (d)	29.70°) (t)
C(7)	30.25 (t)	30.21 (t)	30.33 (t)	30.23 (t)	30.21 (t)	30.34 (t)	30.26 (t)	29.70°) (t)
C(8)	29.62[b]) (t)	29.67[d]) (t)	30.26[f]) (t)	29.56[h]) (t)	29.67[j]) (t)	30.29[l]) (t)	29.49[n]) (t)	29.62°) (t)
C(9)	29.61[b]) (t)	29.41[d]) (t)	29.70[f]) (t)	29.49[h]) (t)	29.43[j]) (t)	29.74[l]) (t)	29.27[n]) (t)	29.62°) (t)
C(10)	29.61[b]) (t)	29.37[d]) (t)	29.63[f]) (t)	29.45[h]) (t)	29.18[j]) (t)	29.68[l]) (t)	29.22[n]) (t)	29.62°) (t)
C(11)	29.57[b]) (t)	29.35[d]) (t)	29.54[f]) (t)	29.41[h]) (t)	29.11[j]) (t)	29.51[n]) (t)	28.90[p]) (t)	29.47°) (t)
C(12)	29.51[b]) (t)	29.18[d]) (t)	29.36[f]) (t)	29.20[h]) (t)	28.99[j]) (t)	29.38[l]) (t)	31.89 (t)	29.47°) (t)
C(13)	29.42[b]) (t)	29.11[d]) (t)	29.27[f]) (t)	28.92[h]) (t)	28.88[j]) (t)	29.29[l]) (t)	22.69 (t)	29.47°) (t)
C(14)	29.25[b]) (t)	28.99[d]) (t)	29.10[f]) (t)	25.72 (t)	25.39 (t)	31.93 (t)	14.11 (q)	31.93 (t)
C(15)	28.93[b]) (t)	28.89[d]) (t)	28.70[f]) (t)	32.79 (t)	30.29 (t)	22.68 (t)	–	22.68 (t)
C(16)	25.73 (t)	25.39 (t)	31.91 (t)	63.09 (t)	70.19 (t)	14.10 (q)	–	14.09 (q)
C(17)	32.83 (t)	30.29 (t)	22.68 (t)	–	–	–	–	–
C(18)	63.09 (t)	70.17 (t)	14.15 (q)	–	–	–	–	–

[a]) $Me_2C=$: 25.49 (q), 26.62 (q); $Me_2C=$: 109.76 (s).
[b]) [d]) [f]) [h]) [j]) [l]) [n]) [o]) These resonances could not be assigned to specific CH$_2$ groups and may be interchanged.
[c]) $Me_2C=$: 25.49 (q), 26.62 (q); $Me_2C=$: 109.78 (s); OSO$_2$Me: 37.42 (q).
[e]) $Me_2C=$: 25.47 (q), 26.61 (q); $Me_2C=$: 109.74 (s).
[g]) $Me_2C=$: 25.48 (q), 26.62 (q); $Me_2C=$: 109.76 (s).
[i]) $Me_2C=$: 25.47 (q), 26.59 (q); $Me_2C=$: 109.74 (s); OSO$_2$Me: 37.34 (q).
[k]) $Me_2C=$: 25.47 (q), 26.61 (q); $Me_2C=$: 109.75 (s).
[m]) 2 CH$_3$C=O: 20.74 (q), 20.91 (q); 2 CH$_3$C=O: 170.13 (s), 170.51 (s).
[p]) $Me_2C=$: 25.44 (q), 26.76 (q); $Me_2C=$: 109.75 (s).

Scheme 2

The case of compound $(-)$-4 is straightforward. Simple catalytic reduction *(Scheme 2)* affords (S)-3-tridecyloxy-1,2-propanediol ((+)-14) [3] whose structure is fully supported by ^{1}H-NMR and MS data [3], thus establishing the (S)-configuration for $(-)$-4.

It is interesting to note that all natural raspailynes have the (S)-configuration and that this is true for all chiral 1-glyceryl monoethers of marine origin so far investigated [2] [3].

Table 6 summarizes the raspailyne distribution. Thus for *R. pumila*, both the percentages of the raspailynes with respect to dry-sponge weight (abs. %) and the relative percentages of the raspailynes with respect to one another (rel. %) are shown. For *R. ramosa*, only the relative percentages have been evaluated. It is seen that the two

Table 6. *Product Distribution and Chromatographic Retention Times* (t_R)[a]) *vs. Structural Features for Natural Raspailynes from the Sponges* R. pumila *and* R. ramosa

Raspailyne	R. pumila		R. ramosa	Side chain		
	abs.[b]) [%]	rel. [%]	rel. [%]	OH at	C_n	t_R [min]
Raspailyne A1 ((+)-**2**)	1	100	100	C(16)	C_{16}	4.6
Isoraspailyne A ((+)-**3**)	0.5	50	1	C(17)	C_{17}	6.5
Raspailyne A ((+)-**1**)	0.9	90	30	C(18)	C_{17}	7.3
Raspailyne B2 ((−)-**4**)	0.1	10	1	–	C_{13}	7.5
Isoraspailyne B1 (**7**)	0.01	1	1	–	C_{14}	8.3
Raspailyne B1 ((−)-**5**)	0.9	90	30	–	C_{14}	9.9
Isoraspailyne B1a (**9**)	< 0.01	<1	<1	–	C_{14}	11.0
Isoraspailyne B1b (**11**)	≪ 0.01	≪ 1	≪ 1	–	C_{14}	11.7
Isoraspailyne B (**8**)	0.5	50	1	–	C_{15}	12.5
Raspailyne B (**6**)	0.2	20	10	–	C_{15}	13.0
Isoraspailyne Ba (**10**)	≪ 0.01	≪ 1	≪ 1	–	C_{15}	13.2

[a]) *RP18* reverse-phase HPLC with CH_3CN/H_2O 65:35. This eluant was the best compromise allowing the comparison of the chromatographic behaviour of all the raspailynes. Actually, the separations were best carried out with the eluants given in the *Exper. Part* (Isolations).
[b]) Yield based on dry-sponge weight after extraction (44 g).

sponges contain the same raspailynes, though at different relative percentages. This may have some taxonomic significance, as it has been often questioned whether *R. pumila* and *R. ramosa* are different names for the same organism[4]).

Table 6 also summarizes the retention times of the raspailynes on reverse-phase chromatography *vs.* type and length of the chain. The observed trend can be rationalized as follows. Raspailynes (+)-**2**, (+)-**3**, and (+)-**1** are eluted first as the additional OH group on the chain lowers their affinity for the stationary phase. Within this group, (+)-**2** is eluted first as the shortest chain results in the lowest attractive interactions towards the stationary phase. The same is true for the raspailynes not hydroxylated on the chain, where those with the shorter chain are eluted first. For the same number of chain C-atoms, branched raspailynes are eluted before unbranched ones ((+)-**3** *vs.* (+)-**1**, **7** *vs.* (−)-**5**, and **8** *vs.* **6**) because the branched-chain compounds can be less strongly bound by hydrophobic interactions to the (unbranched) hydrocarbon of the stationary phase. Finally, for similar reasons, (*E*)-raspailynes are more strongly retained than the corresponding (*Z*)-raspailynes by the stationary phase. In fact, models show that, for steric reasons, raspailynes with the (*E*)-configuration are allowed to approach the unbranched hydrocarbon of the stationary phase more closely than raspailynes with the (*Z*)-configuration.

The raspailynes are unstable compounds, a matter that is dealt with in a forthcoming paper in this Journal.

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[4]) Personal communication from Dr. *L. Cabioch.*

Experimental Part

1. *General.* TLC: *Merck* silica gel *60 PF$_{254}$*. Flash chromatography: *Merck* silica gel *60*, 25–40 μm. HPLC: *Merck LiChrosorb Si-60* (7 μm); for reverse-phase, *Merck LiChrosorb RP-18* (7 μm); 25 × 1 cm column and 5 ml/min solvent flux in both cases. All evaporations were carried out at reduced pressure at r.t. Yields are given on reacted starting compounds. Polarimetric data: *JASCO-DIP-181* digital polarimeter. UV and IR spectra: *Perkin-Elmer-Lambda-3* (λ_{max} in nm, ε in dm^{3}mol^{-1}cm^{-1}) and *Pye-Unicam-SP3-100* ($\tilde{\nu}_{max}$ in cm^{-1}) spectrophotometer, resp. ^{1}H-NMR and ^{13}C-NMR spectra: *Varian XL300* (300 or 75.43 MHz, resp.); δ (ppm) relative to internal Me$_4$Si (= 0 ppm) and *J* in Hz; multiplicities for C-atoms: APT technique [13]. MS (electron impact): home-built quadrupole mass spectrometer based on the *ELFS-4-162-8 Extranuclear* quadrupole [14] (low-resolution experiments) or *VG ZAB2F* mass spectrometer (high-resolution experiments and B/E linked scans [15]).

2. *Isolations.* *R. pumila* (Bowerbank, 1866) was collected by scuba diving in the Baie de Morlaix (Brittany) at depths of 20–30 m, in August 1982 and October 1984. *R. ramosa* (Bowerbank, 1866) was collected on September 22nd, 1984, from gill nets, where the sponge is occasionally entrapped, of professional fishermen. The nets were placed offshore Roscoff, Brittany, at 3–4 h motor boat sailing distance. Fresh sponges were mechanically freed of H$_2$O, plonged in EtOH for some days, homogenized by a *Waring* blender, filtered (the residue was extracted with fresh EtOH) and the filtrate evaporated. The residue from the evaporation was extracted with petroleum ether and then with AcOEt. The weights of the petroleum-ether and AcOEt extracts and of the dried-sponge residue after extraction were, in the given order, for *R. pumila* (373M collection) and, within parentheses, for *R. ramosa* (244M collection): 2.0 g (0.55 g), 0.27 g (0.090 g), and 44 g (23 g). The residue from the petroleum-ether extract of *R. pumila* (the other sponge was only compared by anal. HPLC) was subjected to flash chromatography on 100 g of support, gradient elution hexane/AcOEt. The last eluted fractions contained (+)-1, (+)-2, and (+)-3 which were cleanly separated from one another by reverse-phase HPLC (CH$_3$CN/H$_2$O 58:42). Central fractions contained the other raspailynes which were cleanly separated from one another by reverse-phase HPLC (CH$_3$CN/H$_2$O 65:35). t_R data and abundances: *Table 6*.

MS of Natural Raspailynes[5]). MS ((+)-2): 324 (18, $M^{+·}$), 250 (2), 249 (3), 209 (1), 195 (1.5), 181 (2), 121 (34), 103 (100), 91 (40), 67 (35), 55 (80), 41 (63), 31 (58); B/E: $M^{+·}$→306 (– H$_2$O), 324→249 (– 75) and 250 (– 74), and 250→232 (– H$_2$O) and 221 (– 29). HR-MS ((+)-2): 324.2255 ± 0.008 ($M^{+·}$, C$_{19}$H$_{32}$O$_4$, calc. 324.2300). MS ((+)-3): 352 (23, $M^{+·}$), 277 (2), 260 (3), 209 (1), 181 (1), 135 (15), 121 (20), 103 (100), 91 (80), 77 (30), 57 (25), 45 (60), 31 (20); B/E: $M^{+·}$→334 (– H$_2$O) and 227 (– CH$_2$CH(OH)CH$_2$OH), 334→316 (– H$_2$O), and 277→259 (– H$_2$O). HR-MS ((+)-3): 352.2527 ± 0.008 ($M^{+·}$, C$_{21}$H$_{36}$O$_4$, calc. 352.2613), 277.2115 ± 0.008 ($M^{+·}$ – 75, C$_{18}$H$_{29}$O$_2$, calc. 277.2167). MS ((–)-4): 266 (24, $M^{+·}$), 248 (3, $M^{+·}$ – H$_2$O), 192 (8), 181 (4), 135 (20), 121 (65), 103 (66), 91 (46), 77 (100), 57 (96). HR-MS ((–)-4): 266.1920 ± 0.008 ($M^{+·}$, C$_{16}$H$_{26}$O$_3$, calc. 266.1881). MS ((–)-5): 280 (22, $M^{+·}$), 262 (2, $M^{+·}$ – H$_2$O), 206 (7), 205 (2), 178 (3), 149 (4), 135 (13), 121 (48), 91 (100), 77 (45). HR-MS ((–)-5): 280.2088 ± 0.009 ($M^{+·}$, C$_{17}$H$_{28}$O$_3$, calc. 280.2036). MS (6): 294 (3, $M^{+·}$), 276 (1, $M^{+·}$ – H$_2$O), 220 (1), 163 (2), 149 (8), 135 (4), 131 (11), 121 (24), 91 (84), 77 (16), 43 (100). HR-MS (6): 294.2152 ± 0.008 ($M^{+·}$, C$_{18}$H$_{30}$O$_3$, calc. 294.2194). MS (7): 280 (11, $M^{+·}$), 206 (1), 145 (1), 131 (3), 121 (12), 105 (15), 93 (16), 77 (56), 57 (100). MS (8): 294 (7, $M^{+·}$), 276 (0.5, $M^{+·}$ – H$_2$O), 220 (4), 163 (3), 121 (26), 103 (32), 95 (41), 79 (100). MS (9): 280 (77, $M^{+·}$), 262 (6), 206 (16), 181 (5), 163 (5), 149 (21), 135 (24), 121 (34), 107 (100), 105 (23), 103 (21), 91 (51), 77 (57). MS (10; obtained from 6/10): 294 (4, $M^{+·}$), 276 (1). MS (11): 280 (39, $M^{+·}$), 262 (1), 206 (16), 181 (3), 135 (27), 121 (51), 91 (100).

3. *Full Reduction of the Side Chain of Side-Chain-Hydroxylated Raspailynes.* 3.1. *Batyl Alcohol ((+)-12a) from (+)-1.* To a soln. of (+)-1 (0.0072 g, 0.02 mmol) in dry acetone (1 ml), dry CuSO$_4$ was added in excess and heated at reflux with stirring for 1 h, monitoring by TLC. The mixture was filtered, and the filtrate was directly subjected to reverse-phase chromatography with CH$_3$CN/H$_2$O 72:28 giving *18-[(2,3-(isopropylidenedioxy)propyl)oxy]-13,17-octadecadien-15-yn-1-ol*; ((–)-1a; 0.057 g, 73%), t_R 13 min.

To a soln. of (–)-1a (0.048 g, 0.012 mmol) in dry Et$_2$O, pyridine and MeSO$_2$Cl in excess were added. The mixture was stirred overnight under N$_2$, filtered, and the filtrate directly subjected to TLC with hexane/Et$_2$O 3:7 giving *18-[(2,3-(isopropylidenedioxy)propyl)oxy]-13,17-octadecadien-15-yn-1-yl methanesulfonate*; ((–)-1b; 0.054 g, 98%), R$_f$ 0.40.

To a soln. of (–)-1b (0.045 g, 0.0096 mmol) in dry Et$_2$O (1.5 ml) was added LiAlH$_4$ (2 equiv.). The mixture was heated at reflux for 15 min, whereby all (–)-1b disappeared. Then, H$_2$O was added, the mixture filtered by a phase-separation filter, and the filtrate subjected to TLC with hexane/Et$_2$O 8:2 yielding *18-[(2,3-(isopropylidenedioxy)propyl)oxy]-13,17-octadecadien-15-yne* ((–)-1c; 0.032 g, 89%).

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[5]) Though pure according to NMR spectroscopy, the compounds were usually yellowish oils. Only rarely, they were obtained as amorphous solids [8].

A soln. of (−)-**1c** (0.028 g, 0.0074 mmol) in AcOEt was hydrogenated for 30 min over 10% Pd/C at r.t. The mixture was filtered, and the filtrate was evaporated to give crude *18-[(2,3-(isopropylidenedioxy)propyl)oxy]octadecane* (**12**; 0.026 g, *ca.* 90%). A soln. of crude **12** (0.0023 g, 0.0068 mmol) in 80% aq. AcOH was heated at reflux for 3 h, then evaporated, and the residue subjected to TLC with hexane/AcOEt 1:1 giving (+)-**12a** (0.0016, 76%).

MS ((−)-**1a**): 392 (1, *M*⁺˙), 145 (3), 131 (6), 117 (28), 115 (36), 97 (29), 85 (46), 57 (100). MS ((−)-(**1b**)): 470 (1, *M*⁺˙), 455 (0.6), 376 (3), 316 (11), 133 (5), 115 (100), 105 (11), 91 (16), 79 (28). MS ((−)-**1c**): 376 (0.5, *M*⁺˙), 318 (3), 219 (0.8), 177 (2), 165 (4), 149 (11), 123 (17), 115 (14), 97 (38), 83 (58), 57 (100). MS (**12**): 384 (1, *M*⁺˙), 369 (62), 167 (2), 149 (6), 125 (6), 101 (100), 85 (35), 83 (38), 71 (51), 57 (66).

Data of (+)-**12a**: ¹³C-NMR (CDCl₃) 71.86 (*t*, C(1′)); 70.44 (*d*, C(2′)); 64.30 (*t*, C(3′)); 72.50 (*t*, C(1)); 29.68 (*t*, C(2)); 26.07 (*t*, C(3)); 29.68, 29.64, 29,61, 29.58, 29.44, 29.29 (6*t*, recognized by APT, C(4)–C(15)); 31.92 (*t*, C(16)); 22.68 (*t*, C(17)); 14.09 (*q*, C(18)). MS: in accordance with [2a].

3.2. *Chimyl Alcohol ((+)-**13a**) from (+)-**2**.* A procedure analogous to *3.1* led from (+)-**2** (0.0010 g, 0.03 mmol) to, in sequence, *16-[(2,3-(isopropylidenedioxy)propyl)oxy]-11,15-hexadecadien-13-yn-1-ol*; ((−)-**2a**; *t*ᵣ 8.5 min; 75%), *16-[(2,3-(isopropylidenedioxy)propyl)oxy]-11,15-hexadecadien-13-yn-1-yl methanesulfonate*; ((−)-**2b**; *R*f 0.3; 97%), *16-[(2,3-(isopropylidenedioxy)propyl)oxy]-11,15-hexadecadien-15-yne*; ((−)-**2c**; 91%), **13** *16-[(2,3-(isopropylidenedioxy)propyl)oxy]hexadecane* (*ca.* 98%), and (+)-**13a** (75%).

MS ((−)-**2a**): 364 (2, *M*⁺˙), 161 (20), 145 (15), 131 (24), 117 (44), 115 (73), 105 (43), 91 (83), 43 (100). MS ((−)-**2b**): 442 (0.5, *M*⁺˙), 427 (1), 346 (4), 288 (1), 117 (10), 115 (100), 91 (22), 79 (21), 57 (57). MS ((−)-**2c**): 348 (1, *M*⁺˙), 333 (0.3), 290 (3), 246 (2), 149 (3), 135 (4), 123 (6), 115 (100), 91 (17), 79 (15), 57 (89). MS (**13**): 356 (1.5, *M*⁺˙), 341 (45), 195 (2), 149 (10), 101 (83), 85 (37), 71 (43), 57 (89). MS ((+)-**13a**): in accordance with [2a].

4. *3-Tridecyloxy-1,2-propanediol ((+)-**14**) from (−)-**4**.* A soln. of (−)-**4** (0.0012 g, 0.0045 mmol) in AcOEt (1 ml) was hydrogenated at r.t. for 30 min and filtered, and the filtrate was subjected to TLC with hexane/AcOEt 1:1 yielding (+)-**14** (0.001 g, 81%). MS: in accordance with [3].

5. *Acetylation of (−)-**5**.* Reaction of (−)-**5** (0.0052 g, 0.028 mmol) with Ac₂O/pyridine at 0° under N₂ for 1 h gave *3-[((1Z,5Z)-tetradeca-1,5-dien-3-ynyl)oxy]propane-1,2-diyl diacetate* ((−)-**5a**; 0.0045 g, 75%). IR (film): 2170*w*, 1730*vs*, 1650*m*, 1250*s*, 1130*s*. MS: 364 (4, *M*⁺˙), 205 (4), 159 (100), 117 (3), 99 (10), 44 (50).

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