and anthocyanidins were extracted respectively in MeOH containing 0 01% cc HCl and centrifuged and their absorbance measured The spectral values were compared with lit data [1, 2]

Acknowledgement—The authors thank Dr Ferenc Tarr for his valuable comments on the identifying process of sugars

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Phytochemistry, Vol 24, No 5, pp 1122–1123, 1985
Printed in Great Britain

0031–9422/85 $3 00 + 0 00

FLAVONOID AGLYCONES IN THE RESIN OF *HAZARDIA SQUARROSA* VAR. *GRINDELIOIDES**

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(*Received* 26 *June* 1984)

Key Word Index—*Hazardia squarrosa*, Asteraceae, leaf resin, 34 flavonoid aglycones

Abstract—Thirty three flavonoid aglycones have been identified from the external stem and leaf resin of *Hazardia squarrosa* var *grindelioides* by TLC co-chromatography with authentic samples The occurrence of compounds with oxygenation at C-6 and C-5′, which are also found in the genus *Haplopappus*, supports the previously believed close relationship between these two genera

INTRODUCTION

Hazardia (Compositae) is a genus of 13 species found in the western United States and adjacent Mexico [1] As part of ongoing work on the chemistry and systematics of *Haplopappus* and its segregate genera [1–9], this study was undertaken to initiate the elucidation of aglycones of the genus, beginning with the most widespread taxon, *H squarrosa* (Hooker & Arnott) Greene var *grindelioides* (DC) Clark The flavonoid glycoside profiles of the entire genus have been published [2], but the nature of the aglycones that are usually found in the leaf and stem exudates of these mostly resinous plants have remained undetermined on this point

RESULTS AND DISCUSSION

The following 33 known compounds were identified from the leaf and stem washings of the sample plant material the flavones apigenin, luteolin, luteolin 7- and 3′-monomethyl ethers, 6-methoxyluteolin, scutellarein 6-methyl and 6,4′-dimethyl ethers, the flavonols kaempferol, kaempferol 7- and 4′-monomethyl ethers, kaempferol 3,4′- and 7,4′-dimethyl ethers, kaempferol 3,7,4′-trimethyl ether, 6-hydroxykaempferol 3,6,4′-trimethyl ether, quercetin, quercetin 3-, 3′- and 7-monomethyl ethers, quercetin 3,7-, 3,3′- and 7,3′-dimethyl ethers, quercetin 3,7,3′-, 3,3′,4′- and 7,3′,4′-trimethyl ethers, quercetin 3,7,3′,4′-tetramethyl ether, quercetagetin 6-methyl ether, quercetagetin 3,6- and 6,3′-dimethyl ethers, quercetagetin 3,6,4′-trimethyl ether, the flavanone eriodictyol and its 7-monomethyl and 7,3′-dimethyl ethers, and dihydrotricetin 7,3′-dimethyl ether (5,4′,5′-trihydroxy, 7,3′-di-*O*-methylflavanone) It should also be noted that 13 additional compounds were observed which behaved chromatographically as flavonoids However, these compounds could not be isolated for further identification due to their low quantities, and they could not be co-chromatographed with known standards with any degree of confidence

In summary, the identifiable aglycones of *H squarrosa* var *grindelioides* are all oxygenated at positions 5,7 and 4′, with additional oxygenation occurring variably at C-3 (22 compounds), C-6 (8 compounds), C-3′ (23 compounds), and C-5′ (1 compound) A preponderance of structures (28 compounds) are methylated, varying from one to four methyl groups, thereby accounting for their distribution in the lipophilic external resin

The number of different structures is relatively high for flavonoid aglycones from a single taxon Although none of the other 12 species of *Hazardia* has been examined thoroughly for their aglycone profiles, species of related genera have been studied None of these, including species

*Part 2 in the series "Flavonoids of *Hazardia*" For Part 1 see ref [2]

of *Haplopappus* [4–8, 10], *Ericameria* [11, 12] and *Prionopsis* [13], has revealed such a complexity of aglycone structures

The flavonoid glycoside profile of *H squarrosa* var *grindelioides* is relatively simple in comparison with its aglycone diversity Ten glycosides which are based on four simple aglycone types are known from this taxon [2] Although two species of the genus, *H detonsa* and *H cana*, are tomentose instead of resinous and do not exude lipophilic flavonoids, it remains to be seen whether the remaining *Hazardia* species exhibit the same pattern of diverse aglycones and simple glycosides found in *H squarrosa*

It has been suggested that the nearest relatives of *Hazardia* are to be found in the South American genus *Haplopappus* [1, 14], which at one time included *Hazardia* as one of its North American sections This relationship is seemingly supported by the occurrence of compounds with 6-oxygenation in *Hazardia*, as reported here for the first time, and in two of the three sections of *Haplopappus* (i e sections *Haplopappus* and *Polyphylla*) that have been examined so far [5–8] Two of these species, *H. canescens* [5] and *H rengifoanus* [6], also produce 6-oxygenated glycosides, which is not the case in *Hazardia* [2] A further link is indicated by the presence of one compound with a tri-oxygenated B-ring in *Hazardia squarrosa* and two such compounds in *Haplopappus integerrimus* of section *Gymnocoma* [4] The similarities support a closer link between *Hazardia* and *Haplopappus* than between *Hazardia* and other North American genera

EXPERIMENTAL

Plant material Leaves and stems of *Hazardia squarrosa* var *grindelioides* were collected along Highway 74, Orange County, CA, 16 miles east of Interstate 5, in September 1982 A voucher specimen (Clark and Clark 1512) has been deposited at the herbarium at ASU

Fractionation and identification of flavonoids Leaves and green stems (230 g) were immersed for *ca* 3 min in CH_2Cl_2 The CH_2Cl_2 was quickly poured off, filtered and evapd to a thick syrup (6 g) This syrup was dissolved in warm MeOH, refrigerated overnight to precipitate waxes, filtered, then applied directly to a Sephadex LH-20 (Sigma) column (4 × 50 cm) and eluted with MeOH 23 fractions of 75 ml each were collected Fractions 1–6 were essentially flavonoid-free, fractions 7–23 were rich in flavonoids All compounds were identified in each fraction according to ref [15], using comparative TLC with authentic samples on polyamide (Polyamide DC-11, Macherey-Nagel), visualized under long-wave UV light (366 nm) both before and after spraying with Naturstoffreagenz A (β-amino-ethyl ester of diphenyl boric acid, C Roth) Eriodictoyl 7-methyl ether and eriodictyol 7,3′-dimethyl ether were origina y isolated from *Notholaena fendleri* frond exudate [16], the authentic sample of 5,4′,5′-triOH,7,3′-diO-methylflavanone was from *Notholaena lemmonii* [17] The remaining reference compounds were isolated from various sources, as referred to in ref [18]

Acknowledgements—We thank the Alexander-von-Humboldt Foundation for a fellowship to W D C during the period this work was completed Financial support from the DFG (E W) is also acknowledged

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