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A REINVESTIGATION OF THE STRUCTURES OF ACOMONINE, ILIENSINE, 14-DEHYDROILIENSINE, AND 14-BENZOYLILIENSINE

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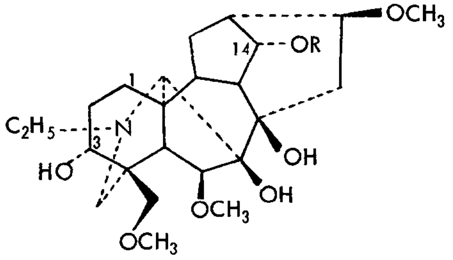
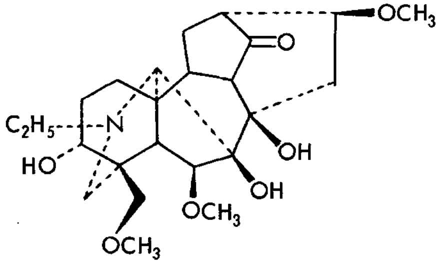
The novel structures assigned by Yunusov et al to the C_{19}-diterpenoid alkaloids, acomonine (1), iliensine (2), 14-dehydroiliensine (3), and 14-benzoylliliensine (4) have been found to be in error. We have demonstrated that these alkaloids are identical with the well-known alkaloids, delsoline (5), delcosine (6), 14-dehydrodelcosine (7), and 14-benzoyldelcosine (8), respectively.

In 1974 Yunusov et al reported the isolation of the C_{19}-diterpenoid alkaloid, *acomonine*, $C_{25}H_{41}NO_7$, from the roots of *Aconitum monticola*.[1,2] On the basis of chemical transformations, ^1H NMR, and mass spectral data, structure 1 was assigned to acomonine. Subsequently, these investigators also isolated a new alkaloid, *iliensine*, $C_{24}H_{39}NO_7$, from *Delphinium biternatum*.[3,4] By chemical correlation of iliensine with acomonine and degradation studies on iliensine, structure 2 was assigned to iliensine. Later they reported the occurrence in the same plant of two other alkaloids, 14-dehydroiliensine and 14-benzoyliliensine, and assigned their structures as 3 and 4, respectively.[5] Each of these structures is unusual in lacking an oxygen substituent at C(1), a feature present in all the known seventy naturally-occurring C_{19}-diterpenoid alkaloids.[6]

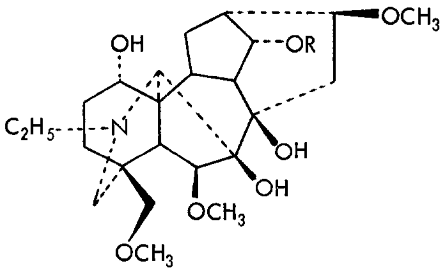


1 R = CH_3 Acomonine
2 R = H Iliensine
4 R = Bz 14-Benzoyliliensine

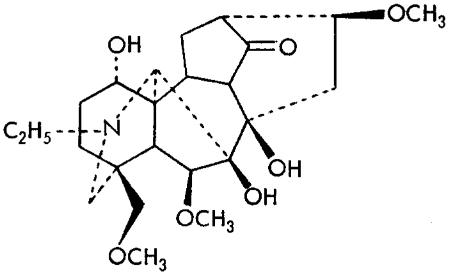


3 14-Dehydroiliensine

In the course of examining authentic samples of acomonine and iliensine for inclusion in a catalogue of ^{13}C NMR spectra, we observed that the ^{13}C NMR spectra of these compounds are identical with those we reported[7] for delsoline (5) and delcosine (6), respectively. Furthermore, the mass spectral fragmentation and ^1H NMR patterns reported for acomonine and iliensine were found also to be identical with those of delsoline and delcosine, respectively.[8,9] Comparison of the physical constants of acomonine, iliensine, and their derivatives with those of delsoline, delcosine and their derivatives (Table 1) provides additional, though unneeded, support for the identification of acomonine and iliensine with delsoline and delcosine, respectively.

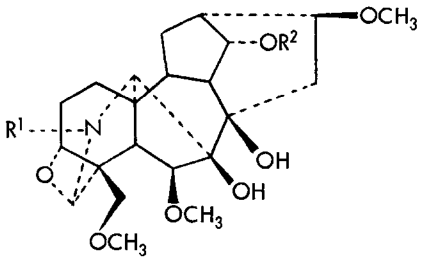


5 R = CH_3 Delsoline
6 R = H Delcosine
8 R = Bz 14-Benzoyldelcosine

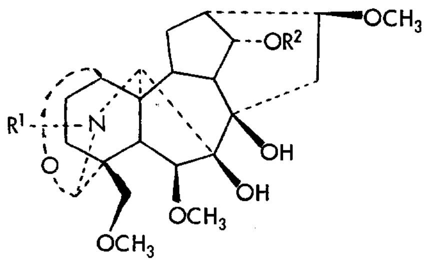


7 14-Dehydrodelcosine

Two additional examples of incorrect structural assignments occur in the case of the related alkaloids, 14-dehydroiliensine and 14-benzoyliliensine, which the Yunusov group converted to iliensine to establish their structures. Since the structure originally assigned to iliensine is in error, the structures assigned to 14-dehydroiliensine (3) and 14-benzoyliliensine (4) are also in error. Because of our demonstration of the identity of iliensine with delcosine (6), these alkaloids must now be identified as 14-dehydrodelcosine (7) and 14-benzoyldelcosine (8), respectively. Comparison of the physical constants and spectral data of 14-dehydroiliensine and 14-benzoyliliensine with those of 14-dehydrodelcosine[6,14] and 14-benzoyldelcosine[15], respectively, supports this identification.



9 $R^1 = C_2H_5$; $R^2 = CH_3$
17 $R^1 = R^2 = H$



10 $R^1 = C_2H_5$; $R^2 = CH_3$
18 $R^1 = R^2 = H$
19 $R^1 = C_2H_5$; $R^2 = H$
20 $R^1 = C_2H_5$; $R^2 = Bz$

The above evidence clearly demonstrates that acomonine ≡ delsoline (5); iliensine ≡ delcosine (6); 14-dehydroiliensine ≡ 14-dehydrodelcosine (7); and 14-benzoyliliensine ≡ 14-benzoyldelcosine (8). In retrospect, the arguments originally presented[2,4] for the assignment of a hydroxyl group to C(3) instead of C(1) in acomonine and iliensine are ambiguous. Because of this error, novel structures and new names were assigned to alkaloids which had been in the literature for more than fifty years.[16] Correction of structures 1-4 may save investigators lengthy, but fruitless efforts to synthesize nonexistent alkaloids. To avoid further confusion we recommend that the names acomonine and iliensine no longer be used.

Table 1. Comparison of Physical Constants of Delcosine-type Alkaloids and their Derivatives

Name	mp.	$[\alpha]_D$
Acomonine[a] (1)[e]	212-213°[d]	+51.5°[d]
Delsoline (5)[9]	212-213°	+53.4°
Anhydrohydroxyacomonine (9)[2]	208-210°	
Anhydrohydroxydelsoline (10)[10]	218-220°	
Iliensine[c] (2)[4]	203-204°	+41°; +55.8°[b]
Delcosine (6)[9]	203-204°	+53.6°
Diacetyliliensine (11)[4]	125-128°	
Diacetyldelcosine (12)[11]	127-128°	
O, O-Dimethyliliensine (13)[4]	198-202°	
O, O-Dimethyldelcosine (14)[12]	203-206°	
Monoacetyliliensine (15)[4]	amorphous	
Monoacetyldelcosine (16)[14]	amorphous	
N-Desethylanhydrohydroxyiliensine (17)[4]	217-220°	
N-Desethylanhydrohydroxydelcosine (18)[13]	218-219°	
14-Dehydroiliensine (3)[5]	208-210°	+26°
14-Dehydrodelcosine (7)[6,14]	208-213°	+25.2°
14-Benzoyliliensine (4)[5]	147-149°	+50°
14-Benzoyldelcosine (8)[15]	148-150°	+63.8°

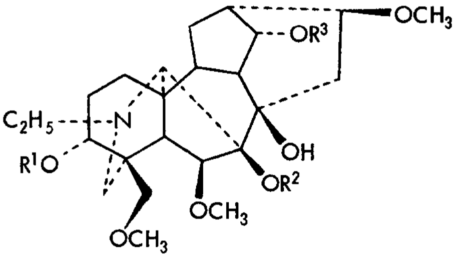
[a] A sample of acomonine provided by Dr. M. S. Yunusov was slightly impure. This impurity may be responsible for low values of melting point (208-210°) and specific rotation (25°). The mixture mp. of acomonine and delsoline was undepressed.

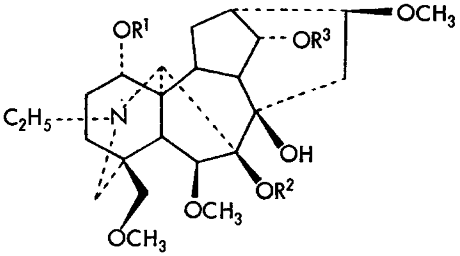
[b] Our determination. Specific rotation in $CHCl_3$.

[c] The mixture mp. of iliensine and delcosine was undepressed.

[d] Our determination on recrystallized material. MP is corrected. Specific rotation in $CHCl_3$.

[e] The structure indicated for the top name of each pair is the incorrect structure originally assigned by Soviet chemists.





11 $R^1 = R^3 = Ac$; $R^2 = H$

13 $R^1 = H$; $R^2 = R^3 = CH_3$

15 $R^1 = Ac$; $R^2 = R^3 = H$

12 $R^1 = R^3 = Ac$; $R^2 = H$

14 $R^1 = H$; $R^2 = R^3 = CH_3$

16 $R^1 = Ac$; $R^2 = R^3 = H$

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15. 14-Benzoyldelcosine (**8**) was prepared from delcosine (**6**) by an unambigous method. $KMnO_4$ oxidation of delcosine gave the known compound anhydrohydroxydelcosine (**19**). The latter was treated with benzoyl chloride and pyridine to afford 14-benzoylanhydrohydroxydelcosine (**20**), which on reduction with $NaBH_4$ yielded 14-benzoyldelcosine (**8**).
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