Results. GC-MS analysis on 1% OV-17 showed only one peak which exhibited m/e 138(18) as the molecular ion with a base peak at m/e 107 and other large peaks at m/e 77(16), 53(5), 51(5) and 39(5). Comparison of retention times (isothermal, 150 °C) and mass spectra of the unknown material with those of synthetic β-(o, m, and p-hydroxyphenyl)ethanol prepared by lithium aluminum hydride reduction of the corresponding methyl esters, p-methoxymethyl phenol and 2-phenoxyethanol indicated that the natural material was β-(p-hydroxyphenyl)ethanol. The base peaks of all 3 hydroxyphenyl ethanol isomers and the p-methoxymethyl phenol were identical while that of 2-phenoxyethanol was m/e 94. The methoxymethyl phenol elutes significantly earlier than the hydroxyphenyl ethanols and the isomers of the latter can be distinguished from both their isothermal gas chromatograms and their mass spectra. Both the m and o isomers have significantly higher m/e 77(35) and m/e 108(67,22). When β-(p-hydroxyphenyl)ethanol was placed on the perch of a galago, the animals responded to it in a way which was never observed with any other odorants (including its isomers). The galago, slowly and deliberately, placed its open mouth over the treated spot. This response appeared to place either the inside of the mouth or the back of the tongue in contact with the perch, and thus constituted a highly distinctive type of biting behavior.

Discussion. Scent marking is important in the social biology of many primates, and the chest gland of G. crassicaudatus is frequently utilized as a marking gland. Field observations of G. senagalensis indicate that galagos frequently mark their territories[6] and the chest gland secretion may possess an important pheromonal role for these animals. However, we are unable to interpret the paticular significance of the oral presentation to sites marked with β-(p-hydroxyphenyl)ethanol and the exact function of this compound remains to be determined. Nevertheless, with the identification of this first aromatic compound in the exocrine secretion of a primate, it may be possible now to explore scent marking in primates in terms of defined chemical releasers of behavior.

(–)-(R)-1-O-Geranylgeranylglycerol from the brown alga Dilophus fasciola[1]

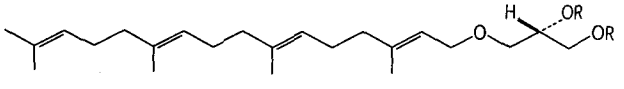
V. Amico, G. Oriente, M. Piattelli, C. Tringali, E. Fattorusso, S. Magno and L. Mayol

Istituto di Chimica Organica dell'Università di Catania, viale Doria, I-95125 Catania (Italy), and Istituto di Chimica Organica dell'Università di Napoli, via Mezzocannone, I-16-80134 Napoli (Italy), 25 January 1977

Summary. A novel ether lipid, (–)-(R)-1-O-geranylgeranylglycerol (**1**), has been isolated from the brown alga Dilophus fasciola and its structure proved by spectroscopic methods and chemical degradation.

Among the brown algae, members of the family Dictyotaceae are a particularly rich source of new natural compounds[2]. During the course of our search for novel metabolites of Mediterranean macroalgae, we have now investigated a further species, Dilophus fasciola (Roth) Howe, belonging to the same family.

Material and methods. Chloroform extraction of the freeze-dried alga gave a green oil which was chromatographed on silica gel using increasing concentrations of ether in light petroleum as the eluent. Repeated chromatography of the more polar fractions eventually resulted in the isolation of (–)-(R)-1-O-geranylgeranylglycerol (**1**) (0.15% yield, dry weight of alga) as a colourless, viscous liquid, $[\alpha]_D$ –2.1° (c 1.5 in $CHCl_3$).



1 R = H **2** R = Ac

Results and discussion. Compound **1**, ν_{max} (liquid film) 3300 cm^{-1} (OH), had molecular formula $C_{23}H_{40}O_3$ (high resolution mass spectrometry m/e 364.2972; calculated for $C_{23}H_{40}O_3$ 364.2977). The IR- and UV-spectra of **1** indicated the absence of carbonyl and conjugated system in the molecule. On acetylation with acetic anhydride in pyridine, **1** afforded the diacetate **2** (M^+ m/e 448), oily, $[\alpha]_D$ –8.4° (c 1.5 in $CHCl_3$), ν_{max} 1750 cm^{-1}, which showed no hydroxyl IR absorption. Thus 2 of the oxygen functions of **1** were assigned to 2 hydroxyls (which must be vicinal, since **1** gives a positive periodate test), the remaining oxygen being probably involved in an ether link (ν_{max} 1150 cm^{-1}). These results and the mass spectrum which indicated cleavage of the molecular ion with loss of 92 amu ($C_3H_8O_3$) suggested that **1** must be a C_{20} 1-ether of glycerol. Indeed, the PMR spectrum of **2** in CCl_4 contains all the required proton signals[3]: a) singlets for 2 acetyl protons at δ 1.98 and 2.01, b) an ABX system (AB-part, 4.20 δ, J_{AB} 14 Hz; X-part, 4.98 δ, obscured by overlapping with the signal of vinyl protons) which could be assigned to the $-CH(OAc)CH_2OAc$ group and c) a doublet at δ 3.43 assigned to $-CH_2O-$. Irradiation at δ 4.98 simplified the AB-part into an AB system and at the same time collapsed the doublet at δ 3.43 to a singlet. The structure of the additional C_{20}-moiety could be deduced from the remaining PMR signals [δ 1.60 (9H, s, 3 vinyl Me's), 1.67 (6H, s, 2 vinyl Me's), 2.03 (12H, m, 6 $>C=CHCH_2-$), 3.94 (2H, d, J 7 Hz, $>C=CHCH_2O-$), 5.10 (3H, b, $>C=CHCH_2-$) and 5.29 (1H, bt, $>C=CHCH_2O-$)], which closely paralleled those reported[4] for all-trans-geranylgeraniol.

At this juncture it became apparent that the new compound must be represented by the formula **1**, which is also supported by the fragmentation pattern in the MS

1 This work was supported by CNR, Rome, Italy.

2 R. E. Moore, J. A. Pettus, Jr, and J. Mistysyn, J. org. Chem. *39*, 2201 (1974); A. G. Gonzalez, J. Darias, J. D. Martin and M. Norte, Tetrahedron Lett. *1974*, 3951; D. R. Hirschfeld, W. Fenical, G. H. Y. Lin, R. M. Wing, P. Radlick and J. J. Sims, J. Am. Chem. Soc. *95*, 4049 (1973); E. Fattorusso, S. Magno, L. Mayol, C. Santacroce, D. Sica, V. Amico, G. Oriente, M. Piattelli and C. Tringali, J. C. S. Chem. Commun. *1976*, 575.

3 In the spectrum of **1** the 2 OH are seen as a D_2O-exchangeable, broad singlet at δ 2.65, while the 5 not-exchangeable protons of the glycerol moiety give rise to a complex pattern of signals between δ 3.42 and 3.95.

4 B. A. Nagasampagi, L. Yankov and S. Dev, Tetrahedron Lett. *1967*, 189.

which, besides M^+ (m/e 364), includes diagnostically important peaks[5] for M^+-C_5H_9 (m/e 295), M^+-$C_3H_8O_3$ (m/e 272), M^+-$C_3H_8O_3$-CH_3 (m/e 257), M^+-$C_3H_8O_3$-C_3H_7 (m/e 229), M^+-$C_3H_8O_3$-C_5H_9 (m/e 203), M^+-$C_3H_8O_3$-$C_{10}H_{17}$ (m/e 135), $C_7H_9^+$ (m/e 93), $C_6H_9^+$ (m/e 81), $C_5H_9^+$ (base, m/e 69) and $C_3H_5^+$ (m/e 41).

The structure was confirmed by reduction with sodium in NH_3 and EtOH at -45 °C which afforded all-trans-2,6,10,14-tetramethylhexadeca-2,6,10,14-tetraene (M^+ m/e 274) as the main product, identified by chromatographic and spectroscopic comparison with an authentic specimen.

Since related, naturally occurring, higher glycerol 1-ethers (chimyl, batyl and selachyl alcohols), all possessing the S configuration, in dilute chloroform solution are slightly dextro-rotatory[6], the optical rotation of **1** suggested that this compound could possibly possess the opposite R configuration. This feature was confirmed by using the general method for the configurational correlation of alcohols described by Mislow[7]. Reaction of **1** with p-toluenesulfinyl chloride yielded a mixture of diastereomers which by reaction with methylmagnesium iodide gave a preponderance of (−)-(S)-methyl-p-tolyl sulfoxide.

Until now higher glycerol ethers with polyisoprenoidic hydrocarbon chains have been found only in extremely halophilic[8] and acidophilic bacteria[9]. It is interesting to note that all these lipids, as well as **1**, possess the 'unnatural' configuration of the glycerol moiety.

5 R. Ryhage and E. von Sidow, Acta chem. scand. *17*, 2025 (1963); E. von Sidow, Acta chem. scand. *17*, 2504 (1963).

6 Y. Toyama and T. Ishikawa, J. Chem. Soc. Japan *59*, 1367 (1938); E. Baer and H. O. L. Fischer, J. biol. Chem. *140*, 397 (1941); V. Prelog, L. Ruzicka and P. Stein, Helv. chim. Acta *26*, 2222 (1943); V. Prelog, L. Ruzicka and F. Steinmann, Helv. chim. Acta *27*, 674 (1944); E. Baer, L. J. Rubin and H. O. L. Fischer, J. biol. Chem. *155*, 447 (1944).

7 M. M. Green, M. Axelrod and K. Mislow, J. Am. Chem. Soc. *88*, 861 (1966); C. Fuganti and D. Ghiringhelli, Gazz. chim. ital. *99*, 316 (1969).

8 M. Kates, in: Ether Lipids. Chemistry and Biology, p. 351. Ed. F. Snyder. Academic Press 1972.

9 M. de Rosa, L. Minale and J. D. Bu' Lock, J. C. S. Chem. Commun. *1974*, 543.

Synthesis of (Glu-OMe)^2-litorin

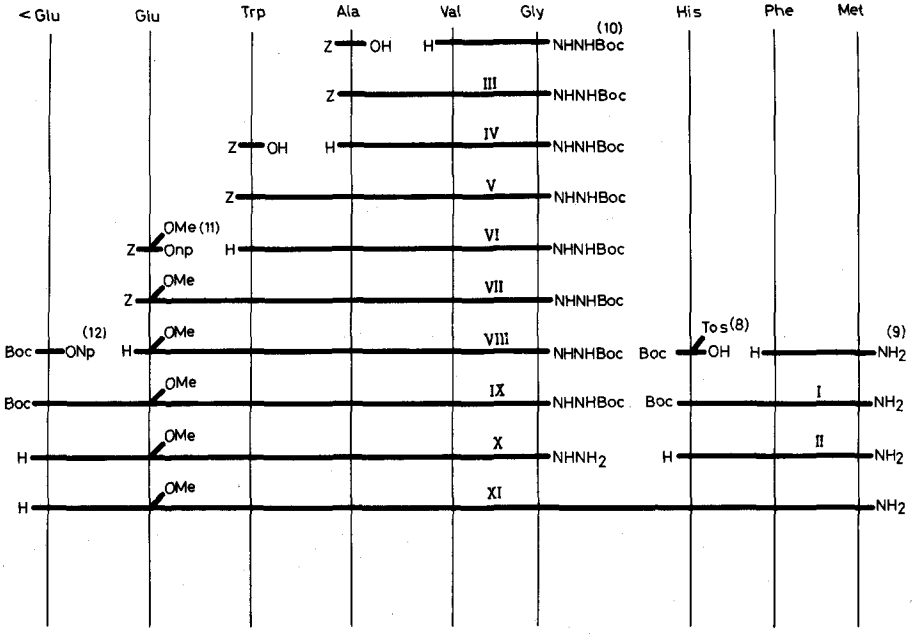
M. Mazzoli and R. de Castiglione

Laboratori Ricerche Farmitalia, I–20146 Milano (Italy), 4 February 1977

Summary. The synthesis of the nonapeptide <Glu-Glu(OMe)-Trp-Ala-Val-Gly-His-Phe-Met-NH_2, corresponding to the formula of the (Glu-OMe)^2-litorin, is described. The compound has the same chemical and biological properties of the second bombesin-like peptide extracted from the skin of the Australian frog Litoria aurea.

We briefly report the synthesis of a nonapeptide of formula <Glu-Glu(OMe)-Trp-Ala-Val-Gly-His-Phe-Met-NH_2[1] (XI), corresponding to the proposed sequence of the second bombesin-like peptide of the skin of the Australian frog Litoria aurea, i.e. Glu(OMe)^2-litorin[2]. Relevant information on the synthesis, accomplished by conventional solution methods, is summarized in the figure and the table.

The condensation of Boc-His(Tos) with Phe-Met-NH_2 via the Geiger procedure[3] (DCCI + HOBT) gave the detosylated[4] tripeptide I ($E_{1,2}$ = 0.32 His; $E_{5,8}$ = 0.45 His)[5]. The final coupling was carried out by the modified azide



Synthesis of Glu(OMe)^2-litorin.