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A TRITERPENOID OF THE SERRATANE TYPE FROM THE LIVERWORT *NARDIA SCALARIS**

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Key Word Index—*Nardia scalaris*; Marchantiopsida; liverworts; chemotaxonomy; (+)-3-oxo-21α-methoxyserrat-14-ene.

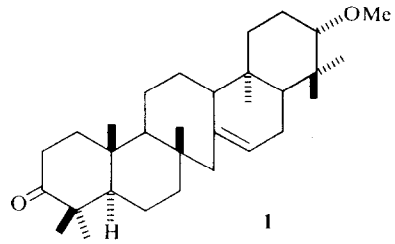
Abstract—The presence of (+)-3-oxo-21α-methoxyserrat-14-ene in the liverwort *Nardia scalaris* augments the present knowledge on distribution of triterpenoids of the serratane type in nature, and represents a further example of triterpene biosynthesis by plants of the Marchantiopsida.

INTRODUCTION

Liverworts (Marchantiopsida) appear to represent an independent developmental line among plants and are placed together with mosses (Musci) in the Bryophyta (see, e.g. ref. [1]). From the chemotaxonomic point of view, liverworts are (besides other markers) characterized by the presence of typical terpenoids, mainly mono-, sesqui- and diterpenoids, whereas mosses lack these types; some of them contain triterpenoids, mostly hydrocarbons of the hopane type (see, e.g. refs. [2] and [3], and citations therein). Triterpenoids of this class are well known also to be present in ferns (Pteridophyta).

Huneck and Overton [4] found ursolic acid and 3α- and 3β-friedelinols in *Gymnocolea inflata* (Huds.) Dum. The indication of the presence of friedelin in *Frullania tamarisci* (L.) Dum. is doubtful as it was invalidated by one of the authors [G. Ourisson, private communication] by the fact that this triterpenoid may have originated at least partly from the substrate of the liverwort studied, i.e. the oak bark. We were, however, able to prove the presence of friedelin in *Conocephalum conicum* (L.) Underw. [6]. Recently, Asakawa *et al.* [3] described the isolation of hop-7(21)-ene and neohop-13(18)-ene in *Takakia ceratophylla* (Mitt.) Grolle and in *T. lepidozioides* Hatt. Inoue, together with sesquiterpenoids previously known from other liverworts (e.g. β-selinene, diplophyllolide in *T. lepidozioides*, and two unidentified sesquiterpenes, as well as two sesquiterpenols in *T. ceratophylla*). *Takakia* belongs to the most primitive leafy liverworts [3], and there are data placing it as a proper order most allied to mosses [7, 8].

In our broad programme on the chemical composition of liverworts, we have now discovered a triterpene of the serratane type in the liverwort *Nardia scalaris* S. Gray corr. Lindb. Triterpenoids of this type have originally been isolated from club mosses (Lycopodiaceae), e.g. *Lycopodium serratum* [9], from ferns (Polypodiaceae), e.g. *Polypodium vulgare* L. [10], and later quite often from Coniferae, e.g. the Sitka spruce [11], the lodgepole pine [12], and the common spruce [13]. Our recent finding [14] of (+)-3-oxo-21α-methoxyserrat-14-ene (**1**) in a composite (*Homogyne alpina*) demonstrates that this unique triterpene containing a seven-membered ring may be of very disparate distribution within the Plant Kingdom.



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RESULTS AND DISCUSSION

During the studies on the chemical composition of *Nardia scalaris*, a common liverwort in Europe, but not yet known chemically (see, e.g. refs. [15, 16]), we have isolated a crystalline compound from the extract of the dried plant and after repeated chromatography, characterized by its mp 213–215°, in no respects differing from the compound defined in the previous work [14], i.e. no mmp depression, identical IR, MS, NMR spectra, CD and ORD curves and optical rotation.

ADDENDUM

The very low content of this serratane-type derivative (**1**) (~10 ppm) suggests that it would conceivably originate from the humus admixture present in the liverwort studied. These plants were growing near the common spruce, the parts of which are known to contain serratane-type derivatives [13]. A re-investigation of a thoroughly purified material is intended and a proof of possible enrichment of **1** in the humic substrate might be discovered.

EXPERIMENTAL

The CC was performed on Si gel prepared according to ref. [17], particle size 50–90 μm, with addition of 10% of water. Prep. HPLC was performed using the column Silpearl for TLC

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(Kavalier Votice, ČSSR; 25 × 250 mm) with a gradient elution (*n*-hexane–ethyl acetate, 10 ml/min. Mps were measured on a Kofler block, NMR in $CDCl_3$, IR spectrum in CCl_4, MS on AEI-902, CD and ORD were measured in dioxane.

Isolation of **1**. The $CHCl_3$ extract (39.16 g) of dried *N. scalaris* (4190 g), collected in June 1976 in Smědava (Iser Mountains), was chromatographed on Si gel; the fraction eluted with C_6H_6 + 1% Et_2O was chromatographed on a HPLC column. The fraction eluted by 4% EtOAc in *n*-hexane (39.8 mg) yielded **1**, which showed mp 213–215°, elemental composition $C_{31}H_{50}O_2$ (HRMS), MS: 454, 439, 422, 407, 307. IR cm^{-1}: 1702 (CO), 1612 and 1660 (C=C), 1364 and 1386 (gem diMe), 1426 ($\underline{CH}_2$—C=O); $[\alpha]_D^{25}$ +81° (dioxane); ORD: ϕ_{307} +3100, ϕ_{282} 0, ϕ_{266} −460, ϕ_{243} −180, ϕ_{225} −3890; CD: $\Delta\varepsilon_{292}$ +0.82, $\Delta\varepsilon_{250}$ 0, $\Delta\varepsilon_{210}$ −9.25. NMR: see [14].

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GENKWADAPHNIN, A POTENT ANTILEUKEMIC DITERPENE FROM *DAPHNE GENKWA**

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Key Word Index—*Daphne genkwa*; Thymelaeaceae; genkwadaphnin; antileukemic diterpene.

Abstract—*In vivo* P-388 assay-directed fractionation of an active extract of *Daphne genkwa* (Yuán Huā) has led to the isolation and characterization of a new antileukemic principle, genkwadaphnin.

INTRODUCTION

The flowers of *Daphne genkwa* Sieb. et Zucc. (Thymelaeaceae) are known as 'Yuán Huā' in Chinese folklore and as herbal remedies for human diuresis for centuries [1–3] as well as for cancer recently [4]. Previous chemical studies on this drug resulted in the isolation of genkwanin, apigenin, sitosterol and benzoic acid [5]. As a result of the continuing search among Chinese plants for new naturally occurring potential antitumor agents, a methanolic extract of Yuán Huā was found to show significant inhibitory activity *in vivo* against the P-388 lymphocytic leukemia in mice. We report herein the isolation and structural elucidation of the new principal antileukemic constituent, genkwadaphin (**1**) from this active extract.

RESULTS AND DISCUSSION

The *in vivo* P-388 assay-directed fractionation of the active extract of *D. genkwa* led to the isolation of **1** as an antileukemic component. The spectral data described in

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