

PYRROLIZIDINE ALKALOIDS IN *CASTILLEJA RHEXIFOLIA* (SCROPHULARIACEAE)

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Collections were made in the northern Colorado mountains of *Castilleja rhexifolia* Rydb. (Colorado State University Accession Number 57109), *C. flava* Watson (Accession Number 4875) and *C. sulphurea* Rydb. (Accession Number 57123). These species are commonly called Indian paint brush. 50% Aqueous ethanol extracts of whole plant material showed no activity in the KB cell cytotoxicity or the P388 leukemia screens of the National Cancer Institute [1]. These extracts were also tested for alkaloid content. *C. flava* and *C. sulphurea* were negative, but the extract from *C. rhexifolia* was strongly positive. The residue of a MeOH extract from 263 g dried plant material of *C. rhexifolia* was dissolved in dil. H_2SO_4 and extracted with $CHCl_3$. The aqueous phase was made basic to pH 8.6 and extracted with $CHCl_3$. This $CHCl_3$ extract was dried and evaporated to yield 114 mg of crude alkaloid which showed mainly one spot on TLC. A Si gel prep. plate of the crude was developed in 2:1 acetone- H_2O and the 0.20-0.30 region eluted. The residue was recrystallised from ethanol to yield 15 mg of a crystalline alkaloid whose IR, 1H NMR, TLC behavior and MS were identical with those of senecionine, a pyrrolizidine alkaloid we had previously isolated [2] from *Caltha leptosepala*. Traces of two alkaloids of lower R_f on TLC were also present. Blossoms of *C. rhexifolia* gave very strong alkaloid tests on TLC, but insufficient material was available for isolation work. These qualitative tests indicated that the alkaloid content of blossoms was much higher than that in the whole plant [3].

This is the first report of alkaloids of any kind in the genus *Castilleja* and the first report of pyrrolizidine alkaloids in the Scrophulariaceae. The high alkaloid content in the blossoms parallels the report of high

pyrrolizidine alkaloid content in blossoms of *Senecio* species. The hepatotoxic alkaloids have been found to be transferred into milk by cows [4] and into honey by bees [5]. Pyrrolizidine alkaloids are apparently also responsible for human deaths which have occurred [6] when blossoms of toxic *Senecio* flowers have been incorporated into herbal teas. Wherever *C. rhexifolia* occurs in quantity, the possible transfer of toxic pyrrolizidine alkaloids into milk or honey should be considered. Although two of the three Indian paint brush species in the present report did not contain alkaloids, it would certainly be wise not to incorporate plants of the genus *Castilleja* into herbal teas.

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REFERENCES

1. Testing was performed by National Cancer Institute contractors.
2. Stermitz, F. R. and Adamovics, J. A. (1977) *Phytochemistry* **16**, 500.
3. *Castilleja rhexifolia* is a partial parasite, but nonspecific in its parasitism. It is found in a variety of ecological situations, with a variety of hosts. It seems unlikely, therefore, that the pyrrolizidines found in *C. rhexifolia* came from a specific host. We are, however, checking this possibility.
4. Dickinson, J. O., Cooke, M. P., King, R. R. and Mohamed, P. A. (1976) *J. Am. Vet. Med. Assoc.* **169**, 1192.
5. Deinzer, M. L., Thomson, P. A., Burgett, D. M. and Isaacson, D. L. (1977) *Science* **195**, 497.
6. Private communication, National Center for Disease Control, Atlanta, GA.