Tetrahedron Letters, Vol 32, No 6, pp 753-756, 1991
Printed in Great Britain

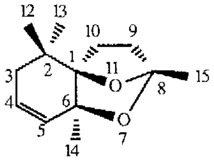
0040 4039/91 $3 00 +
Pergamon Press plc

STRUCTURE AND SYNTHESIS OF TWO NOVEL IONONE-TYPE COMPOUNDS IDENTIFIED IN QUINCE BRANDY (*CYDONIA OBLONGA* MIL.)

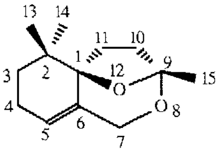
Regula Naf, Alain Velluz, René Decorzant and Ferdinand Naf
Firmenich SA, Research Laboratories, CH-1211 Geneva 8

Summary Two new ionone-type compounds (**1** and **2**) were isolated from quince brandy (*Cydonia oblonga* Mil) and their structures deduced from spectroscopic data and confirmed by synthesis ^{13}C-, ^{1}H-NMR and MS data as well as olfactive properties of **1** and **2** are given

In the analysis of the brandy of quince fruit [1] [2] (*Cydonia oblonga* Mil), the two novel acetals **1** [3] [4] and **2** [4] with an ionone skeleton were identified



1



2

The extract, prepared by continuous extraction of the diluted brandy with ether, was separated on silica gel (60, Merck, 0 040-0 063, 230-400 mesh) with pentane/ether = 9/1 The two new acetals were in a fraction with an R_f=0 17 (pentane/ether = 9/1) On GC (capillary column, Supelcowax, 60 m, 0 25 mm ID 80-220°C 5°/min 1 5 kg He) **1** eluted after 18'20" and **2** after 23'40" The ^{1}H-NMR spectrum (Bruker WH 360, $CDCl_3$, ppm, J in Hz) of compound **1** [5] showed four tertiary methyl groups (δ=0 97, 1 13, 1 37, 1 52), two of which seemed to be adjacent to oxygen, two olefinic protons of one double bond (δ=5 36, 5 53) attached to a quaternary centre on one side and a methylene group on the other side, (δ_A=1 74, δ_B=2 28) The number of hydrogen atoms and the mass spectral data (Finnigan 4021 C, 70 eV, m/e, % of base peak) suggested a $C_{13}H_{20}O_2$ compound (four parameters) The R_f was in accord with a diether or an acetal, and in the NMR no hydrogen atoms adjacent to oxygen were visible Thus the structure shown was in good agreement with spectral data and was confirmed by synthesis The relative stereochemistry shown with the oxygen atoms in *cis*-configuration was the more stable one and was corroborated by nOe (irrad H_3-C(14) $\rightarrow$ increases H'-C(9), H -C(10) and H_3-C(13), irrad H_3-C(13) $\rightarrow$ increases H'-C(10) and H_3-C(14))

The ^{1}H-NMR spectrum of **2** [6] revealed three methyl groups as singlets (δ=0 93, 1 01, 1 48), an AB system at δ_A=4 07 (J=13) and δ_B=4 45 (J=13 with fine splitting), suggesting a cyclic CH_2-group attached to oxygen, and a vinyl proton at δ=5 48 The number of hydrogen atoms together with the mass spectrum (m/e = 208) suggested a $C_{13}H_{20}O_2$ compound having four parameters The R_f on TLC was in agreement with the acetal structure The much larger synthetic sample also allowed measurement of a ^{13}C spectrum

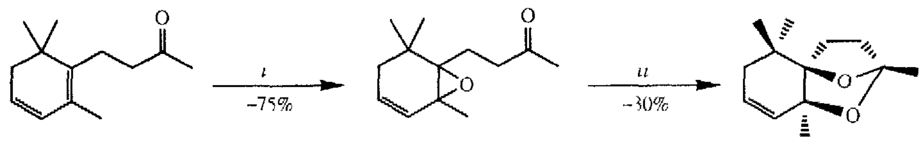
Acetal **1** was synthesized from the known ionone **3** [7] in two steps (*Scheme 1*) Peracetic acid epoxidation with a NaOAc buffer followed by careful neutral work-up allowed isolation of epoxyketone **4** [8] (75% yield) *Winterhalter* et al [3], under slightly different conditions, did not obtain this epoxide which is extremely acide-labile and is unstable even with silica gel at room temperature Dilute sulfuric acid in acetone transformed epoxide **4** directly into acetal **1** (30% yield, remainder polymers) [9][5]

Acetal **2** was prepared in three steps (*Scheme 2*) 2,6,6-Trimethyl-2-cyclohexenone (**5**) [10] was oxidized with SeO_2 to yield, in agreement with Sharpless' mechanism [11], acetoxyketone **6** as the main product which was isolated in pure form by column chromatography Reaction of **6** with an organolithium reagent (prepared from 2-(2-bromoethyl)-1,3-dioxalan **7** [13] by metal-halogen exchange with *tert* butyllithium, see also [14]) gave the key intermediate **8** [15] possessing the correct carbon skeleton with all oxygen functions at the right place It is not stable in the GC and was purified by column chromatography (49% yield) Mild acid treatment of **8** cleaved the ethylene glycol acetal and formed the internal acetal **2** which was isolated by bulb-to-bulb distillation at 100-110°/14 Torr (50% yield) [9][6]

The odour of our repetitively purified synthetic sample of **1** is rather weak, vaguely woody and camphoraceous, as opposed to Winterhalter's sample which he describes as "highly fruity with an ionone-like aroma" [3] Acetal **2** exhibits a camphoraceous, herbal, slightly floral note

Acknowledgement We wish to thank Mr W Thommen and Mr R Brauchli for the measurements of the NMR spectra, Dr P A Blanc, Firmenich SA, for the perfumistic evaluations, and Drs B Maurer and A F Thomas, Firmenich SA, for helpful discussions

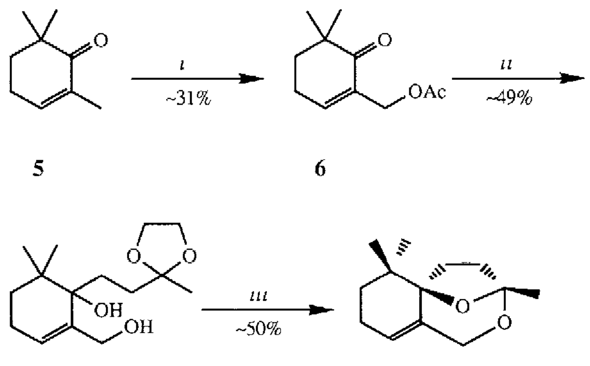
Scheme 1



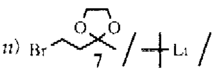
3 **4** **1**

Reagents *i*) 40% AcOOH in $AcOH/CH_2Cl_2/NaOAc$/20°/4h, *ii*) aq 1n H_2SO_4-acetone 1 1/2h RT

Scheme 2



5 **6** **8** **2**

Reagents i) SeO_2/AcOH-Ac_2O 3 1/7h reflux ii)  / THF-Et_2O-pentane 2 5 1 1/-95°/1h, then addition of **6** /-90°/1h→ RT, iii) aq 70% $HClO_4$-H_2O-THF 3 3 5/RT/3h

REFERENCES AND NOTES

[1] R Naf and A Velluz, J Ess Oil Res , submitted

[2] F Naf, R Naf and G Uhde in Flavour Science and Technology, Proceedings of the 6th Weurman Flavour Research Symp , Geneva, 2-4 May, 1990 Ed Y Bessière, A F Thomas, Wiley Chichester **1990**

[3] Compound **1** was independently found in Riesling wine by P Winterhalter, Institut fur Lebensmittel-Chemie, Universitat Wurzberg, Germany, P Winterhalter, M A Sefton and P J Williams, Chem Ind (London) **1990**, 463

[4] Chemical Abstract nomenclature 2,2,6,8-tetramethyl-7,11-dioxatricyclo[6 2 1 $0^{1\ 6}$]undec-4-ene (**1**)[3] and 2,2,9-trimethyl-8,12-dioxatricyclo[7 2 1 $0^{1\ 6}$]dodec-5-ene (**2**)

[5] Spectral data of **1** MS 208 (0 5, M^+), 193 (0 5), 180 (0 5), 175 (0 5), 165 (2), 148 (17), 138 (47), 125 (37), 123 (34), 119 (13), 109 (11), 95 (10), 43 (100) ^1H-NMR (360 MHz) 0 97 (s, 3H), 1 13 (s, 3H), 1 37 (s, 3H) 1 52 (s, 3H), 1 74 (dd, J_1=17 5, J_2=5 5, 1H), 1 76-2 00 (m, 4H), 2 28 (br ddd, J_1=17 5, J_2=3 0, J_3=2 1, 1H), 5 37 (dd, J_1=10 2, J_2=3 0, 1H), 5 54 (ddd, J_1=10 2, J_2=5 5, J_3=2 1, 1H) nOe, F_2 H_3-C(12) → H', H"-C(3), H"-C(10) and H_3-C(13), H_3-C(13) → H'-C(10), H"-C(3), H_3-C(12) and H_3-

C(14), H$_3$-C(14) $\rightarrow$ H-C(5), H'-C(9), H'-C(10) and H$_3$-C(13) ^{13}C-NMR (90 MHz) (of synth sample) 131 4 (d, C(5)), 123 7 (d, C(4)), 106 9 (s, C(8)), 91 7 (s, C(1)), 79 4 (s, C(6)), 37 9 (t, C(3)), 37 5 (t, C(9)), 33 3 (s, C(2)), 25 4 (q, C(12)), 24 3 (2q, C(13), C(14)), 24 1 (t, C(10)), 19 5 (q, C(15))

[6] Spectral data of **2**
MS 208 (5, M$^+$), 193 (3), 190 (1), 180 (3), 178 (12), 165 (8), 151 (5), 133 (17), 124 (12), 105 (21), 95 (29), 81 (15), 67 (18), 43 (100) ^{1}H-NMR (360 MHz) 0 93 (s, 3H), 1 01 (s, 3H), 1 36 (ddd, J$_1$=14, J$_2$=6, J$_3$=5, 1H), 1 48 (s, 3H), 1 62 (ddd, J$_1$=14, J$_2$=7, J$_3$=6, 1H), 1 73 (ddd, J$_1$=13, J$_2$=9, J$_3$=5, 1H), 1 91 (ddd, J$_1$=13, J$_2$=13, J$_3$=5, 1H), 2 03 (m, 1H), 2 10 (ddd, J$_1$=13, J$_2$=13, J$_3$=5, 1H), 2 21 (ddd, J$_1$=2, J$_2$=2, J$_3$=2, 1H), 4 07 (d, J=13, 1H), 4 45 (br d, J=13, 1H), 5 48 (br s, 1H) ^{13}C-NMR (90 MHz) of synth sample 135 3 (s, C(6)), 119 6 (d, C(5)), 106 (s, C(5)), 85 7 (s, C(1)), 65 6 (t, C(7)), 34 9 (t, C(10)), 34 7 (t, C(3)), 33 8 (s, C(2)), 29 6 (t, C(11)), 24 3 (q, C(15)), 23 7 (q, C(14)), 22 8 (q, C(13)), 21 9 (t, C(4))

[7] H R Wolf and M P Zink, Helv Chim Acta, **1973**, *56*, 1062

[8] Spectral data of **4**
MS 208 (1, M$^+$), 190 (4), 172 (9), 157 (13), 147 (10), 138 (16), 131 (32), 119 (24), 109 (30), 91 (24), 77 (18), 67 (13), 55 (15), 43 (100) ^{1}H-NMR (360 MHz) 0 93 (s, 3H), 1 09 (s, 3H), 1 35 (s, 3H), 1 59 (dd, J$_1$=7, J$_2$=17, 1H), 1 96 (ddd, J$_1$=7, J$_2$=9, J$_3$=15, 1H), 2 05-2 15 (m, 2H), 2 16 (s, 3H), 2 56 (dd, J$_1$=7, J$_2$=9, 2H), 5 68 (dd, J$_1$=10, J$_2$=3, 1H), 5 76 (ddd, J$_1$=2, J$_2$=7, J$_3$=10, 1H)

[9] The synthetic sample was identical with the natural product by retention time, ^{1}H-NMR and MS spectra

[10] M Baumann, W Hoffmann and A Nurrenbach, Liebigs Ann Chem **1979**, 1945

[11] K B Sharpless and R F Lauer, J Am Chem Soc **1972**, *94*, 7154, D Angoni, A Vasella, K B Sharpless and H P Jensen, *ibid* **1973**, *95*, 7919, L M Stephenson and R D Speth, J Org Chem **1979**, *44*, 4683, W -D Woggon, F Ruther and H Egli, Chem Commun **1980**, 706

[12] Spectral data of **6**
MS 196 (1, M$^+$), 153 (37), 140 (27), 121 (3), 112 (12), 98 (100), 93 (15), 84 (8), 70 (15), 53 (13), 43 (83) ^{1}H-NMR (360 MHz) 1 13 (25, 6H), 1 85 (t, J=6, 2H), 2 08 (s, 3H), 2 44 (dt with fs, J$_1$=6, J$_2$=4, 2H), 4 73 (s with fs, 2H), 6 89 (t, J=4, 1H)

[13] R P Hsung, Synth Commun **1990**, 1175, A A Ponaras, Tetrahedron Lett **1976**, 3105, C Feugeas, Bull Soc Chim Fr **1963**, 2568

[14] D Seebach and H Neumann, Chem Ber **1974**, *107*, 847, H Neumann and D Seebach, Tetrahedron Lett **1976**, 4839

[15] Spectral data of **8**
MS 252 (1, M$^+$), 235 (0 5), 214 (5), 190 (8), 175 (7), 157 (9), 147 (11), 131 (17), 119 (18), 105 (26) 87 (100), 67 (14), 55 (16), 43 (72) ^{1}H-NMR (360 MHz) 0 98 (2s, 6H), 1 31 (s, 3H), 1 39 (dd with fs, J$_1$=7, J$_2$=11, 1H), 1 64–2 19 (M, 7H), 3 96 (M, 5H), 4 36 (d, J=11, 1H), 5 71 (dd, J$_1$=3, J$_2$=3, 1H)

(Received in France 12 November 1990)