341. *Experiments on Vitexin.*

By Ervin Péteri.

Triacetylapigenin has been obtained from a mixture of vitexin and zinc dust by sublimation in a high vacuum and subsequent acetylation. No new degradation products were obtained by oxidation of vitexin.

Vitexin, isolated from the New Zealand dye-wood *Vitex littoralis* by Perkin (J., 1898, **73**, 1019) and from *Saponaria officinalis* by Barger (J., 1906, **89**, 1210), has been investigated by the former (*loc. cit.*; J., 1900, **77**, 416), who assigned to it the formula $C_{15}H_{14}O_7$ or $C_{17}H_{16}O_8$.

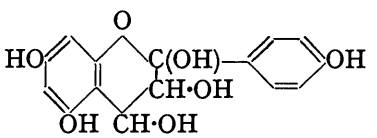
Attempts that have now been made to convert vitexin directly into apigenin ($C_{15}H_{10}O_5$) by the action of dehydrating agents (phosphoric oxide, potassium hydrogen sulphate, a mixture of sulphuric and acetic acids, formic acid) have not been successful. Sublimation with zinc dust in a high vacuum, however, yielded in minute quantity a *polyphenol*, $C_{15}H_{12}O_6$, which on acetylation gave a triacetyl compound the melting point, 180°, of which was not depressed by triacetylapigenin (m. p. 181—182°).

From vitexin, a tetranitro-compound was prepared by Perkin's method, but with dioxan as solvent; a much purer product, $C_{15}H_6O_5(NO_2)_4$, was thus obtained, which did not depress the melting point of tetranitroapigenin, thereby proving the identity of the two substances surmised by Perkin.

Attempts were made to oxidise the aliphatic hydroxyls of vitexin so as to give ketones or aldehydes or to obtain a degradation product containing all three of the aliphatic carbon atoms. Oxidation with Fehling's reagent yielded phloroglucinol, *p*-hydroxyacetophenone, and an amorphous acid; potassium ferricyanide gave *p*-hydroxybenzoic acid; hydrogen peroxide yielded *p*-hydroxybenzoic acid and a minute amount of quinol. A large quantity of ammoniacal silver nitrate was reduced by vitexin; the oxidation product could not be isolated. Vitexin did not react with lead tetra-acetate in acetic acid, owing possibly to the insolubility of vitexin in that solvent.

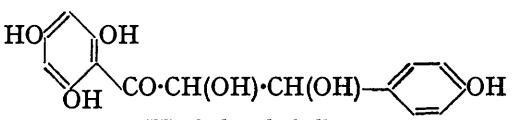
Vitexin did not yield crystalline compounds with the usual methylating agents (cf. Barger, *loc. cit.*).

The formulæ (I) and (II) suggested for vitexin by Barger account for the formation of



(I) Reduced flavanone.

or



(II) Reduced chalkone.

p-hydroxyacetophenone and of triacetyl- and tetranitro-apigenin. Both formulæ have six hydroxyls, although acetyl determinations by Barger and by Perkin indicated only five acetyl groups. Steric hindrance at the tertiary hydroxyl group of the reduced flavanone derivative may be responsible for this; however, no flavanone derivative of this type is known.

Experimental.

Preparation of Vitexin.—The dark sticky residue (200 g.) obtained from an alcoholic extract of the wood of *Vitex littoralis* was digested thrice with small amounts of water, leaving 22·5 g. undissolved. After addition of more water and decantation from the tarry precipitate thus produced, the aqueous solution was evaporated to dryness in a vacuum, leaving a golden-yellow amorphous residue (96 g.). This substance, a mixture of glucosides, was hydrolysed by Perkin's method (*loc. cit.*, p. 1020), 96 g. being heated for 2 hours with stirring with 900 c.c. of 2% hydrochloric acid. On the following day the acid liquid was decanted, and the tarry residue washed several times with boiling alcohol. The microcrystalline mass thus obtained, m. p. 246°, was recrystallised from 40% pyridine, vitexin separating in pale yellow plates with a greenish tint; after being washed with hot glacial acetic acid and then with hot

methyl alcohol, these had m. p. 263°, not raised by two further crystallisations (Found : loss at 100° in a high vacuum, 1·3; C, 58·5; H, 4·8. Calc. for $C_{15}H_{14}O_7$: C, 58·5; H, 4·6%).

Acetylvitexin.—Vitexin (0·17 g.) was heated for 6 hours with acetic anhydride (1·7 g.) and, after cooling, absolute alcohol was added. Acetylvitexin crystallised overnight in large, white, stout prisms. A sample recrystallised twice from hot glacial acetic acid to which alcohol was added, twice from glacial acetic acid, and finally from dioxan to which a few drops of light petroleum (b. p. 60—80°) were added, had m. p. 251—256° [Found : C, 57·9, 57·7; H, 4·8, 4·9. Calc. for $C_{15}H_9O_7(CO\cdot CH_3)_5$: C, 58·1; H, 4·65%].

Oxidation with Hydrogen Peroxide.—To a solution of vitexin (1 g.) in approx. 2N-sodium hydroxide (4 c.c.), 30% hydrogen peroxide (6 c.c.) and water (3 c.c.) were added, followed next day by platinum oxide to decompose the excess of peroxide. Acidification of the solution gave a crystalline precipitate, m. p. 246°, not depressed by vitexin. An ethereal extract of the mother-liquor was shaken with sodium hydrogen carbonate solution, which removed *p*-hydroxybenzoic acid, m. p. 210°, and then with sodium carbonate solution. The latter solution was acidified and extracted with ether. Evaporation of the dried extract left a brownish residue, which was extracted with boiling benzene. On cooling, a crystalline compound was obtained (40 mg. from 5 g. of vitexin). The yield depended greatly on the concentration of the alkali; if 5 c.c. of 2N-sodium hydroxide were taken in place of 4 c.c., none of this oxidation product was obtained. The m. p. was 168° and was raised by sublimation to 173°, not depressed by quinol. 20 Mg. were heated with 1 c.c. of acetic anhydride and a trace of pyridine; after precipitation with water and crystallisation from alcohol the acetylated product had m. p. 123°, not depressed by acetylquinol.

Oxidation with Fehling's Solution.—Vitexin (0·5 g.) was refluxed with Fehling's solution (50 c.c.) for 45 minutes. After cooling, the solution was filtered through asbestos and acidified with hydrochloric acid. The crystalline product, recrystallised from water, proved to be potassium hydrogen tartrate derived from the reagent. The mother-liquor was extracted with ether, the extract shaken with aqueous sodium hydrogen carbonate, and this solution acidified and extracted with ether. A red amorphous compound was obtained, which did not sublime, was very soluble in alcohol, and resisted attempts to crystallise it. A small portion of the ethereal extract left after the shaking with sodium hydrogen carbonate was extracted with sodium hydroxide solution; nothing was left in the ether, from which it appeared that all the compound present must have been phenolic. This being the case, the main portion was dried over sodium sulphate, and the ether evaporated. On extraction of the residue with benzene a separation into two parts was effected. One substance, m. p. 209°, was but slightly soluble in benzene, gave a blue-violet coloration with ferric chloride, reddened pine-wood dipped in concentrated hydrochloric acid, and did not depress the m. p. of phloroglucinol. Concentration of the benzene solution gave the second substance, m. p. 106°, obviously identical with *p*-hydroxyacetophenone (previously isolated from vitexin by hydrolysis with 50% potassium hydroxide solution).

Oxidation with Potassium Ferricyanide.—Vitexin (0·5 g.) was dissolved in 33% sodium hydroxide solution (7·5 g.), and 25% aqueous potassium ferricyanide added in small portions. An amount of potassium ferricyanide (15 g.) corresponding approximately to 15 atoms of oxygen was used before excess of the reagent was detected by the Prussian-blue test. The solution was acidified and extracted with ether, the extract dried (sodium sulphate) and evaporated, and the crystalline residue sublimed. It had m. p. 209°, alone or mixed with *p*-hydroxybenzoic acid.

Nitration of Vitexin.—Vitexin (1·33 g.), heated with 33 c.c. of 15% nitric acid (cf. Perkin, J., 1898, **73**, 1024), slowly gave a clear solution, but after ½ hour a pale yellow, crystalline powder separated in small quantity; this was removed and washed with a little water. (On cooling the reaction mixture or on adding a little water to it, dinitro-*p*-hydroxybenzoic acid also may separate. It can be removed by washing the mixture of the nitro-compounds with boiling alcohol, in which the tetranitro-compound derived from vitexin is insoluble.) The dry tetranitro-compound crystallised from dioxan in yellow prisms, m. p. 257°, unchanged by recrystallisation [Found : C, 40·3, 40·5; H, 1·55, 1·6; N, 12·9, 12·7. Calc. for $C_{15}H_6O_5(NO_2)_4$: C, 40·0; H, 1·3; N, 12·4%] or in admixture with tetranitroapigenin prepared by Perkin's method (J., 1900, **77**, 416).

Sublimation with Zinc Dust.—Portions of a mixture of vitexin (1 g.) and zinc dust (10 g.) were covered with a little asbestos in several small test-tubes and heated in a high vacuum. Above 310° a yellow sublimate appeared; the main part sublimed rather slowly at 350—360°. The tubes were opened, and the yellow substance collected and twice resublimed at 260—270°;

a great part of it charred, the final yield being about 5 mg. The *substance* was readily soluble in sodium carbonate solution (Found: C, 62·5; H, 3·8. $C_{15}H_{12}O_6$ requires C, 62·5; H, 4·2%).

About 20 mg. of the sublimate were heated for 3 hours with 1 c.c. of acetic anhydride. After cooling, water was added, and the precipitate washed, dried, and crystallised from alcohol (yield, 11 mg.). It had m. p. 180° [Found: C, 63·9, 63·8; H, 3·9, 4·1. Calc. for $C_{15}H_7O_5(CO\cdot CH_3)_3$: C, 63·6; H, 4·0%] and did not depress the m. p. of triacetylapigenin (m. p. 181—182°).

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