*Chemistry of Natural Compounds, Vol. 32, No. 4, 1996*

# ALKALOID CONTENT OF *Codonopsis clematidea*

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UDC 547.944/945

*The alkaloids of* Codonopsis clematidea *Schrenk. from nine growth sites have been studied. Plants from the Kashkadar'inskaya Oblast and the Darvaza range in Tadzhikistan were distinguished by the highest level of the desired alkaloid codonopsine.*

The family Campanulaceae, to which the plant that we are studying, clematis Asia bell, *Codonopsis clematidea*, belongs, includes 40 genera and 600 species. In the flora of the CIS, 20 genera and 224 species have been recorded. The genus *Codonopsis* numbers 40 species growing predominantly in Eastern and Central Asia. In the flora of the CIS, species of the *Codonopsis* genus are found in the Far East and the mountains of Central Asia, along mountain streams, on their banks, by springs, and in other similar places. In Central Asia a single representative of the genus — *C. clematidea* — is found in the Tien-Shan, Pamir-Alai, and Dzhungarian Ala-Tau [1, 2].

The presence of alkaloids in plants of the family Campanulaceae has been established only for the genus *Lobelia*. Some workers separate out this genus into an independent family Lobeliaceae, representatives of which contain considerable amounts of nitrogen bases and are typical alkaloid-bearers [3]. Other genera of the Campanulaceae family have not been studied or have been studied to only a small extent: according to the literature, many species contain no alkaloids at all or only traces of them.

Some species of the *Codonopsis* genus have long been used in folk medicine; for example, in Chinese medicine the Asia bell tang-sheng is widely used as a substitute for ginseng [4]. It is applied in hypertension, diseases of the heart, and other affections. Galenical preparations of the related species *C. clematidea* possess a stimulating action on the CNS and the heart, exhibit a weak tranquilizing effect [5, 6], and raise the resistance of experimental animals to physical stresses [7].

The individual alkaloids codonopsine and codonopsinine isolated from *C. clematidea* are substances of low toxicity with a broad spectrum of pharmacological action, the bile-stimulating effect of which is more than twice as great as that of the berberine and flamine that are widely used in medical practice [8].

At the present time a number of drugs based on codonopsine have been created for the prophylaxis and treatment of diseases of the liver and the gall bladder, including toxic hepatitis. The problem of the treatment of hepatitises and other diseases of the liver is an extremely urgent one. Various extracts of plants and plant products have long been used for the restoration of disturbed liver functions. One of them is the medicinal plant product LSKh, approved by the pharmacological committee of the Uzbekistan Ministry of Health for use in medical practice. The main component of this plant product is *C. clematidea.*

We have studied the alkaloid content of *C. clematidea* from various growth sites. The local name of this plant is "dogvoi;" it reaches a height of 1 m, and is hispid, with bluish or whitish bell-shaped flowers. From the result of the study of the amounts of total alkaloids of plants from different growth sites we have found an area for gathering this plant for practical purposes. Plants gathered in the Sukhandar'inskaya and Kashkadar'inskaya oblasts of Uzbekistan are distinguished by the highest levels of total alkaloids (Table 1).

The *C. clematidea* was collected by a botanical expedition under the direction of S. A. Khamidkhodzhaev. As follows from Table 1, the amount of the mixture of bases depends to a considerable degree on the growth site. Because of this, we studied plants with the highest levels of alkaloids from two growth sites: close the village of Suvtushar in the Kashkadar'inskaya Oblast of Uzbekistan, and from the Darzava range in Tadzhikistan.

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 0009-3130/96/3204-0564$15.00 

TABLE 1. Total Amounts of Alkaloids in *C. clematidea* from Various Growth Sites

| Growth site | Vegetation period | Total alkaloids, % |
|---|---|---|
| 1. Gorge of the R. Obingau, Tadzhikistan | Budding | 0.025 |
| 2. Village of Minzhilke, Kungei Ala-Tau | Budding and incipient flowering | 0.06 |
| 3. Village of Suvtushar, Kashkadar'inskaya Obl. | " | 0.08 |
| 4. Darvaza range, village of Sagirdasht, Tadzhikistan | " | 0.065 |
| 5. Aksu, R. Pozdnyakova | Budding | 0.023 |
| 6. Chatkal, southern Kazakhstan | Budding and incipient flowering | 0.02 |
| 7. Arslanbob, Kyrgyzstan | " | 0.06 |
| 8. Gorge of the R. Khanaka, Tadzhikistan | " | 0.069 |
| 9. Gorge of the R. Vorzob, Tadzhikistan | " | 0.05 |

TABLE 2. Total Amounts of *C. clematidea* Alkaloids in Various Organs of the Plant

| Plant organ | Vegetation period | Total alkaloids, % |
|---|---|---|
| Epigeal part | Budding and incipient flowering | 0.08 |
| Roots | " | 0.02 |
| Leaves | Vigorous growth | 0.094 |

The results of our investigation of the plant gathered in the Kashkadar'inskaya Oblast are given in Table 2.

Chloroform extraction of the epigeal part of *C. clematidea* led to the isolation of two bases: codonopsine and codonopsinine, which have been shown to be pyrrolidine derivatives. Their structures have been established by a correlation of spectral characteristics and chemical transformations [9, 10]. In all the mixtures of alkaloids obtained, the main one quantitively was codonopsine (~60%).

In 1986, Japanese scientists achieved a synthesis of codonopsinine and established its absolute configuration [11].

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