Continuing a study of the seeds of the plant mentioned, we have established that it contains not less than 18 cardenolides. In accordance with the method of preparation described below, the latter have been divided provisionally into two groups: moderately and highly polar cardenolides. A chemical study of the substances of the first group has begun.

The comminuted seeds, after being defatted with petroleum ether, were exhaustively extracted with 96% and 70% ethanol. The ethanolic extracts were evaporated in vacuum. The still residue was dissolved in water and purified with petroleum ether and then with alumina. The glycosides were extracted from the purified aqueous solution three times with an equal volume of a mixture of chloroform and ethanol (2 : 1). After evaporation in vacuum, these extracts yielded the combined moderately polar cardenolides. The aqueous solution was saturated with sodium chloride and the remaining glycosides were extracted completely by repeated treatment with the mixture of ethanol and chloroform (1 : 2). The extracts were evaporated, giving the combined highly polar glycosides.

The cardenolides of the first group were chromatographed on alumina (activity grade III) and were eluted with mixtures of chloroform and ethanol (95 : 5–70 : 30). The following compounds were isolated in the individual crystalline state and identified by direct comparison: allioside A [1] (erysimin [4], helveticoside [5]), desglucoerycordin [6], glucodigifucoside [7, 8], erysimoside [9], and erycordin [6] and, in addition, two new cardenolides were isolated which we have called alliside and allotoxin.

Alliside, $C_{29}H_{44}O_{10}$ crystallizes from acetone–benzene, mp 180–183° C; $[\alpha]_D^{23}$ – 47.7 ±5° (c 0.5; methanol); with concentrated H_2SO_4 it gives a coloration changing with time: 0 min, yellow-brown; 60 min, violet.

Alliotoxin $C_{29}H_{44}O_9$ crystallizes from methanol–water; mp 262–272° C; $[\alpha]_D^{24}$ – 40.0 ±7° [c 0.35; chloroform–ethanol (2 : 1)]; with 84% H_2SO_4 it gives a coloration changing with time: 0 min; yellow-brown; 6 min, red-violet; 20 min, violet.

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ALLIOTOXIN AND ALLIOTOXIGENIN

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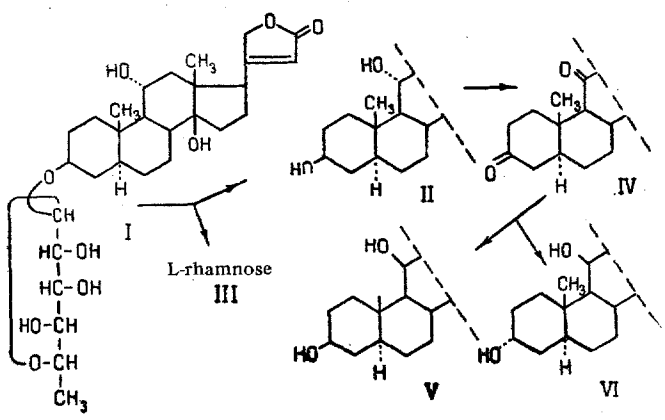
Alliotoxin is a new cardiac glycoside isolated [1] from the seeds of Cheiranthus allioni Hort.; it has the composition $C_{29}H_{44}O_9$. It exhibits biological activity at 0.25 mg/kg bodyweight of the cat (determined by S. I. Lutokhin). UV spectrum: $\lambda_{max}^{ethanol}$ 217 mμ (log ε 4.18). The optical rotatory dispersion spectrum (recorded by I. P. Kovalev) shows a smooth positive curve (for the other properties of the glycoside, see [1]).

The hydrolysis of alliotoxin gave the aglycone (II), which we have called alliotoxigenin and a monosaccharide (III). The aglycone (II) has mp 295–301° C; $[\alpha]_D^{22}$ + 25.8° ±5° (c 0.5; pyridine); it dissolves in 84% H_2SO_4 giving a coloration changing with time: 10 sec, yellow; 15 sec, yellow-red; 7 min, brown; 30 min, blue.

Found, %: C 71.02; H 8.93; mol. wt. 395 (spectroscopic method). Calculated for $C_{23}H_{34}O_5$, %: C 70.74; H 8.77; mol. wt. 390.5.

The presence of alcohol groups at C_3 and C_{14}, a butenolide ring at C_{17}, and their β-configuration in alliotoxigenin is is obligatory for cardiotonically active cardenolides. Under the action of Jensen's reagent, the aglycone fluoresces yellow in UV light. This confirms the normal β-position of the butenolide ring and, in addition, shows the absence of OH groups at C_{12} and C_{16} [2,3]. By acetylating the aglycone (II) with acetic anhydride in pyridine and analyzing the course of the reaction by a published method [4], we have established that it forms a diacetate and that both the OH groups acetylated are secondary and equatorial. One of them is obviously located at C_3. The presence of an equatorial β-OH group at C_3 simultaneously shows the trans-linkage of rings A and B.



The further study of alliotoxigenin reduced to the determination of the position of the second equatorial OH group. Alliotoxigenin is not oxidized by sodium metaperiodate (test for a 1,2-glycol group). Consequently, the presence in it of an OH group at C_2, C_4, or C_{15} is excluded. In order to show the presence or absence of an OH group in the α-position, we attempted to convert alliotoxigenin into the known aglycone mallogenin [5], making use of the circumstance that the reduction of 11-oxocardenolides leads to the stereo-specific formation of 11β-hydroxy derivatives [5]. For this purpose, 6 mg of the aglycone (II) was oxidized with chromic anhydride. The oxidized cardenolide (IV), with mp 281–285° C, was reduced with sodium borohydride. Of the two reaction products, the main one was obtained in the pure state with mp 263–270° C. A mixed melting point, paper chromatography, reaction with concentrated H_2SO_4, and the formation of the monoacetate [4] showed that the compound obtained was identical with mallogenin (V) (a sample of the latter was kindly given to us by Prof. T. Reichstein). The conversion of alliotoxigenin into mallogenin confirms the presence of an OH group in position 11 and structure II.

Thus, alliotoxigenin is the new cardiac aglycone 3β,11α,14β-trihydroxy-5α-H-card-20(22)-enolide. The monosaccharide of alliotoxin was identified by paper chromatography as L-rhamnose.

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STRUCTURE OF ALLISIDE

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It has been reported previously [1] that a new cardiac glycoside, alliside, with the composition $C_{29}H_{44}O_{10}$ has been isolated from the seeds of Cheiranthus allioni Hort. Alliside possesses a comparatively high biological activity (0.157 mg/kg body weight in the cat), as has been shown by N. A. Kisten. On hydrolyzing this glycoside by the Mannich-Siewert method [2] we obtained the aglycone and a monosaccharide.