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A NOTE ON THE ASCORBIC ACID CONTENT OF SOME TREES AND WOODY SHRUBS

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Key Word Index—Angiospermae, woody species, leaves, ascorbic acid, vitamin C

Abstract—The foliar ascorbic acid (vitamin C) content of 41 species of 'woody' shrubs and trees is recorded, the mean value for the 41 species was significantly greater ($P < 0.0001$) than that of 'non-woody' angiosperms previously examined

INTRODUCTION

In a previous publication the distribution of ascorbic acid (L-xyloascorbic acid, vitamin C) in the leaves of 211 angiosperm species was recorded [1] The mean ascorbic acid content for the 211 species was 160 1 mg/100 g—almost three times the mean value for 10 commonly cultivated vegetables There was a considerable disparity between the different families examined with mean ascorbic concentrations (mg/100 g) ranging from 60 3 for the Compositae to 391 3 for the Primulaceae The survey was confined, for the most part, to 'non-woody' herbaceous species but it was noted that the foliar ascorbic content of the few trees and 'woody' shrubs included in the survey (e g *Alnus glutinosa*, *Betula pubescens*, *Buxus sempervirens*, *Cornus sanguinea*, *Corylus avellana*, *Fraxinus excelsior*, *Sorbus aucuparia*) was significantly greater ($P = 0.039$) than that of the 'non-woody' species

As there are obvious biochemical differences between 'woody' and 'non-woody' species the survey was extended to include some common trees and shrubs

RESULTS AND DISCUSSION

The results are summarized in Table 1 The mean foliar ascorbic acid concentration in the 41 'woody' species examined was 292 8 ± 27 0 mg/100 g (mean value with standard error of mean) This was significantly greater ($P < 0.0001$) than the mean concentration (157 9 ± 7 9) in

Table 1 Ascorbic acid content of the leaves of woody species

Species	Ascorbic acid (mg/100 g)	Species	Ascorbic acid (mg/100 g)
Acer campestre L	237 2 ± 12 7 (7)	*Picea pungens* Engelm	404 7 ± 25 4 (3)
Acer palmatum Thunb	257 0 ± 4 0 (3)	*Pinus sylvestris* L	207 7 ± 23 1 (3)
Acer pseudoplatanus L	193 7 ± 19 0 (3)	*Populus nigra* L	326 5 ± 2 5 (3)
Aesculus hippocastanum L	177 8 ± 23 4 (3)	*Populus nigra* cv 'Italica'	282 0 ± 10 6 (3)
Alnus glutinosa (L) Gaertn	261 0 ± 47 4 (3)	*Prunus avium* L	353 0 ± 20 9 (3)
Betula pendula Roth	415 0 ± 25 1 (4)	*Prunus domestica* L	210 0 ± 74 9 (4)
Buxus sempervirens L	146 2 ± 12 5 (3)	*Prunus serrulata* Lindl	223 7 ± 5 4 (3)
Castanea sativa Mill	191 3 ± 24 1 (6)	*Prunus spinosa* L	403 2 ± 62 9 (4)
Cedrus libani A Richard	143 7 ± 27 5 (3)	*Quercus cerris* L	149 6 ± 22 8 (3)
Chaemocyparis lawsoniana (A Murr) Parl	142 8 ± 28 3 (5)	*Quercus pontica* K Koch	237 7 ± 45 9 (3)
Corylus avellana L	317 8 ± 32 1 (3)	*Quercus robur* L	272 8 ± 27 5 (4)
Crataegus monogyna Jacq	441 5 ± 23 3 (3)	*Rhamnus catharticus* L	196 5 ± 18 7 (3)
Fagus sylvatica L	260 0 ± 12 1 (4)	*Robinia pseudoacacia* L	212 3 ± 5 4 (3)
Fagus sylvatica forma *purpurea* (Ait) Schneid	256 7 ± 11 1 (3)	*Salix babylonica* L	206 7 ± 35 6 (4)
Ficus carica L	331 0 ± 30 6 (3)	*Salix caprea* L	329 8 ± 22 4 (5)
Frangula alnus Mill	937 5 ± 53 5 (4)	*Salix fragilis* L	293 3 ± 24 6 (3)
Fraxinus excelsior L	187 9 ± 12 4 (7)	*Sambucus nigra* L	299 7 ± 29 5 (3)
Ginkgo biloba L	143 3 ± 10 3 (4)	*Sorbus aucuparia* L	205 0 ± 10 2 (4)
Juglans regia L	925 0 ± 84 1 (3)	*Tilia* × *vulgaris* Hayne	185 0 ± 6 1 (3)
Larix decidua Mill	304 5 ± 46 3 (6)	*Ulmus procera* Salisb	237 3 ± 16 6 (3)
Malus domestica Borkh	495 6 ± 27 6 (5)		

Mean values with standard errors the figures in parentheses are the number of samples analysed

the 192 'non-woody' angiosperms previously examined [1]

It would have been interesting to compare, within the same families, the ascorbic acid concentrations in 'woody' and 'non-woody' species, respectively, but the limited number of local representatives of families that contain a significant number of both 'woody' and 'non-woody' common species precluded this The mean ascorbic acid concentrations in seven 'woody' and eight 'non-woody' members of the Rosaceae were $339 \pm 43\,7$ and $262 \pm 19\,0$ mg/100 g, respectively, but the difference did not attain statistical significance at the $P = 0\,05$ level

It would appear that the relationship between foliar ascorbic acid and 'woodiness', or its biochemical correlates, is one that merits further study

EXPERIMENTAL

Sampling and analysis were as previously described [1] An attempt was made to analyse as many common trees as possible, there was no pre-selection of species for analysis The samples were taken between April and August 1983 and some were remeasured in September and October 1983 There was no significant difference between the pre-September and the post-September analyses

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A BIOGENETICALLY IMPORTANT HYDROCARBON FROM *CYPERUS SCARIOSUS*

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Key Word Index—*Cyperus scariosus*, Cyperaceae, biogenesis, sesquiterpenoids, isopatchoul-3-ene

Abstract—A new hydrocarbon isopatchoul-3-ene has been isolated from the essential oil of *Cyperus scariosus* The structure and stereochemistry was assigned on the basis of spectroscopic and chemical data Its biomimetic conversion to isopatchoulenol has been achieved

INTRODUCTION

The essential oil from *Cyperus scariosus* has already been reported to be biologically active in plant growth regulation [1] One of its several known components (cyperene [2], rotundene [3], rotundenol [3], isopatchoula-3,5-diene [4], β-selinene [4], cyperenol [5], isopatchoulenol [5], patchoulenol [5], scariodione [6]) namely isopatchoulenone (**3**) [6] was found to be a potent root promotor in the stem cuttings of mung beans [7] During our studies for the isolation of further pure components to test them as plant growth regulators and to pin-point the biological activity, we have been able to isolate a hitherto unknown hydrocarbon from the non-polar fraction of the oil

RESULTS AND DISCUSSION

Careful analysis of the hydrocarbon fraction of the oil has revealed the presence of a component different from the already known hydrocarbons cyperene (**4**), isopatchoula-3,5-diene (**5**), β-selinene (**6**) and rotundene (**7**) Repeated chromatography over silver nitrate–silica gel (1 5 6) resulted in the isolation of hydrocarbon isopatchoul-3-ene (**1**), $C_{15}H_{24}$, HRMS (M^+ 204 187), $[\alpha]_D^{20}$ $-24\,9°$, exhibited spectroscopic properties requiring two tertiary methyls, a secondary methyl, an olefinic methyl group [δ1 07 (6 H, *s*), 0 90 (3H, *d*, $J = 6\,5$ Hz) 1 75 (3H, *d*, $J = 2$ Hz)] and an olefinic proton 5 49 (1H, *br s*) and IR bands at 3050, 1625, 1450, 1370 and 815 cm^{-1} On hydrogenation, it consumed one mole of hydrogen to afford a fully saturated hydrocarbon identified as isopatchoulane (**8**) by comparison of its IR spectrum with that of an authentic sample Therefore, hydrocarbon **1** is a tricylic compound with the isopatchoulane type carbon skeleton These properties did not match with those of any other known naturally occurring sesquiterpene hydrocarbon and thus ruled out α-patchoulene (**9**) [8] as a probable structure

Hydrocarbon **1** on treatment with perbenzoic acid at 0° for 1 hr yielded a liquid which was found to be a stereoisomeric mixture of 3α,4α-epoxyisopatchoulene (**10**) and 3β,4β-epoxyisopatchoulane (**11**) by ^{1}H NMR spectroscopy (some of the ^{1}H NMR signals of this

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