



ELSEVIER

Available online at [www.sciencedirect.com](http://www.sciencedirect.com)

SCIENCE @ DIRECT®

Biochemical Systematics and Ecology 32 (2004) 559–563

[www.elsevier.com/locate/biochemsysseco](http://www.elsevier.com/locate/biochemsysseco)

biochemical  
systematics  
and ecology

# The co-occurrence and systematic significance of pregeijerene B and 8- $\alpha$ -acetoxyelemol in *Juniperus*

Robert P. Adams\*

Biology Department, Baylor University, P.O. Box 97388, Waco, TX, 76798 USA

Received 22 May 2003; accepted 25 September 2003

---

## Abstract

The identity of a major unknown component in *Juniperus* volatile leaf oils has recently been determined as pregeijerene B. The occurrence of pregeijerene B in *Juniperus* is shown to be highly correlated with 8- $\alpha$ -acetoxyelemol. These compounds are shown to be present in section *Sabina*, but absent in sections *Caryocedrus* and *Juniperus*. In section *Sabina*, these compounds are very common among the smooth leaf margined, one seeded junipers of the eastern hemisphere and the smooth leaf margined junipers of the western hemisphere. Pregeijerene B and 8- $\alpha$ -acetoxyelemol are thought to arise from 8- $\alpha$ -acetoxyhedycaryol, accounting for their co-occurrence.

© 2004 Elsevier Ltd. All rights reserved.

Keywords: *Juniperus*; Systematics; Pregeijerene B; 8- $\alpha$ -Acetoxyelemol

---

## 1. Introduction

For several years an unknown compound of  $M^+$  162 (KI 1274) has been reported (Adams, 1997; 1999; 2000a, b, c, d) in numerous *Juniperus* species. The compound occurs in large amounts (13.2%) in the leaf essential oil of *J. erectopatens* (Cheng and L.L. Fu) R. P. Adams from Yunnan, China (Adams, 1999).

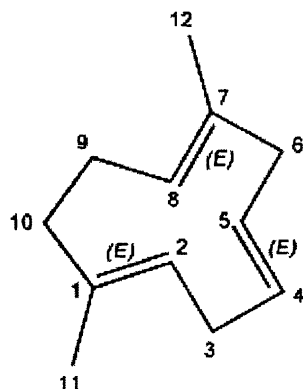
Recently, the structure of this compound has been identified as (*E,E,E*)-1,7-dimethylcyclodeca-1,4,7-triene (**1**) in *J. erectopatens* and given the common name of pregeijerene B (Cool and Adams, 2003). Pregeijerene B (**1**) is unusual in having

---

\* Corresponding author. Tel.: +1-254-759-8733.

E-mail address: [robert\\_adams@baylor.edu](mailto:robert_adams@baylor.edu) (R.P. Adams).

three *E, E, E* double bonds.



A cursory examination of *Juniperus* leaf oils revealed that pregeijerene B seemed to co-occur with 8- $\alpha$ -acetoxyelemol. The purpose of this paper is to examine the distribution of pregeijerene B in *Juniperus* and its co-occurrence with 8- $\alpha$ -acetoxyelemol.

## 2. Materials and methods

The distribution of pregeijerene B and 8- $\alpha$ -acetoxyelemol was taken from previous reports (Adams, 1997; 1999; 2000a,b,c,d; 2001a) in *Juniperus* species. The reader is referred to Adams (2001b) for details on methodology.

## 3. Results and discussion

The complete listing of all *Juniperus* species is shown in Table 1. Pregeijerene B has an interesting distribution in *Juniperus* (Table 1). Notice that pregeijerene B and 8- $\alpha$ -acetoxyelemol are present in section *Sabina* but absent in all junipers in sections *Juniperus* and *Caryocedrus*. These compounds are present in all the smooth leaved, one seeded junipers of the eastern hemisphere (Table 1). However, they are found in only three two multi-seeded junipers with the highest concentration in *J. erectopatens*. Using RAPD data, Adams (1999) showed that *J. erectopatens* (described as *J. sabina* var. *erectopatens*) is actually not closely related to *J. sabina* but clusters loosely along with *J. procera*. Notice that both *J. erectopatens* and *J. procera* contain pregeijerene and 8- $\alpha$ -acetoxyelemol (Table 1).

The distribution among the smooth leaf margined junipers of the western hemisphere shows an interesting pattern in these compounds are absent in the Caribbean junipers, except for the anomalous *J. saxicola* of Cuba, but present in all the continental junipers, except *J. horizontalis*. About half of the seventeen serrate leaf margined junipers have pregeijerene B and 8- $\alpha$ -acetoxyelemol (Table 1). *Juni-*

Table 1

Distribution of pregeijerene B and 8- $\alpha$ -acetoxyelemol in *Juniperus* leaf oils. Within subgroups, the species are listed in groupings to reflect relationships based on DNA fingerprinting data (Adams, 1999, 2000a,b,c,d, 2001a)

Species	Pregeijerene B	8- $\alpha$ -Acetoxyelemol
<b>Section <i>sabina</i></b>		
<b>Smooth leaves, one seeded, eastern hemisphere</b>		
<i>J. carinata</i> (Y. K. Yu & L. K. Fu) R. P. Adams	4.9	2.0
<i>J. convallium</i> Rehder & Wils.	–	–
<i>J. coxii</i> A. B. Jacks.	0.05	0.05
<i>J. indica</i> Bertol.	0.2	0.1
<i>J. komarovii</i> Florin	4.5	2.0
<i>J. microsperma</i> (Cheng & L. K. Fu) R. P. Adams	4.3	1.6
<i>J. morrisonicola</i> Hayata	1.3	4.4
<i>J. pingii</i> W. C. Cheng & Ferre	2.9	1.4
<i>J. przewalskii</i> Kom.	3.7	3.9
<i>J. pseudosabina</i> Fisch. & C. A. Mey.	0.2	0.05
<i>J. recurva</i> Buch.-Ham. ex D. Don	2.2	1.9
<i>J. saltuaria</i> Rehder & Wils.	0.9	0.3
<i>J. squamata</i> Buch.-Ham. ex D. Don	5.5	4.7
<i>J. tibetica</i> Kom.	5.6	3.6
<i>J. wallachiana</i> Hook. f. & Thomson ex Brandis	t	0.8
<b>Smooth leaves, multi-seeded, eastern hemisphere</b>		
<i>J. chinensis</i> L.	–	–
<i>J. dayurica</i> Pall.	–	–
<i>J. erectopatens</i> (Cheng & L. K. Fu) R. P. Adams	13.2	1.5
<i>J. excelsa</i> M.-Bieb., Greece	–	–
<i>J. excelsa</i> M.-Bieb., Georgia (CIS)	–	–
<i>J. foetidissima</i> Willd.	–	–
<i>J. jarkendensis</i> Kom.	–	–
<i>J. phoenicea</i> L.	–	–
<i>J. polycarpus</i> K. Koch, Armenia	–	–
<i>J. polycarpus</i> K. Koch, Kazakhstan	–	–
<i>J. polycarpus</i> K. Koch, Pakistan	–	–
<i>J. polycarpus</i> K. Koch, Turkmenistan	–	–
<i>J. procera</i> Hochst. ex Endl.	0.3	3.5
<i>J. sabina</i> L.	–	–
<i>J. semiglobosa</i> Regel	–	–
<i>J. semiglobosa</i> var. <i>talassica</i> (Lipinsky) Silba	–	–
<i>J. thurifera</i> L.	0.4	0.3
<b>Smooth leaf margins, western hemisphere</b>		
<i>J. barbadensis</i> L.	–	–
<i>J. bermudiana</i> L.	–	–
<i>J. blancoi</i> Mart.	3.0	6.8
<i>J. gracilior</i> Pilger	–	–
<i>J. gracilior</i> var. <i>ekmanii</i> (Florin) R. P. Adams	–	–
<i>J. gracilior</i> var. <i>urbaniana</i> (Pilger & Ekman) R. P. Adams	–	–
<i>J. lucayana</i> Britton	–	–
<i>J. horizontalis</i> Moench.	–	–
<i>J. mucronata</i> R. P. Adams	2.2	2.3
<i>J. saxicola</i> Britt. & P. Wilson	0.9	3.3

(continued on next page)

Table 1 (continued)

Species	Pregeijerene B	8- $\alpha$ -Acetoxyelemol
<i>J. scopulorum</i> Sarg.	7.6	8.7
<i>J. virginiana</i> L.	5.3	4.9
<i>J. virginiana</i> var. <i>silicicola</i> (Small) E. Murray	3.9	2.7
<b>Serrate leaf margins, western hemisphere</b>		
<i>J. angosturana</i> R. P. Adams	0.05	0.05
<i>J. ashei</i> Buch.	–	–
<i>J. californica</i> Carr.	0.3	0.1
<i>J. coahuilensis</i> (Mart.) Gausson ex R. P. Adams	0.3	1.3
<i>J. comitana</i> Mart.	–	–
<i>J. deppeana</i> Steudel var. <i>deppeana</i>	–	–
<i>J. durangensis</i> Mart.	–	–
<i>J. flaccida</i> Schlecht. var. <i>flaccida</i>	–	–
<i>J. gamboana</i> Mart.	–	–
<i>J. jaliscana</i> Mart.	–	–
<i>J. monosperma</i> (Engelm.) Sarg.	2.8	1.7
<i>J. monticola</i> Mart.	0.7	2.0
<i>J. occidentalis</i> Hook. var. <i>occidentalis</i>	–	–
<i>J. osteosperma</i> (Torr.) Little	–	–
<i>J. pinchotii</i> Sudw.	0.1	–
<i>J. saltillensis</i> M. T. Hall	0.4	0.5
<i>J. standleyi</i> Steyer.	–	–
<b>Section <i>Juniperus</i> (= sect. <i>oxycedrus</i>)</b>		
<i>J. brevifolia</i> (Seub.) Ant.	–	–
<i>J. cedrus</i> Webb & Berthol.	–	–
<i>J. communis</i> L. var. <i>communis</i>	–	–
<i>J. communis</i> var. <i>saxatilis</i> Pall.	–	–
<i>J. formosana</i> Hayata	–	–
<i>J. lutchensis</i> Koidz.	–	–
<i>J. macrocarpa</i> Sibth. & Sm.	–	–
<i>J. navicularis</i> Grand	–	–
<i>J. oxycedrus</i> L.	–	–
<i>J. oxycedrus</i> var. <i>badia</i> H. Gay	–	–
<i>J. rigida</i> Siebold & Zucc.	–	–
<i>J. rigida</i> var. <i>conferta</i> Parl.	–	–
<i>J. taxifolia</i> Hook & Arn.	–	–
<b>Section <i>caryocedrus</i></b>		
<i>J. drupacea</i> Labill.	–	–

*perus pinchotii* is the only species in this survey that contained pregeijerene but not 8- $\alpha$ -acetoxyelemol.

Cool and Adams (2003) postulate that both pregeijerene B and 8- $\alpha$ -acetoxyelemol arise from 8- $\alpha$ -acetoxyhedycaryol leading to their co-occurrence. Pregeijerene B may be found in other *Cupressaceae* species so it is useful to publish the mass spectrum of pregeijerene B (Fig. 1). The Kovat's Index (KI) for pregeijerene B is 1277 on DB-5.

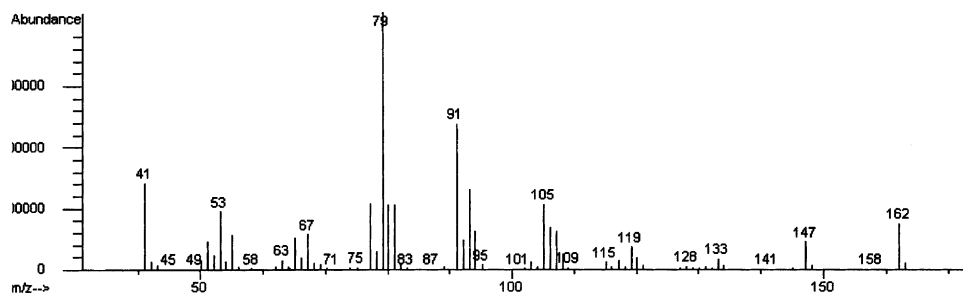


Fig. 1. Quadrupole mass spectrum of pregeijerene B.

The presence of these compounds in section *Sabina*, but absent in sections *Caryocedrus* and *Juniperus* has phylogenetic significance. Section *Caryocedrus* is thought to be ancestral to section *Juniperus* and section *Juniperus* is thought to be ancestral to section *sabina* (Adams, 2000b). So it seems likely that the enzymes for the synthesis of these compounds arose in section *sabina*. In section *Sabina*, these compounds are very common among the smooth leaf margined, one seeded junipers of the eastern hemisphere and the smooth leaf margined junipers of the western hemisphere.

## References

- Adams, R.P., 1997. Comparisons of the leaf oils of *Juniperus drupacea* Labill. from Greece, Turkey and the Crimea. *J. Ess. Oil Res.* 9, 541–544.
- Adams, R.P., 1999. Systematics of multi-seeded eastern hemisphere *Juniperus* based on leaf essential oils and RAPD DNA fingerprinting. *Biochem. Syst. Ecol.* 27, 709–725.
- Adams, R.P., 2000a. Systematics of smooth leaf margin *Juniperus* of the western hemisphere based on leaf essential oils and RAPD DNA fingerprinting. *Biochem. Syst. Ecol.* 28, 149–162.
- Adams, R.P., 2000b. Systematics of *Juniperus* section *Juniperus* based on leaf essential oils and RAPD DNA fingerprinting. *Biochem. Syst. Ecol.* 28, 515–528.
- Adams, R.P., 2000c. Systematics of the one seeded *Juniperus* of the eastern hemisphere based on leaf essential oils and random amplified polymorphic DNAs (RAPDs). *Biochem. Syst. Ecol.* 28, 529–543.
- Adams, R.P., 2000d. The serrate leaf margined *Juniperus* (Section *Sabina*) of the western hemisphere: Systematics and evolution based on leaf essential oils and Random Amplified Polymorphic DNAs (RAPDs). *Biochem. Syst. Ecol.* 28, 975–989.
- Adams, R.P., 2001a. Geographic variation in leaf essential oils and RAPDs of *J. polycarpus* K. Koch in central Asia. *Biochem. Syst. Ecol.* 29, 609–619.
- Adams, R.P., 2001b. Identification of Essential Oil Components by Gas Chromatography/Quadrupole Mass Spectroscopy. . Allured Publ, Carol Stream, IL.
- Cool, L.G., Adams, R.P., 2003. A pregeijerene isomer from *Juniperus erectopatens* foliage. *Phytochemistry* 63, 105–108.