Phytochemistry, 1979, Vol. 18, pp. 1226–1227. © Pergamon Press Ltd. Printed in England. 0031-9422/79/0701-1226 $02.00/0

15-HYDROXYBLENNIN A, A NEW LACTARANE-TYPE SESQUITERPENE LACTONE ISOLATED FROM *LACTARIUS TORMINOSUS*[*]

KARL-GUSTAV WIDÉN and EEVA-LIISA SEPPÄ
Department of Pharmacognosy, University of Helsinki, SF-00170 Helsinki 17, Finland

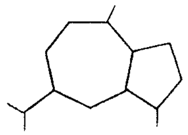
(*Received* 5 *October* 1978)

Key Word Index—*Lactarius torminosus*; Russulaceae; new lactaranolide; 15-hydroxyblennin A.

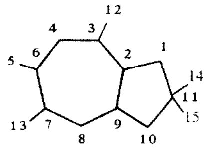
Abstract—15-Hydroxyblennin A, a new lactarane-type sesquiterpene lactone was isolated from *Lactarius torminosus* mushrooms. Through spectroscopic (IR, ^{1}H NMR, ^{13}C NMR, MS, UV) investigation and comparison with data for other known lactaranolides its structure was deduced as **3**.

INTRODUCTION

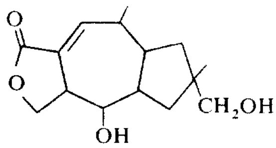
Several guaiane type **1** sesquiterpenoids, including hydrocarbons, aldehydes, alcohols and their esters, have been isolated from *Lactarius deliciosus* [1–5]. Recently several sesquiterpenoids have been isolated from other *Lactarius* species (*L. blennius* [6], *L. helvus* [7], *L. necator* [8, 9], *L. pergamenus* [7, 10–14], *L. rufus* [15–19], *L. scrobiculatus* [20, 21], *L. vellereus* [7, 10–14, 22]). Structurally, however, these latter sesquiterpenoids belong to the lactarane **2** skeletal type, or can easily be derived from it. We have now begun a study of the sesquiterpenoid composition in Finnish *Lactarius* species. The first species studied is *L. torminosus* (Fr.) S. F. Gray, which is found throughout Finland and is extensively used as an edible mushroom.



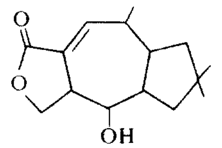
1



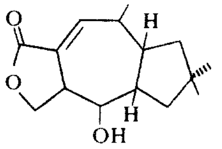
2



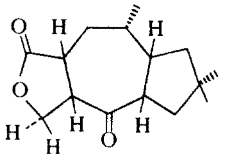
3



4



5



6

RESULTS AND DISCUSSION

A fraction containing mainly sesquiterpenoids was isolated from the ethanolic extract of frozen *Lactarius torminosus* mushrooms, chiefly according to Daniewski *et al.* [15]. From this fraction a new compound, 15-hydroxyblennin A, was separated by column chromatography with silica gel as adsorbent. The colourless crystals had mp 144°.

The MS of the compound had the parent peak at *m/e* 266, which together with information from ^{13}C NMR and ^{1}H NMR spectra indicated the molecular formula $C_{15}H_{22}O_4$. The IR spectrum displayed bands at 1750, 1675 and 833 cm^{-1}, which were attributed to an α,β-unsaturated γ-lactone [6, 21]. The UV absorption maximum at 222 nm was also compatible with this interpretation. The existence of alcoholic hydroxyls in the molecule was evidenced by the strong IR band at 3350 cm^{-1} and the ^{1}H NMR signals at δ 3.44 ppm (2H, *s*, —C$\underline{H}_2$OH) and δ 3.62 ppm (1H, *dd*, —C$\underline{H}$OH). The ^{1}H NMR and ^{13}C NMR spectra (Tables 1 and 2) showed a close esemblance with those of blennin A (**4**). For comparison ^{1}H NMR spectral data for lactarorufin N (**5**), a stereoisomer of blennin A, and deoxydihydroketolactarorufin N (**6**) are included in Table 1. ^{13}C NMR data for these compounds were not available. Inspection of the ^{1}H NMR spectra of 15-hydroxyblennin A and blennin A showed one of the two signals for geminal methyls in blennin A to be lacking in 15-hydroxyblennin A. In turn the latter compound had a signal for methylene protons in a —CH$_2$OH grouping, which was lacking in the spectrum of blennin A. Likewise blennin A had signals for three methyl carbons in its ^{13}C NMR spectrum, whereas 15-hydroxyblennin A had signals for only two methyl carbons, and a signal for a —CH$_2$O— carbon which was lacking in the spectrum of blennin A. The structure of 15-hydroxyblennin A is thereby assigned as **3**. Furthermore the close resemblance between the ^{1}H NMR and ^{13}C NMR spectra of 15-hydroxyblennin A and blennin A indicates the same, but still unknown configuration, for these two compounds. The configuration of lactarorufin N has been reported as shown in structure **5**, but it is different from that of blennin A [9].

EXPERIMENTAL

Material and isolation procedure. Frozen commercial *Lactarius torminosus* mushrooms (10 kg) collected in summer 1976

---

[*] Part 1 in the series "Sesquiterpenoids in Finnish *Lactarius* mushrooms".

Table 1. ^{1}H NMR data for 15-hydroxyblennin A and related lactaranolides

Protons at	C-4	C-7	C-8	C-12	C-13	C-14 or C-15	
15-Hydroxyblennin A (3)	6.73 (1H, *t*) $J_{3\text{-}4} = J_{4\text{-}7} = 3$ Hz	3.40 (1H, *m*)	3.62 (1H, *dd*) $J_1 = 8$ Hz, $J_2 = 4$ Hz	1.14 (3H, *d*) $J = 7$ Hz	4.18 (1H, *t*) $J_{13\text{-}13} = J_{13\text{-}7} = 9$ Hz 4.57 (1H, *t*) $J_{13\text{-}13} = J_{13\text{-}7} = 9$ Hz	3.44 (2H, *s*)	1.03 (3H, *s*)
Blennin A (4)*	6.67 (1H, *t*) $J_{3\text{-}4} = J_{4\text{-}7} = 2.5$ Hz	3.3 (1H, *m*)	3.66 (1H, *t*) $J_{7\text{-}8} = J_{8\text{-}9} = 9.5$ Hz	1.11 (3H, *d*) $J_{12\text{-}3} = 7$ Hz	4.11 (1H, *t*) $J_{13\text{-}13} = J_{13\text{-}7} = 9$ Hz 4.54 (1H, *t*) $J_{13\text{-}13} = J_{13\text{-}7} = 9$ Hz	1.00 (3H, *s*)	1.08 (3H, *s*)
Lactarorufin N (5)†	6.62 (1H, *dd*) $J_1 = 6$ Hz, $J_2 = 3$ Hz	3.62 (1H, *m*)	3.93 (1H, *dd*) $J_1 = 7$ Hz, $J_2 = 5$ Hz	1.14 (3H, *d*) $J = 6$ Hz	4.27 (2H, AB part of ABX system)	1.13 (3H, *s*)	1.02 (3H, *s*)
Deoxydihydroketolactarorufin N (6)†		3.70 (1H, *m*)		1.05 (3H, *d*) $J = 7$ Hz	4.15 (1H, *dd*) $J_1 = 10$ Hz, $J_2 = 7$ Hz β-H-13 4.65 (1H, *dd*) $J_1 = 10$ Hz, $J_2 = 3$ Hz α-H-13	1.22 (3H, *s*)	1.07 (3H, *s*)

* Assignments according to ref. [6].

† Assignments according to ref. [9].

Table 2. ^{13}C NMR data for 15-hydroxyblennin A* and blennin A

	C-1, C-10	C-2, C-9	C-3	C-4	C-5	C-6	C-7	C-8	C-11	C-12	C-13	C-14, C-15
15-Hydroxyblennin A (3)	41.6 (*t*) 40.4 (*t*)	51.9 (*d*) 44.8 (*d*)	34.5 (*d*)	145.5 (*d*)	171.7 (*s*)	128.5(*s*)	45.3 (*d*)	75.5 (*d*)	42.9 (*s*)	20.8 (*q*)	69.7 (*t*)	25.9 (*q*) 71.6 (*t*)
Blennin A (4)†	47.3 (*t*) 44.8 (*t*)	51.3 (*d*) 43.7 (*d*)	34.9 (*d*)	145.7 (*d*)	171.9 (*s*)	126.7 (*s*)	45.0 (*d*)	75.1 (*d*)	36.8 (*s*)	20.7 (*q*)	69.4 (*t*)	30.7 (*q*) 29.1 (*q*)

* Recorded with $(CD_3)_2CO$ as solvent. Chemical shifts in ppm (TMS). Signal multiplicity according to 'off resonance' experiments.

† Assignments according to ref. [6].

were delivered by Valio Ltd (Helsinki). A fraction (10 g) containing chiefly sesquiterpenoids was isolated from the EtOH extract of the frozen mushrooms mainly according to ref. [15]. CC with Si gel as adsorbent and mixtures of C_6H_6–Me_2CO as eluant yielded several sesquiterpenoids [23], including chromatographically (TLC) pure 15-hydroxyblennin A (30 mg), which crystallized from the eluant.

15-*Hydroxyblennin A*. Colourless crystals, mp 144°. IR ν_{max}^{KBr} cm^{-1}: 3350, 1750, 1675, 1650, 1470, 1430, 1370, 1340, 1325, 1220, 1180, 1120, 1025, 895, 833, 797, 765, 740. ^{1}H NMR ($(CD_3)_2CO$, TMS): see Table 1. ^{13}C NMR ($(CD_3)_2CO$, TMS): see Table 2. MS 70 eV, *m/e* (rel. int.): 43 (47), 55 (43), 67 (33), 69 (23), 77 (29), 79 (58), 81 (70), 91 (42), 93 (100), 94 (32), 95 (60), 97 (45), 105 (43), 107 (62), 108 (50), 109 (30), 119 (30), 121 (43), 122 (34), 125 (25), 126 (34), 133 (30), 145 (27), 163 (35), 175 (25), 217 (37), 248 (40), 266 M$^+$ (15). UV ν_{max}^{EtOH} nm: 222.

Acknowledgements—We thank Dr. Erkki Rahkamaa and Ms. Liisa Heino of the Department of Organic Chemistry, University of Helsinki, for recording the NMR spectra. For the MS we thank Dr. Heikki Pyysalo of the Food Research Laboratory, Technical Research Centre of Finland. We also thank Valio Ltd, Helsinki, for the generous gift of the mushrooms studied.

REFERENCES

1. Willstaedt, H. (1935) *Ber. Dtsch. Chem. Ges.* **68**, 333.
2. Heilbronner, E. and Schmid, R. W. (1954) *Helv. Chim. Acta* **37**, 2018.
3. Šorm, F., Benešova, V., Krupička, J., Šneberk, V., Dolejš, L., Herout, V. and Sicher, J. (1955) *Collect. Czech. Chem. Commun.* **20**, 227.
4. Bertelli, D. J. and Crabtree, J. H. (1968) *Tetrahedron* **24**, 2079.
5. Vokáč, K., Samek, Z., Herout, V. and Šorm, F. (1970) *Collect. Czech. Chem. Commun.* **35**, 1296.
6. Vidari, G., De Bernardi, M., Vita-Finzi, P. and Fronza, G. (1976) *Phytochemistry* **15**, 1953.
7. Magnusson, G., Thorén, S., Dahmén, J. and Leander, K. (1974) *Acta Chem. Scand. Ser. B* **28**, 841.
8. Daniewski, W. M., Kocór, M. and Król, J. (1975) *Bull. Acad. Pol. Sci., Ser. Sci. Chim.* **23**, 637.
9. Daniewski, W. M., Kocór, M. and Król, J. (1976) *Rocz. Chem. Ann. Soc. Chim. Pol.* **50**, 2095.
10. Magnusson, G., Thorén, S. and Wickberg, B. (1972) *Tetrahedron Letters* 1105.
11. Magnusson, G. and Thorén, S. (1973) *Acta Chem. Scand.* **27**, 1573.
12. Magnusson, G., Thorén, S. and Drakenberg, T. (1973) *Tetrahedron* **29**, 1621.
13. Magnusson, G. and Thorén, S. (1973) *Acta Chem. Scand.* **27**, 2396.
14. Magnusson, G. and Thorén, S. (1974) *Tetrahedron* **30**, 1431.
15. Daniewski, W. M. and Kocór, M. (1970) *Bull. Acad. Pol. Sci., Ser. Sci. Chim.* **18**, 585.
16. Daniewski, W. M. and Kocór, M. (1971) *Bull. Acad. Pol. Sci., Ser. Sci. Chim.* **19**, 553.
17. Daniewski, W. M., Kocór, M. and Zóltowska, B. (1973) *Bull. Acad. Pol. Sci., Ser. Sci. Chim.* **21**, 785.
18. Daniewski, W. M., Kocór, M. and Thorén, S. (1976) *He erocycles* **5**, 77.
19. Konitz, A., Bogucka-Ledóchowska, M., Dauter, Z., Hempel, A. and Borowski, E. (1977) *Tetrahedron Letters* 3401.
20. Vidari, G., Garlaschelli, L., De Bernardi, M., Fronza, G. and Vita-Finzi, P. (1975) *Tetrahedron Letters* 1773.
21. De Bernardi, M., Fronza, G., Vidari, G. and Vita-Finzi, P. (1976) *Chim. Ind.* (*Milan*) **58**, 177.
22. List, P. H. and Hackenberg, H. (1969) *Arch. Pharm.* **302**, 125.
23. Seppä, E.-L. and Widén, K.-G., unpublished results.