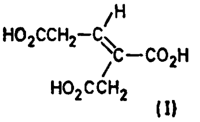
Revision of the Structure of the Cyanogenic Glucoside Triglochinin

By Martin Ettlinger
(*Chemical Laboratory II, University of Copenhagen, Universitetsparken 5, Copenhagen Ø, Denmark*)
and Reynir Eyjólfsson*†
(*Chemical Laboratory B, Royal Danish School of Pharmacy*)

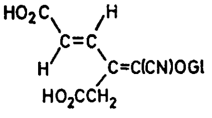
Summary Triglochinin, reformulated as a 4-carboxymethyl-5-cyano-5-β-D-glucopyranosyloxy-*cis*-penta-2,4-dienoic acid, appears to be a product of ring cleavage of an *o*-diphenolic cyanohydrin glucoside.

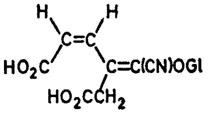
Triglochinin, the principal cyanogenic component of the monocotyledons *Triglochin maritima*[1] and *Lilaea scilloides*,[2] is an αβ-unsaturated glucosyloxy-nitrile, the glucoside of an enolized acyl cyanide. Hydrolysis of triglochinin yields glucose, hydrogen cyanide, and triglochinic acid (I).[1,3] The ^1H n.m.r. spectra of triglochinin derivatives show an AB pattern, δ 6·15 and 6·83 p.p.m. (J 12·5 Hz) in the dimethyl ester.[1] Triglochinin was therefore originally assigned the constitution (II; Gl = β-D-glucopyranosyl), the AB pattern being ascribed to the central protons of a butadiene system.[1]

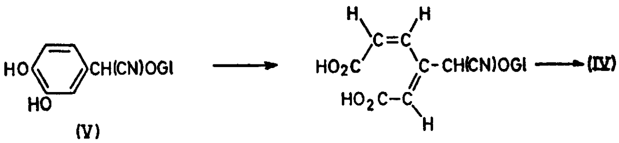
Triglochinin has now been isolated as the major source of cyanide in *Triglochin palustris* L. also. Moreover, extracts of both *T. palustris* and *T. maritima* have been found on chromatography[1] to contain smaller amounts of a second glucoside, isotriglochinin, eluted before triglochinin [cellulose column; EtOAc–AcOH–H_2O (8:1:1)]. Isotriglochinin has an i.r. spectrum similar to that of triglochinin and furnishes the same products on enzymatic or acid-catalysed hydrolysis. With methanolic hydrogen chloride[1] isotriglochinin gave, besides trimethyl triglochinate, a crystalline dimethyl ester, m.p. 123—125°, isomeric with dimethyltriglochinin. The n.m.r. spectra of the pertrimethylsilyl derivative and dimethyl ester of isotriglochinin are closely


(I)

$GlO(NC)C{=}CH{-}CH{=}C(CO_2H)CH_2CO_2H$
(II)


(III)


(IV)


(V)

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† *Present address:* Pharmaco Inc., P.O. Box 1077, Reykjavik, Iceland.

similar to those of the corresponding triglochinin derivatives, except that the lowest-field signal (B proton) is shifted downfield by *ca.* 0·8 p.p.m. (δ_A 6·2, δ_B 7·6 for the dimethyl ester) and J_{AB} is increased to 15·5 Hz. This coupling constant is too large for the central coupling in a butadiene and shows that isotriglochinin contains a *trans*-1,2-disubstituted double bond. Therefore, in isotriglochinin the glutaconic acid system of triglochinic acid is enolized in the opposite sense to that assumed in the derivation of structure (II) for triglochinin; isotriglochinin is one of the two stereoisomeric substances having structure (III). The previously unconsidered possibility that the AB pattern of triglochinin corresponds to a *cis*-1,2-disubstituted double bond, shown in structure (IV), stereoisomeric with (III), is hence compatible with the hydrolysis of triglochinin to triglochinic acid. The u.v. spectrum of triglochinin, λ_{max} (H_2O) 275 nm (ϵ *ca.* 11,000), compared with that of isotriglochinin, λ_{max} 283 nm (ϵ *ca.* 22,000), indicates a diene system whose planarity is markedly hindered. This fact and the chemical shifts of the olefinic protons of triglochinin, which are difficult to reconcile in detail with structure (II) but follow from (IV) on comparison with the data for (III), lead us to conclude that structure (IV) correctly represents triglochinin.

One important consequence of the revised constitution of triglochinin is that the substance now can be seen as derived from a diphenolic 3,4-dihydroxymandelonitrile glucoside (V) by oxidative cleavage between the aromatic hydroxy-groups[4] followed by a well-known double-bond shift.[5] Isotriglochinin presumably arises by stereomutation of triglochinin.

The stereoisomers of structure (III) have been separated; moreover, tyrosine, but not phenylalanine or 3,4-dihydroxyphenylalanine, appears to be converted into triglochinin in *T. maritima*.[7] Triglochinin is biochemically related to the *p*-hydroxymandelonitrile glucosides found widely in higher plants[2,6] and may occur more frequently than is known at present.[8]

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[7] L. M. Larsen and P. O. Larsen) (Royal Veterinary and Agricultural College, Copenhagen) personal communication and M. Ettlinger and R. Eyjólfsson unpublished data.

[8] D. Sharples and J. R. Stoker, *Phytochemistry*, 1969, **8**, 597, reported a highly polar, tyrosine-derived cyanogenic compound of undetermined constitution along with small amounts of two *p*-hydroxymandelonitrile glucosides in a species of Ranunculaceae.