845. *Wessely–Moser Rearrangement of Chromonols and Flavonols.*

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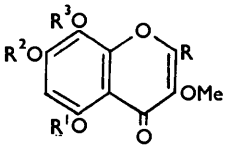
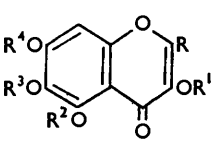
5 : 8-Dihydroxy-chromonols and -flavonols, on treatment with hydriodic acid under sufficiently drastic conditions, undergo the Wessely–Moser rearrangement to form the corresponding 5 : 6-dihydroxy-compounds.

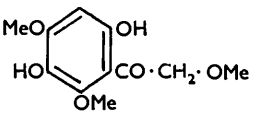
Chakravorty, Mukerjee, Murty, and Seshadri [1] concluded that derivatives of 5 : 8-dihydroxychromonols (*e.g.*, I; R = R^1 = R^2 = R^3 = Me) did not undergo the well-known Wessely–Moser rearrangement [2] to the corresponding 5 : 6-dihydroxychromonol (*e.g.*, II*a*) on treatment with hydriodic acid. 5 : 8-Dihydroxyflavonols were also believed not to



(I)



(II)



(III)

(II) (*a*) R = Me, R^1 = R^2 = R^3 = R^4 = H
(*b*) R = 3 : 4-$(HO)_2C_6H_3$, R^1 = R^2 = R^3 = R^4 = H.
(*c*) R = R^1 = R^4 = Me, R^2 = R^3 = Ac.
(*d*) R = R^2 = R^4 = Me, R^1 = R^3 = Ac.
(*e*) R = R^1 = R^4 = Me, R^2 = R^3 = H.
(*f*) R = R^2 = R^4 = Me, R^1 = R^3 = H.
(*g*) R = 3 : 4-$(MeO)_2C_6H_3$, R^1 = R^2 = R^4 = Me, R^3 = H.

undergo this transformation [3] although an observation by Briggs and Locker [4] indicated that the gossypetin ether, ternatin (I; R = 4-hydroxy-3-methoxyphenyl, R^1 = H, R^2 = R^3 = Me), on demethylation by hydriodic acid in phenol rearranged to give quercetagetin (II*b*). This result was unexpected as meliternin (I; R = 3 : 4-methylenedioxyphenyl, R^1 = R^2 = R^3 = Me) yielded gossypetin (5 : 7 : 8 : 3′ : 4′-pentahydroxyflavonol) under the same conditions.

It has now been found [5] that, on demethylation by hydriodic acid under pressure, both 5 : 7 : 8-trihydroxy-3-methoxy-2-methylchromone (I; R = Me, R^1 = R^2 = R^3 = H) and 5 : 7 : 8-trihydroxy-3 : 3′ : 4′-trimethoxyflavone (I; R = 3 : 4-dimethoxyphenyl, R^1 = R^2 = R^3 = H) give, respectively, 5 : 6 : 7-trihydroxy-2-methylchromonol (II*a*) and quercetagetin (II*b*).

The preparation of an authentic sample of 5 : 6 : 7-trihydroxy-2-methylchromonol (II*a*) involved, as a first stage, Kostanecki acylation of 3 : 6-dihydroxy-ω : 2 : 4-trimethoxyacetophenone (III). Analysis of the product indicated that one methoxyl group had been demethylated during the fusion.[2a] The formation of 5 : 6-diacetoxy-3 : 7-dimethoxy-2-methylchromone (II*c*) was shown by the following considerations. Whether dealkylation occurred before or after cyclic acylation, the methoxyl group in the 7-position is most likely to remain. This assumption leaves for discussion three possible structures (I; R = R^2 = Me, R^1 = R^3 = Ac), (II*c*), and (II*d*) for the diacetoxydimethoxymethylchromone formed. Examination of the deacylated chromone showed that it was not 5 : 8-dihydroxy-3 : 7-dimethoxy-2-methylchromone (I; R = R^2 = Me, R^1 = R^3 = H) already described by Chakravorty and his co-workers.[1] Of the remaining two possible dihydroxy-isomers, 5 : 6-dihydroxy-3 : 7-dimethoxy- (II*e*) and 3 : 6-dihydroxy-5 : 7-dimethoxy-2-methylchromone (II*f*), the former (a catechol derivative) was shown to be present by its retardation when run on borate-buffered paper. This test is diagnostic for *ortho*-hydroxyl groups.[6] The chromone did not fluoresce in ultraviolet light, thus confirming the absence of a 3-hydroxyl group.[7]

[1] Chakravorty, Mukerjee, Murty, and Seshadri, *Proc. Indian Acad. Sci.*, 1952, **35**, *A*, 37.
[2] (*a*) Wessely and Moser, *Monatsh.*, 1930, **56**, 97; (*b*) cf. Gallagher, Hughes, O'Donnell, Philbin, and Wheeler, *J.*, 1953, 3770.
[3] Seshadri, Varadarajan, and Venkateswarlu, *Proc. Indian Acad. Sci.*, 1950, **32**, *A*, 251.
[4] Briggs and Locker, *J.*, 1949, 2157.
[5] Cf. Donnelly, Philbin, and Wheeler, *Chem. and Ind.*, 1953, 567; 1954, 163.
[6] Wachtmeister, *Acta Chem. Scand.*, 1951, **5**, 976.
[7] Swain, *Chem. and Ind.*, 1954, 1480.

Experimental

Derivatives of 5 : 6 : 7-*Trihydroxy*-2-*methylchromonol* (IIa).—A mixture of 3 : 6-dihydroxy-ω : 2 : 4-trimethoxyacetophenone [8] (III) (0·5 g.), acetic anhydride (1·4 ml.), and anhydrous sodium acetate (0·8 g.) was heated at 170° for 4 hr. The product was triturated with water. The residual 5 : 6-*diacetoxy*-3 : 7-*dimethoxy*-2-*methylchromone* (IIc) formed pale yellow needles (0·1 g.) (from ligroin–ethanol), m. p. 141° (Found : C, 57·2, 56·8; H, 4·9, 4·9. $C_{16}H_{16}O_8$ requires C, 57·1; H, 4·8. Calc. for $C_{15}H_{16}O_7$: C, 58·4; H, 5·2%). This was deacylated by treatment on a steam-bath with ethanolic hydrochloric acid for 30 min. The resulting solution was diluted with water and 5 : 6-*dihydroxy*-3 : 7-*dimethoxy*-2-*methylchromone* (IIe) was collected in ether. It separated from ethanol in needles, m. p. 182° (Found : C, 57·6; H, 5·0; OMe, 23·8. $C_{12}H_{12}O_6$ requires C, 57·1; H, 4·8; 2OMe, 24·6%). The ethanolic ferric colour was green.

The diacetoxydimethoxymethylchromone (0·2 g.) was refluxed at 135—140° for 1½ hr. with hydriodic acid (*d* 1·7; 3 ml.) and acetic anhydride (0·5 ml.). The product was poured into aqueous sodium hydrogen sulphite, and the precipitate was crystallised from ethanol and acetylated (acetic anhydride–sodium acetate). 3 : 5 : 6 : 7-*Tetra-acetoxy*-2-*methylchromone* (II; $R^1 = R^2 = R^3 = R^4 = Ac$, R = Me) separated from ethyl acetate in needles, m. p. 168—169° (Found : C, 55·1; H, 4·0. $C_{18}H_{16}O_{10}$ requires C, 55·1; H, 4·1%). No rearrangement occurred during demethylation as the m. p. of the above acetate was depressed by the addition of 3 : 5 : 7 : 8-tetra-acetoxy-2-methylchromone (see next paragraph).

Derivatives of 5 : 7 : 8-*Trihydroxy*-2-*methylchromonol.* A mixture of 5 : 7 : 8-trihydroxy-3-methoxy-2-methylchromone [1] (I; R = Me, $R^1 = R^2 = R^3 = H$) (Found : C, 48·3; H, 5·2. Calc. for $C_{11}H_{10}O_6,2H_2O$: C, 48·2; H, 5·2%) (0·2 g.), aluminium chloride (2 g.), and sodium chloride (0·5 g.) was heated for 2 min. at 180° (method of Bruce, Sorrie, and Thomson [9]), and the product was decomposed by ice and hydrochloric acid. The chromonol separated from ethanol in aggregates (0·12 g.), m. p. 248° (decomp.) (Found : C, 53·9; H, 4·0. Calc. for $C_{10}H_8O_6$: C, 53·6; H, 3·6%). Chakravorty and his co-workers [1] state that 5 : 7 : 8-trihydroxy-2-methylchromonol becomes brown at 250° and decomposes at 270—273°. 3 : 5 : 7 : 8-*Tetra-acetoxy*-2-*methylchromone* was crystallised successively from ethyl acetate and ethanol. It formed pale yellow needles, m. p. 179—180° (Found : C, 54·9; H, 4·3. $C_{18}H_{16}O_{10}$ requires C, 55·1; H, 4·1%). The m. p. was depressed to 156—160° by addition of 3 : 5 : 6 : 7-tetra-acetoxy-2-methylchromone, m. p. 168—169° (see above).

The absence of rearrangement in the demethylation was confirmed by remethylation of the chromonol (methyl sulphate–acetone–potassium carbonate) which gave 3 : 5 : 7 : 8-tetramethoxy-2-methylchromone, m. p. and mixed m. p.,[1] 158—159°.

Rearrangement of 5 : 7 : 8-*Trihydroxy*-3-*methoxy*-2-*methylchromone*.—This chromone (0·2 g.) was heated with hydriodic acid (*d* 1·7; 5 ml.) and phenol (4·5 ml.) for 1 hr. at 170—180°. The product was treated with aqueous sodium hydrogen sulphite. The precipitate separated from ethanol in aggregates, m. p. *ca.* 300°. On acetylation (sodium acetate–acetic anhydride) it gave 3 : 5 : 6 : 7-tetra-acetoxy-2-methylchromone, m. p. and mixed m. p. 169°.

Rearrangement of Gossypetin.—(a) *Demethylation at ordinary pressure.* 5 : 7-Dihydroxy-3 : 3′ : 4′-trimethoxyflavone (from acetic acid) had m. p. 248—250° (Allan and Robinson [10] give m. p. 240—245°) (Found : C, 63·2; H, 4·7. Calc. for $C_{18}H_{16}O_7$: C, 62·8; H, 4·7%). Persulphate hydroxylation of this compound gave 5 : 7 : 8-trihydroxy-3 : 3′ : 4′-trimethoxyflavone (I; R = 3 : 4-dimethoxyphenyl, $R^1 = R^2 = R^3 = H$) [11] which (0·4 g.) was heated for 3 hr. at 150—160° with hydriodic acid (*d* 1·7; 15 ml.) and phenol (4·5 ml.) in an atmosphere of carbon dioxide. The product was poured into aqueous sodium hydrogen sulphite, and the resulting precipitate was crystallised from aqueous ethanol and acetylated (sodium acetate–acetic anhydride). The acetyl derivative [4] separated from ethanol and ethyl acetate in needles, m. p. 215—220°, depressed by addition of 3 : 5 : 6 : 7 : 3′ : 4′-hexa-acetoxyflavone [8] (hexa-*O*-acetylquercetagetin; m. p. 211—212°) but raised to 227—228° by addition of 3 : 5 : 7 : 8 : 3′ : 4′-hexa-acetoxyflavone [12] (hexa-*O*-acetylgossypetin; m. p. 228—230°) (Found : C, 57·0; H, 4·2. Calc. for $C_{27}H_{22}O_{14}$: C, 56·8; H, 3·9%). A solution of the hexa-acetoxyflavone in sulphuric acid exhibited a green fluorescence in ultraviolet light similar to that shown by hexa-*O*-acetylquercetagetin, indicating the presence of a trace of this compound. Hexa-*O*-acetylgossypetin does not fluoresce in sulphuric acid solution.

[8] Row and Seshadri, *Proc. Indian Acad. Sci.*, 1946, **23**, *A*, 23.
[9] Bruce, Sorrie, and Thomson, *J.*, 1953, 2403.
[10] Allan and Robinson, *J.*, 1926, 2336.
[11] Rao and Seshadri, *Proc. Indian Acad. Sci.*, 1947, **25**, *A*, 417.
[12] Baker, Nodzu, and Robinson, *J.*, 1929, 74.

In the synthesis of hexa-*O*-acetylquercetagetin, the intermediate compound 6-hydroxy-3 : 5 : 7 : 3′ : 4′-pentamethoxyflavone (II*g*) (Found : C, 61·8; H, 5·3. Calc. for $C_{20}H_{20}O_8$: C, 61·9; H, 5·2%) was found to have m. p. 245° (from ethanol) : Row and Seshadri [8] give m. p. 209—210°.

No rearrangement occurred when 5 : 7 : 8-trihydroxy-3 : 3′ : 4′-trimethoxyflavone (see above) was demethylated by aluminium chloride in benzene in the usual way. The product on acetylation (sodium acetate–acetic anhydride), and remethylation (methyl sulphate–acetone–potassium carbonate), gave hexa-*O*-acetyl- and hexa-*O*-methyl-gossypetin, respectively. The identity of each product was confirmed by mixed m. p. determinations.[11, 12]

(b) *Rearrangement experiments.* A mixture of 5 : 7 : 8-trihydroxy-3 : 3′ : 4′-trimethoxyflavone or of gossypetin (0·2 g.), hydriodic acid (*d* 1·7; 9 ml.), and phenol (4·5 ml.) was heated for 1½ hr. at 180—190°, and the product was mixed with aqueous sodium hydrogen sulphite. The precipitate separated from ethanol in yellow plates, m. p. 306—310°. The acetyl derivative crystallised from ethyl acetate in needles, m. p. 210°, not depressed by addition of hexa-*O*-acetylquercetagetin.

The compound, m. p. 306—310°, gave on remethylation (methyl sulphate–potassium carbonate–acetone) hexa-*O*-methylquercetagetin,[12, 13] m. p. and mixed m. p. 141° and 157° (dimorphic).

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[13] Perkin, *J.*, 1913, **103**, 209.