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ALKALOIDS OF Rauwolfia SPECIES GROWING IN VIETNAM

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UDC 547.99

Reserpine, ajmaline, serpentine, ajmalicine, isoreserpiline, and other alkaloids have been isolated from the roots of Rauwolfia cambodiana Pierre ex Pitard, R. verticillata Baill. and R. serpentina Benth. R. vomitoria Afz. was the richest in alkaloids.

Plants of the devilpepper genus Rauwolfia L., family Apocynaceae are widely known as producers of cardiovascular drugs. An investigation of some of Rauwolfia species growing in tropical regions of the terrestrial globe has shown that they contain valuable alkaloids possessing hypotensive and antiarrhythmic action [1].

The object of our study were the following plants growing in Vietnam: Rauwolfia verticillata Baill., R. cambodiana Pierre ex Pitard [2], R. serpentina Benth. [3], and R. vomitaria Afz. [4]. The quantitative determination of the total alkaloids in the bark of the roots of the above-mentioned species showed that they were rich in alkaloids (Table 1). A particularly high level of alkaloids was found in the bark of the roots of R. vomitoria.

A number of alkaloids were isolated from the root bark of Rauwolfia species from the Vietnam flora, and of these, in all the species studied, ajmaline and reserpine were identified; serpentine was detected in R. verticillata and in R. serpentina. The results, which are given in Table 1, confirm the fact that Vietnam species of Rauwolfia can serve as an industrial source of the hypotensive drug reserpine, the antiarrhythmic drug ajmaline, and preparations based on the total alkaloids.

The structures of all the compounds isolated were shown by physicochemical methods, qualitative reactions, and comparison with authentic samples. The composition of R. vomitoria was investigated in more detail. From the bark of the roots of this plant we isolated 16 alkaloids, of which 8 were identified.

The results obtained show that with respect to the composition of the main alkaloids and their amount, the Rauwolfia species from the Vietnam flora are not inferior to plants growing in other regions of Southeast Asia and Africa.

EXPERIMENTAL

UV spectra were taken on a SF-26 instrument (USSR). IR spectra were obtained on a Specord 75-1R instrument (Germany) for solutions of the substances in paraffin oil. Melting points were determined on a Boëtius stage.

The quantitative determination of the total alkaloids was made by a gravimetric method [5], and that of individual alkaloids by an extraction-photometric method [6]. For thin-

Leningrad Institute of Pharmaceutical Chemistry. Translated from Khimiya Prirodnykh Soedinenii, No. 6, pp. 813-816, November-December, 1991. Original article submitted July 24, 1991.

 0009-3130/91/2706-0718$12.50

TABLE 1. Alkaloid Productivity of Species of Rauwolfia L. Growing in Vietnam

Rauwolfia species	Amount of alkaloids, % of the weight of the dry root bark			
	total	ajmaline	reserpine	serpentine
Rauwolfia cambodiana Pierre ex Pitard	4,10	0,65	0,42	Absent
R. serpentina Benth.	3,40	1.45	0,3	0,16
R. verticillata Baill.	2,95	0,55	0,35	Traces.
R. vomitoria Afz.	6,4	2,90	0,74	Absent

layer chromatography we used Silufol UV-254 plates and the following solvent systems: n-butanol–acetic acid–water (4:1:1) and $CHCl_3$–CH_3OH–25% NH_4OH (50:9:1); for column chromatography we used Al_2O_3.

Isolation of the Alkaloids. The dried and comminuted root barks of Rauwolfi serpentina, R. verticillata and R. cambodiana (50 g each) and R. vomitoria (1000 g) were wetted with a 10% solution of ammonia, and the alkaloids were extracted with 96% ethanol. Each extract was evaporated in vacuum to a small residue, and this was acidified with 10% HCl, left overnight, and filtered. The residue was treated with 20% CH_3COOH in the water bath, after which it was cooled and was filtered again. The acetic acid solution was washed with petroleum ether, and the ether was driven off from the acetic acid solution by heating in the water bath. The alkaloids were extracted from the acetic acid solution with benzene, which was then distilled off, and the dried residue was dissolved in chloroform and this solution was neutralized with 10% aqueous ammonia to pH 7 and was chromatographed on a column (1.5 × 30 cm) of Al_2O_3, from which the alkaloids were eluted with CH_3OH. The acetic acid mother solution after extraction with benzene was made alkaline to pH 8 with 25% ammonia and the alkaloids were extracted with benzene–acetone (8:2).

The alcoholic extract, acidified with HCl, was extracted with $CHCl_3$, giving a chloroform fraction consisting of a mixture of weak bases. The acid solution was brought with 10% ammonia solution successively to pH 5,7, 8, 11, and was extracted with chloroform.

All the fractions were chromatographed on a column of Al_2O_3, the alkaloids being eluted with n-C_6H_{12}, C_6H_6, C_2H_5OH, and ethyl acetate and also with n-C_6H_{12}–ethyl acetate (1:5) and ethyl acetate–ethanol (9:1).

As a result, the following compounds were isolated:

Reserpine – mp 263-265°C, UV spectrum: λ_{max}^{EtOH} 224, 268; λ_{min} 295, 247. IR spectrum (ν, cm^{-1}): 3435, 1735, 1715, 1625, 1590, 1500, 1355, 1235, 1125, 770 [7].

Ajmaline – mp 156-158°C, UV spectrum: λ_{max}^{EtOH} 248, 290; λ_{min} 270. IR spectrum (ν, cm^{-1}): 3370, 1615, 1300, 1240, 1100, 1050, 1020, 770 [8].

Serpentine – mp 158-159°C, UV spectrum: λ_{max}^{EtOH} 251, 309, 370; λ_{min} 280. IR spectrum (ν, cm^{-1}): 1710, 1690, 1625, 1580, 1305, 1250, 1205, 1120, 1090, 780 [9].

In addition, from R. verticillata we isolated ajmalicine with mp 248-250°C, IR spectrum: λ_{max}^{EtOH} 227, 282; λ_{min} 265. IR spectra (ν, cm^{-1}): 3360, 1700, 1590, 1270, 1230, 1200, 1130, 760 [10]. From R. cambodiania we isolated isoreserpiline with mp 210-215°C, IR spectrum: λ_{max}^{EtOH} 216, 302; λ_{min} 250. IR spectrum (ν, cm^{-1}): 3435, 1735, 1715, 1630, 1590, 1415, 1335, 1230, 1130, 1080, 820 [11].

A number of the alkaloids isolated were not identified: bases (I-IV) from R. cambodiana, and bases (V) and (VI) from R. serpentina.

Base (I) with mp 115-117°C, IR spectrum: λ_{max}^{EtOH} 228, 304; λ_{min} 275.

Base (II) with mp 293-295°C, IR spectrum: λ_{max}^{EtOH} 225, 280; λ_{min} 247. IR spectrum (ν, cm^{-1}): 3050, 3130, 1730, 1710, 1590, 1300, 1170, 750.

Base (III) with mp 183-185°C, IR spectrum: λ_{max}^{EtOH} 220, 275; λ_{min} 250. IR spectrum (ν, cm^{-1}): 1730, 1570, 1305, 1220, 1150, 1120.

Base (IV) with mp 145°C, IR spectrum: λ_{max}^{EtOH} 245, 285; λ_{min} 270. IR spectrum (ν, cm^{-1}): 1733, 1593, 1420, 1300, 1160, 1130, 1060, 730.

Base (V) with mp 115-117°C, IR spectrum: λ_{max}^{EtOH} 225, 283; λ_{min} 250. IR spectrum (ν, cm^{-1}): 3435, 3200, 1720, 1600, 1330, 1220, 1130, 1100, 1070, 770.

Base (VI) with mp 125-130°C, IR spectrum: λ_{max}^{EtOH} 225, 285; λ_{min} 265. IR spectrum (ν, cm^{-1}): 3300, 1715, 1605, 1300, 1200, 1160, 1105, 1070, 750.

From R. vomitoria we isolated the alkaloids reserpine [7], methyl reserpate [12], isorakhimbine [13], isoreserpine [14], deserpidine [15], akuammidine [16], ajmalicine [10], ajmaline [8], and a number of unidentified bases (I-VII).

Base (I) with mp 205-210°C, UV spectrum: λ_{max}^{EtOH} 217, 269, 293; λ_{min} 245, 285. IR spectrum (ν, cm^{-1}): 3270, 1740, 1710, 1625, 1590, 1510, 1420, 1336, 1265, 1230, 1130.

Base (II) with mp 165-170°C, IR spectrum: λ_{max}^{EtOH} 218, 270, 295; λ_{min} 250, 285. IR spectrum (ν, cm^{-1}): 1720, 1630, 1590, 1505, 1420, 1335, 1276, 1230, 1130, 1030, 765.

Base (III) with mp 170-175°C, IR spectrum: λ_{max}^{EtOH} 216, 267, 291; λ_{min} 245. IR spectrum (ν, cm^{-1}): 3430, 1730, 1715, 1625, 1590, 1505, 1415, 1335, 1280, 1230, 1130, 770.

Base (IV) with mp 205-207°C, IR spectrum: λ_{max}^{EtOH} 217, 268, 294; λ_{min} 245. IR spectrum (ν, cm^{-1}): 3270, 1740, 1625, 1585, 1500, 1410, 1330, 1230, 1130, 770.

Base (V) with mp 213-215°C, IR spectrum: λ_{max}^{EtOH} 217, 270, 293; λ_{min} 246, 287. IR spectrum (ν, cm^{-1}): 3270, 1740, 1710, 1625, 1590, 1505, 1420, 1330, 1230, 1130.

Base (VI) with mp 297-300°C, IR spectrum: λ_{max}^{EtOH} 214, 250, 292; λ_{min} 227, 272. IR spectrum (ν, cm^{-1}): 1610, 1585, 1420, 1300, 1260, 1200, 1120, 1060, 1020, 760.

Base (VII) with mp 277-280°C, IR spectrum: λ_{max}^{EtOH} 20, 250, 290; λ_{min} 227, 270. IR spectrum (ν, cm^{-1}): 1610, 1420, 1350, 1300, 1270, 1150, 1125, 1065, 1055, 1020, 770, 740.

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