179. *The Chemistry of Subterranean Clover. Part II.* Synthesis and Reduction of* iso*Flavones related to Genistein and Formononetin.*

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Two new *iso*flavones, 2-ethyl-7 : 4′-dihydroxy*iso*flavone and 2-ethyl-5 : 7 : 4′-trihydroxy*iso*flavone, and some of their methyl and acyl derivatives are described. Some related *iso*flavanones, *iso*flavanols, and *iso*flavens have been obtained by reduction of the *iso*flavones. 7 : 4′-Dimethoxy-2-methyl*iso*flav-3-en and 4-ethyl-7 : 4′-dimethoxy*iso*flav-3-en are œstrogenic.

GENISTEIN (5 : 7 : 4′-trihydroxy*iso*flavone) is a pro-œstrogen, responsible for most of the œstrogenic activity of subterranean clover (Part I *), which also contains, *inter alia*, formononetin (7-hydroxy-4′-methoxy*iso*flavone). Some compounds related to these *iso*flavones have now been prepared for the study of their œstrogenic effects.

2-Ethyl-4′-methoxy-7-propionoxy- and 2-ethyl-4′-methoxy-5 : 7-dipropionoxy-*iso*flavone have been prepared by propionylation of the appropriate deoxybenzoin (cf. Baker and Robinson, *J.*, 1925, **127**, 1981). Treatment with hydriodic acid yields 2-ethyl-7 : 4′-dihydroxy- and 2-ethyl-5 : 7 : 4′-trihydroxy-*iso*flavone, while sodium carbonate affords 2-ethyl-5 : 7-dihydroxy-4′-methoxy*iso*flavone.

Compound	Light absorption				Oscillator strength[3] (f)	Œstrogenic activity, total dose per mouse (mg.)	
	mμ	$\varepsilon_{max.}$	mμ	$\varepsilon_{max.}$		Inactive at	Active at
iso*Flavones.*							
5 : 7 : 4′-Trihydroxy	—	—	262	42,700	0·91	—	1·0
5 : 7 : 4′-Trihydroxy-2-methyl	—	—	257·5	33,740	0·74	8·3	—
2-Ethyl-5 : 7 : 4′-trihydroxy	—	—	258	32,582	—	3·3	—
5 : 4′-Dihydroxy-7-methoxy	—	—	—	—	—	—	2·1
5-Hydroxy-7 : 4′-dimethoxy	—	—	—	—	—	5·0	—
7 : 4′-Dihydroxy	—	—	—	—	—	5·4	—
7-Hydroxy-4′-methoxy	300	11,240	250	27,440	—	—	—
7 : 4′-Dihydroxy-2-methyl	—	—	—	—	—	6·6	—
2-Ethyl-7 : 4′-dihydroxy	—	—	—	—	—	12·6	—
iso*Flavanones.*							
7 : 4′-Dimethoxy	312·5	8,090	275	16,450	—	—	—
7 : 4′-Dimethoxy-2-methyl	312·5	7,600	272·5	16,340	—	—	—
5 : 7 : 4′-Trimethoxy	283·5	20,580	—	—	—	—	—
iso*Flav-2-en.*							
5 : 7 : 3′ : 4′-Tetramethoxy[1]	285	13,520	225	26,880	—	5·6	—
iso*Flav-3-ens.*							
7 : 4′-Dimethoxy	335	23,900	250	14,660	0·43[4]	4·1	—
7 : 4′-Dimethoxy-2-methyl	330	22,820	246	14,430	0·44[4]	—	0·07
7 : 4′-Dimethoxy-4-methyl	316	17,470	—	—	0·29	—	0·35
4-Ethyl-7 : 4′-dimethoxy	315	15,660	—	—	0·25	—	0·07
Miscellaneous.							
7-Methoxy-3-*p*-methoxyphenylcoumarin[5]	348	23,660	245	14,070	—	1·8	—
7 : 4′-Dimethoxy*iso*flavan[2]	282	5,394	—	—	—	—	—
7-Acetoxy-4′-methoxy-2-methyl*iso*flavan-4-ol	275	4,200	—	—	—	3·1	—
5 : 7 : 4′-Trihydroxyflavone[1]	—	—	—	—	—	1·7	—

[1] Kindly supplied by Professor W. Baker, Bristol. [2] Wessely and Prillinger, *Ber.*, 1939, **72**, 629.
[3] Calc. on the assumption that the absorption band is symmetrical. Error probably at least 5%.
[4] Calc. for the long wave-length band. [5] This compound will be described in a later paper.

The *iso*flavones are hydrogenated to *iso*flavanones at a platinum catalyst in acetic acid (cf. Anderson and Marrian, *J. Biol. Chem.*, 1939, **127**, 649). Further reduction of 7 : 4′-dimethoxy*iso*flavanone gave a mixture of 7 : 4′-dimethoxy*iso*flav-3-en and 7 : 4′-di-

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* Part I, *J.*, 1951, 3447.

methoxy*iso*flavan. A similar reduction of 7 : 4′-dimethoxy-2-methyl*iso*flavone gave only a small amount of the *iso*flavanone, the main product being 7 : 4′-dimethoxy-2-methyl*iso*flav-3-ene, also obtained by reduction of the *iso*flavone with excess of lithium aluminium hydride. 7 : 4′-Diacetoxy- and 7-acetoxy-4′-methoxy-2-methyl*iso*flavone yielded *iso*flavanones, accompanied by small amounts of the corresponding *iso*flavan-4-ols, while 5 : 7 : 4′-trimethoxy*iso*flavone gave a good yield of *iso*flavanone. Reduction of genistein gave an inseparable mixture.

That the double bond of the flavones is first attacked on hydrogenation is shown by the presence of a carbonyl group in the products (infra-red spectra of 7 : 4′-dimethoxy- and 7 : 4′-dimethoxy-2-methyl-*iso*flavanone, and the formation of a 2 : 4-dinitrophenylhydrazone from 5 : 7 : 4′-trimethoxy*iso*flavanone).

The assignment of the double bond to the 3-position in the *iso*flavens is based on the formation of 7 : 4′-dimethoxy*iso*flavene by hydrogenation of the corresponding *iso*flavanone, the intermediate *iso*flavanol apparently suffering dehydration in acetic acid. The presence of the double bond in the 3-position, rather than the 2-position, is supported by the fact that introduction of an alkyl group in the 2-position, as in 7 : 4′-dimethoxy-2-methyl*iso*flaven has a comparatively small effect on the two main ultra-violet absorption bands (Table and Fig. 3) in contrast to the large effect of a 2-alkyl group (situated on a doubly-bonded carbon) in the *iso*flavones (Table and Fig. 1); similarly the effect of a 2-alkyl substituent in the *iso*flavanones is small (Table and Fig. 2). Also a substituent in the 4-position in the *iso*flavenes (7 : 4′-dimethoxy-4-methyl- and 4-ethyl-7 : 4′-dimethoxy-*iso*flav-3-en) has a hypsochromic effect similar to that of 2-substituents in the *iso*flavones, and, in addition, there is a strong resemblance between the spectra of the *iso*flav-3-ens and 7-methoxy-3-*p*-methoxyphenylcoumarin. Furthermore, 5 : 7 : 3′ : 4′-tetramethoxy-*iso*flav-2-en (Baker, *J.*, 1929, 1593) has a quite different ultra-violet spectrum (Table and Fig. 3), confirming the structure assigned to it by Freudenberg, Carrara, and Cohn (*Annalen*, 1926, **446**, 87).

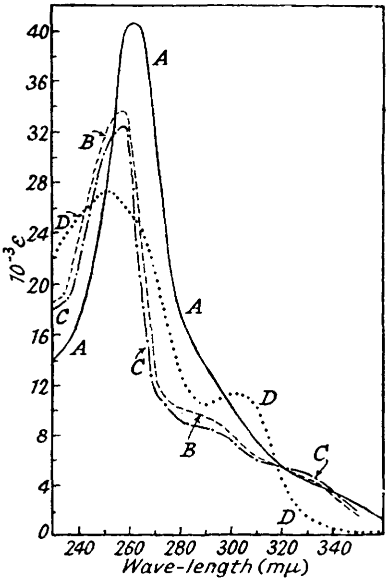
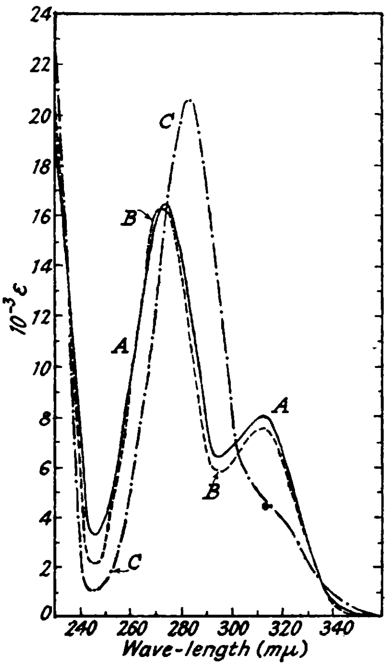


FIG. 1.

A, 5 : 7 : *4′-Trihydroxy*iso*flavone.*
B, 5 : 7 : *4′-Trihydroxy-2-methyl*iso*flavone.*
C, *2-Ethyl-*5 : 7 : *4′-trihydroxy*iso*flavone.*
D, *7-Hydroxy-4′-methoxy*iso*flavone.*

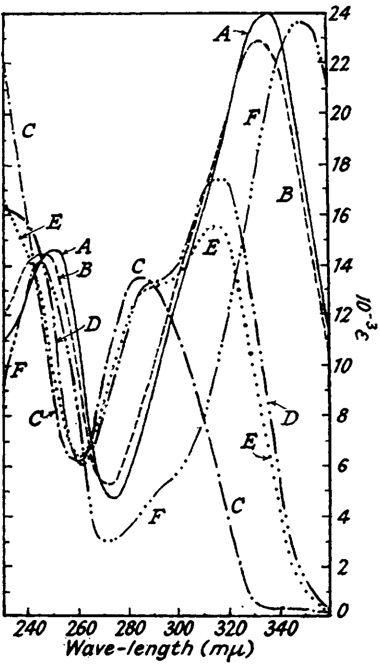
Preliminary tests of the œstrogenic activity of a number of the compounds prepared have been carried out by measuring increases in the uterine weight of mice (cf. Robinson, *Austral. J. Exp. Biol. Med. Sci.*, 1949, **27** 297) and by the vaginal cornification method (Table). The œstrogenic activity of the *iso*flavones is not analogous to that of the stilbœstrol series. A 5-hydroxyl group (chelated with the carbonyl group) appears to be essential for activity while 2-alkyl substituents greatly reduce the activity, probably owing to distortion of the planar ring system of genistein, which is indicated by models and the effects of these substituents on the ultra-violet absorption spectra of the *iso*flavones (Table and Fig. 1). Such effects are generally attributed to " steric inhibition of resonance " (cf. Henbest and Woods, *J.*, 1952, 1150) in non-planar compounds. The observed reduction in oscillator strength (cf. Table) caused by a 2-methyl group is comparable with that observed by Beale and Roe (*J. Amer. Chem. Soc.*, 1952, **74**, 2302) for the presence of two hindering methyl groups in 4-dimethylaminostilbene.

FIG. 2.



A, 7 : 4′-*Dimethoxy*iso*flavanone*.
B, 7 : 4′-*Dimethoxy*-2-*methyl*iso*flavanone*.
C, 5 : 7 : 4′-*Trimethoxy*iso*flavanone*.

FIG. 3.



A, 7 : 4′-*Dimethoxy*iso*flav*-3-*en*.
B, 7 : 4′-*Dimethoxy*-2-*methyl*iso*flav*-3-*en*.
C, 5 : 7 : 3′ : 4′-*Tetramethoxy*iso*flav*-2-*en*.
D, 7 : 4′-*Dimethoxy*-4-*methyl*iso*flav*-3-*en*.
E, 4-*Ethyl*-7 : 4′-*dimethoxy*iso*flav*-3-*en*.
F, 7-*Methoxy*-3-p-*methoxyphenylcoumarin*.

In contrast, the *iso*flav-3-ens are œstrogenic only when they have a 2- or 4-substituent and are then much more active than genistein. Furthermore the active compounds have no 5-hydroxyl group and appear to be strictly analogous to compounds of the stilbœstrol series in their œstrogenic activity.

EXPERIMENTAL

M. p.s are corrected. Analyses are by the C.S.I.R.O. Organic Microanalytical Laboratory, Melbourne, and Drs. Weiler and Strauss, Oxford. The ultra-violet absorption spectra were determined in ethanol with a Beckman Model D.U. spectrophotometer.

7 : 4′-*Dihydroxy*-2-*methyl*iso*flavone*.—7-Acetoxy-4′-methoxy-2-methyl*iso*flavone (Baker, Robinson, and Simpson, *J.*, 1933, 274; Wessely and Lechner, *Sitzungsber. Akad. Wiss. Wien*, 1930, **139**, II*b*, 1061) had m. p. 197°. Hydrolysis gave 7-hydroxy-4′-methoxy-2-methyl*iso*flavone, m. p. 286—287°, and demethylation 7 : 4′-dihydroxy-2-methyl*iso*flavone, m. p. 322—323°. Treatment of the latter compound with excess of diazomethane gave the dimethyl ether, m. p. 170—171°. The above authors gave somewhat lower m. p.s for these compounds.

7 : 4′-Dihydroxy-2-methyl*iso*flavone (0·89 g.), when refluxed with acetic anhydride (20 ml.) for 2 hours, gave the 7 : 4′-*diacetate*, needles, m. p. 193—194° (1·0 g.) (from alcohol) (Found : C, 68·1; H, 4·7. $C_{20}H_{16}O_6$ requires C, 68·2; H, 4·6%).

7-*Acetoxy*-4′-*methoxy*-2-*methyl*iso*flavanone*.—7-Acetoxy-4′-methoxy-2-methyl*iso*flavone (0·78 g.), platinum oxide (0·117 g.), and glacial acetic acid (50 ml.) were shaken under hydrogen at 1 atm. for 0·5 hour, 1 mol. being absorbed. After removal of catalyst and acetic acid (*in vacuo*), *7-acetoxy-4′-methoxy-2-methyl*iso*flavanone* was obtained as needles, m. p. 176—178° (0·21 g.) (from alcohol) (Found : C, 70·15; H, 5·4. $C_{19}H_{18}O_5$ requires C, 69·9; H, 5·6%).

*7-Acetoxy-4′-methoxy-2-methyl*iso*flavan-4-ol.*—7-Acetoxy-4′-methoxy-2-methyl*iso*flavone (1·62 g.), platinum oxide (0·36 g.) and glacial acetic acid (100 ml.) on full hydrogenation gave, as above, solvated *7-acetoxy-4′-methoxy-2-methyl*iso*flavan-4-ol*, needles (0·76 g.), m. p. 88—89° (from alcohol). This lost alcohol of crystallisation *in vacuo* at 88° and then melted at 112—113° (Found, on compound, m. p. 88—89° : loss, 12·35, 12·2. $C_{19}H_{20}O_5,C_2H_5{\cdot}OH$ requires 12·3. Found : on compound, m. p. 112—113° : C, 69·4, 69·6; H, 5·9, 5·8; Ac, 12·4. $C_{19}H_{20}O_5$ requires C, 69·5; H, 6·1; Ac, 13·1%).

*7 : 4′-Diacetoxy-2-methyl*iso*flavanone.*—7 : 4′-Diacetoxy-2-methyl*iso*flavone (1·0 g.), platinum oxide (0·20 g.) and glacial acetic acid (60 ml.) were shaken with hydrogen as before, and *7 : 4′-diacetoxy-2-methyl*iso*flavanone* (0·33 g.) was obtained having m. p. 157—158° (from alcohol) (Found : C, 67·95; H, 5·1; Ac, 23·9. $C_{20}H_{18}O_6$ requires C, 67·8; H, 5·1; Ac, 24·3%).

This (0·15 g.), alcohol (10 ml.), and sulphuric acid (2 ml.) were refluxed for 2 hours, affording *7 : 4′-dihydroxy-2-methyl*iso*flavanone*, needles (18·3 mg.), m. p. 266° (from aqueous alcohol) (Found : C, 70·7; H, 5·3. $C_{16}H_{14}O_4$ requires C, 71·1; H, 5·2%).

*7 : 4′-Diacetoxy-2-methyl*iso*flavan-4-ol.*—7 : 4′-Diacetoxy-2-methyl*iso*flavone (1·37 g.), under the above conditions, eventually absorbed slightly more than two mols. of hydrogen After filtration and removal of acetic acid *in vacuo*, the residue crystallised from alcohol, giving the *iso*flavanone (0·22 g.). The mother-liquors were evaporated, and the residue dissolved and chromatographed in benzene on alumina (40 g.). The benzene eluate (0·23 g.) and the 1 : 9 ether–benzene eluate (0·25 g.) were viscous liquids, but the 1 : 4 ether–benzene eluate (0·16 g.), on addition of light petroleum and a few drops of alcohol, yielded prisms of *7 : 4′-diacetoxy-2-methyl*iso*flavan-4-ol*, m. p. 139° (Found: C, 67·4; H, 5·8. $C_{20}H_{20}O_6$ requires C, 67·4; H, 5·7%).

*7 : 4′-Dimethoxy-2-methyl*iso*flavanone.*—7 : 4′-Dimethoxy-2-methyl*iso*flavone (1·71 g.), platinum oxide (0·48 g.), and glacial acetic acid (100 ml.) were shaken with hydrogen until the uptake of hydrogen was very slow, then set aside under hydrogen overnight. On working up in the usual way and crystallisation from alcohol yellowish granules, m. p. 126—127° (0·44 g.), separated. A second crop (0·18 g.), m. p. 110—150°, separated from the mother-liquors and on repeated crystallisation from acetone gave *7 : 4′-dimethoxy-2-methyl*iso*flavanone*, needles, m. p. 158° (36·2 mg.) (Found : C, 72·6, 72·7; H, 5·8, 6·1; OMe, 21·2. $C_{18}H_{18}O_4$ requires C, 72·5; H, 6·1; OMe, 20·8%). A further quantity (m. p. 151—156°) of this compound was obtained from the mother-liquors. It showed strong absorption in the infra-red at 1680 cm.$^{-1}$ as expected from a carbonyl group conjugated with the benzene nucleus.

*7 : 4′-Dimethoxy-2-methyl*iso*flav-3-en.*—(*a*) The compound, m. p. 126—127°, obtained in the last experiment, after one crystallisation from alcohol and one from benzene–light petroleum gave *7 : 4′-dimethoxy-2-methyl*iso*flav-3-en*, prisms, m. p. 128° [Found : C, 76·65; H, 6·4; OMe, 23·0%; *M* (Rast), 259, 261. $C_{18}H_{18}O_3$ requires C, 76·6; H, 6·4; OMe, 22·0%; *M*, 282·3].

(*b*) 7 : 4′-Dimethoxy-2-methyl*iso*flavone (1 g.) in benzene (30 ml.) was added dropwise to refluxing ether (30 ml.) containing lithium aluminium hydride (1 g.), and the solution refluxed for 3 hours. It was then filtered and cooled, and cold dilute sulphuric acid (50 ml.) added cautiously. The benzene–ether layer was washed with water and dried ($CaCl_2$). The semi-solid mass (0·925 g.) obtained on evaporation formed pale yellow prisms, m. p. 127° (0·152 g.), from alcohol. Sublimation at 130—140°/4 mm. gave a colourless product, m. p. 128°, undepressed by the sample obtained by procedure (*a*).

*2-Ethyl-4′-methoxy-7-propionoxy*iso*flavone.*—2 : 4-Dihydroxyphenyl *p*-methoxybenzyl ketone (2 g.), sodium propionate (2 g.), and propionic anhydride (15 ml.) were refluxed for 16 hours, poured into water, filtered, and washed with water. *2-Ethyl-4′-methoxy-7-propionoxy*iso*flavone* formed prisms, m. p. 122° (1·58 g.), from alcohol (Found : C, 71·6; H, 5·5; OMe, 9·4. $C_{21}H_{20}O_5$ requires C, 71·6; H, 5·7; OMe, 8·8%).

*2-Ethyl-7 : 4′-dihydroxy*iso*flavone.*—2-Ethyl-4′-methoxy-7-propionoxy*iso*flavone (1·35 g.) was refluxed with hydriodic acid (23 ml.) for 3 hours, yielding *2-ethyl-7 : 4′-dihydroxy*iso*flavone* as rhombic prisms, m. p. 278—279°, from alcohol (Found : C, 72·8; H, 5·0. $C_{17}H_{14}O_4$ requires C, 72·3; H, 5·0%).

*2-Ethyl-4′-methoxy-5 : 7-dipropionoxy*iso*flavone.*—*p*-Methoxybenzyl 2 : 4 : 6-trihydroxyphenyl ketone (Baker and Robinson, *J.*, 1926, 2717) (2 g.), sodium propionate (2·5 g.), and propionic anhydride (15 ml.) were heated at 180—185° for 17 hours. They afforded *2-ethyl-4′-methoxy-*

5 : 7-*dipropionoxy*iso*flavone*, prisms, m. p. 150° (1·52 g.) (from alcohol) (Found : C, 68·4; H, 5·9. $C_{24}H_{24}O_7$ requires C, 67·9; H, 5·7%).

2-*Ethyl*-5 : 7-*dihydroxy*-4′-*methoxy*iso*flavone*.—The dipropionoxy-compound (0·5 g.) was refluxed with 0·5N-sodium carbonate (120 ml.) for 3 hours; almost all dissolved. The solution was filtered and acidified, and the solid (0·3 g.) collected. 2-*Ethyl*-5 : 7-*dihydroxy*-4′-*methoxy*iso*flavone* formed needles, m. p. 228—229°, from 50% methanol (Found : C, 69·25; H, 5·1. $C_{18}H_{16}O_5$ requires C, 69·2; H, 5·2%).

2-*Ethyl*-5 : 7 : 4′-*trihydroxy*iso*flavone*.—The dipropionoxy-compound (0·55 g.) and hydriodic acid (10 ml.) were heated at 150° for 2½ hours and poured into water. 2-*Ethyl*-5 : 7 : 4′-*trihydroxy*iso*flavone* (0·38 g.) formed rhombs, m. p. 244—245°, from 30% alcohol (Found : C, 68·8; H, 4·7. $C_{17}H_{14}O_5$ requires C, 68·4; H, 4·7%). This compound, similarly obtained from 2-ethyl-5 : 7-dihydroxy-4′-methoxy*iso*flavone, had m. p. 244—245°, undepressed on admixture with the sample described above.

7 : 4′-*Dimethoxy*iso*flavanone*.—This compound, prepared by Anderson and Marrian's method (*loc. cit.*), formed prisms, m. p. 125—126° from alcohol (Found : C, 71·9; H, 5·5. Calc. for $C_{17}H_{16}O_4$: C, 71·8; H, 5·7%). The presence of a carbonyl group was confirmed by the infra-red absorption spectrum, which showed a strong band at 1678 cm.$^{-1}$ in chloroform solution.

7 : 4′-*Dimethoxy*-4-*methyl*iso*flav*-3-*en*.—7 : 4′-Dimethoxy*iso*flavanone (1·0 g.) in dry benzene (50 ml.) was added to a solution of methylmagnesium iodide [from magnesium (0·17 g.) and methyl iodide (1·6 g.) in ether (20 ml.)], the ether distilled off, and the mixture refluxed for 4 hours. After decomposition with 10% hydrochloric acid, the benzene layer was washed with water, dried ($CaCl_2$) and evaporated. The residue (1·007 g.) solidified and formed needles of the *flaven*, m. p. 124—125°, when crystallised from alcohol and then from acetone (Found : C, 76·7; H, 6·3; OMe, 20·4. $C_{18}H_{18}O_3$ requires C, 76·7; H, 6·4; OMe, 22·0%).

4-*Ethyl*-7 : 4′-*dimethoxy*iso*flav*-3-*en*.—7 : 4′-Dimethoxy*iso*flavanone (0·84 g.) in dry benzene (30 ml.) was added dropwise to ethereal ethylmagnesium iodide (10 ml.) [from magnesium (0·23 g.) and ethyl iodide (1·8 g.)]. The mixture was distilled to remove most of the ether and then refluxed for 16 hours. On cooling, 10% hydrochloric acid (100 ml.) was added, and the benzene layer separated, washed with water, twice with 10% aqueous sodium hydroxide, again with water, and dried ($CaCl_2$), and evaporated. The pale yellow oil (0·8 g.) distilled at 194°/2 mm. and afforded needles of 4-*ethyl*-7 : 4′-*dimethoxy*iso*flav*-3-*en*, m. p. 81—82°, from alcohol (Found : C, 77·1; H, 6·7. $C_{19}H_{20}O_3$ requires C, 77·0; H, 6·8%).

7 : 4′-*Dimethoxy*iso*flav*-3-*en*.—7 : 4′-Dimethoxy*iso*flavanone (1·23 g.), platinum oxide (0·098 g.), and glacial acetic acid (100 ml.) were shaken with hydrogen for 17 minutes, 1·25 mols. of hydrogen being absorbed. The product, separated in the usual way, formed flakes of 7 : 4′-*dimethoxy*iso*flav*-3-*en*, m. p. 155—156°, from benzene. Another crystallisation from benzene–alcohol raised the m. p. to 160—161° (50·6 mg.) (Found : C, 76·1; H, 6·1; OMe, 22·4. $C_{17}H_{16}O_3$ requires C, 76·1; H, 6·0; OMe, 23·1%). The mother-liquors deposited a further quantity of the *iso*flaven and also a compound, m. p. 115—116°.

7 : 4′-*Dimethoxy*iso*flavan*.—The combined mother-liquors from the last experiment were evaporated to dryness and the residue (1·04 g.) was dissolved in glacial acetic acid (60 ml.); platinum oxide (0·2 g.) was added and the mixture shaken in hydrogen until no more was absorbed. The product, separated in the usual way, formed plates, m. p. 90—104° (0·2 g.), from alcohol. Two more crystallisations from alcohol gave pure 7 : 4′-dimethoxy*iso*flavan, m. p. 106—107°. Repeated crystallisation from alcohol of the solid from the above mother-liquors gave needles, m. p. 112—113°, which when mixed with the plates previously obtained melted at 108—110°. The compound appears to be dimorphous (Found : C, 75·6; H, 6·7; OMe, 22·6. Calc. for $C_{17}H_{18}O_3$: C, 75·5; H, 6·7; OMe, 23·0%). Anderson and Marrian (*loc. cit.*) describe it as white crystals, m. p. 112·5—114°.

5 : 4′-*Dihydroxy*-7-*methoxy*iso*flavone*.—5 : 7 : 4′-Trimethoxy*iso*flavone (4·15 g.), hydriodic acid (35 ml.), and acetic acid (10 ml.) were refluxed for 4 hours. They gave needles, m. p. 236—237°. After three more crystallisations from alcohol the m. p. was raised to 241—242° (Found : C, 67·5; H, 4·5; OMe, 10·5. Calc. for $C_{16}H_{12}O_5$: C, 67·6; H, 4·3; OMe, 10·9%). Finnemore (*Pharm. J.*, 1910, IV, **31**, 604) gives the m. p. of prunetin as 242°.

5 : 7 : 4′-*Trimethoxy*iso*flavanone*.—5 : 7 : 4′-Trimethoxy*iso*flavone (3·12 g.), platinum oxide (0·097 g.), and glacial acetic acid (70 ml.) were shaken with hydrogen for 5 minutes, 1 mol. of hydrogen being absorbed. The product isolated as before formed needles of 5 : 7 : 4′-*trimethoxy*iso*flavanone*, m. p. 153° (2·2 g.) (from alcohol). Further crystallisation from alcohol and benzene raised the m. p. to 156—157°, depressed on admixture with 5 : 7 : 4′-trimethoxy*iso*flavone (Found : C, 68·9; H, 5·8; OMe, 29·5. Calc. for $C_{18}H_{18}O_5$: C, 68·8; H, 5·8; OMe, 29·6%).

Narasimhachari and Seshadri (*Proc. Indian Acad. Sci.*, 1952, *A*, **35**, 202) record m. p. 146—147° for this compound (padmakastein dimethyl ether). The 2 : 4-*dinitrophenylhydrazone* formed red flakes, m. p. 227°, from acetic acid (Found: C, 58·25; H, 4·4; N, 11·1. $C_{24}H_{22}O_8N_4$ requires C, 58·3; H, 4·5; N, 11·3%).

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