

was removed under vacuum and the residue taken up in MeOH. The flavonoids were purified using paper chromatography (TBA and 15% HOAc) and identified according to Mabry *et al.*³ The sugar moieties of the flavonoids were chromatographically identified on Avicel (TG-101) plates in EtOAc-HOAc-H₂O (9:2:2), *iso*-PrOH-HOAc-H₂O (60:1:39), *n*-BuOH-EtOH-H₂O (40:11:19)⁴ and EtOAc-pyridine-H₂O (12:4:5)⁵ and by paper chromatography using EtOAc-pyridine-H₂O (12:5:4).⁶ The sugars were detected with a periodate positive benzidine hydrochloride reagent or a *p*-anisidine hydrochloride reagent.⁶ The phenolic acids were identified according to Wallace.⁷ A more detailed account of the above can be found in McGowan.⁸

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³ T. J. MABRY, K. R. MARKHAM and M. B. THOMAS, *The Systematic Identification of Flavonoids*, Springer-Verlag, New York (1970).

⁴ S. HOLLMAN, in *Non-glycolytic Pathways of Metabolism of Glucose* (edited by S. HOLLMAN), Academic Press, New York (1964).

⁵ J. B. PRIDHAM, *Analyt. Chem.* **28**, 1967 (1956).

⁶ G. HOWARD, Ph.D. Dissertation, The University of Texas at Austin (1970).

⁷ J. W. WALLACE, *Am. J. Bot.* **59** (in press) (1972).

⁸ S. G. MCGOWAN, M.A. Thesis, Western Carolina University (1971).

Key Word Index—*Cirsium lanceolatum*; Compositae; flavonol glycosides; apigenin 7-diglucoside; genkwanin 4'-glucoside; phenolic acids.

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FLAVONOL-3-GLUCOSIDES IN EIGHT *EUPATORIUM* SPECIES

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Plants and sources. Almost all the plants were collected by Dr. R. K. Godfrey to whom the authors are grateful. *Eupatorium album* L. (in clearing 16 miles west of Tallahassee, on Nov. 5, 1961; FSU herbarium No. 68 317). *E. capillifolium* (Lam.) Small. (near Tallahassee, on Oct. 2, 1961; Godfrey No. 61 490). *E. capillifolium perfoliatum* (along Florida route 361, 2 miles from the coast in Taylor County, Florida, on Oct. 14, 1961; Houk No. 370, FSU herbarium No. 67 390). *E. coelestinum* L.* (near St. Marks, Wakulla Co., on Oct. 2, 1961; FSU herbarium No. 66 988). *E. cuneifolium* Willd. (in the vicinity of Lake Seminole, north of Sneads, Florida; Godfrey No. 61 389 and 3 miles west of Ponce de Leon, Holmes Co., Florida along US 90; Lazor No. 928). *E. hyssopifolium* L. var. *calcaratum* (diploid) (in Leon County, Florida, on Aug. 28, 1968; Godfrey No. 68-119). *E. perfoliatum* L. (in vicinity of St. Marks, Wakulla Co., on Oct. 2, 1961; Godfrey No. 61 493 and at crossing of side road and Florida route 20, 7 miles east of Hosford, Florida, on Sept. 20, 1968; Lazor No. 1218). *E. 'recurvans'* Small. (a special naturally occurring hybrid of *E. recurvans* and

* Revised to *Conoclinium coelestinum* (L.) A. P. DECANDOLLE, R. M. KING and H. ROBINSON, *Phytologia* **19**, 299 (1970).

E. rotundifolium) (4 miles north of Carabelle, Franklin Co., Florida; along Florida route 67, on Aug. 4, 1968; FSU herbarium No. 67 977). *E. rotundifolium* L. (in vicinity of Hosford, Liberty Co., on Nov. 5, 1961; Godfrey No. 61 642). *E. rugosum* Houtt. (along Apalachicola river, west of Hosford, Florida, on Nov. 5, 1961; FSU herbarium No. 68 144).

Previous work. *E. rotundifolium*: Tumor inhibitory sesquiterpene lactones,¹⁻³ hispidulin;⁴ *E. cuneifolium*: hispidulin and eupafolin,⁴ tumor inhibitory sesquiterpene lactone epuacunin;^{5,*} *E. perfoliatum*:⁶ terpenes;⁷ *E. capillifolium*: alkaloids,⁸ essential oils.⁹

Compounds isolated. Quercetin, kaempferol, quercetin 3- β -galactoside (hyperoside), kaempferol 3- β -glucoside (astragalin), quercetin 3-rutinoside (rutin) and kaempferol 3-rutinoside isolated from the methanolic extracts of the aerial parts of the plants by the methods described earlier¹⁰ and identified by direct comparison with authentic materials, cochromatography (TLC, 3 solvents) and UV analysis. Though the pattern of the compounds present in all the species and varieties is almost same, minute variations do occur; for instance, hyperoside and astragalin were the only compounds present in *E. capillifolium*, *E. capillifolium perfoliatum* and *E. cuneifolium* (Lazor 928). Likewise, only rutin and kaempferol 3-rutinoside were present in *E. alba*, *E. 'recurvans'* and *E. rugosum*. Kaempferol and quercetin as aglycones are represented only in *E. cuneifolium* (Lazor 928) and *E. hyssopifolium*. The ether fraction of *E. hyssopifolium* yielded an interesting compound which is being characterized. Instead of hyperoside, quercetin 3-glucoside appears in *E. hyssopifolium*.

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* KUPCHAN *et al.* refer to *E. cuneifolium* Willd. erroneously as *E. cuneifolium* (Tourn.) L.

- ¹ S. M. KUPCHAN, J. C. HEMINGWAY, J. M. CASSADY, J. R. KNOX, A. T. MCPHAIL and G. A. SIM, *J. Am. Chem. Soc.* **89**, 465 (1967).
- ² S. M. KUPCHAN, J. E. KELSEY, M. MARUYAMA and J. M. CASSADY, *Tetrahedron Letters* 3517 (1968).
- ³ S. M. KUPCHAN, J. E. KELSEY, M. MARUYAMA, J. M. CASSADY, J. C. HEMINGWAY and J. R. KNOX, *J. Org. Chem.* **34**, 3876 (1969).
- ⁴ S. M. KUPCHAN, C. W. SIGEL, R. J. HEMINGWAY, J. R. KNOX and M. S. UDAYAMURTHY, *Tetrahedron* **25**, 1603 (1969).
- ⁵ S. M. KUPCHAN, M. MARUYAMA, R. J. HEMINGWAY, J. C. HEMINGWAY, S. SHIBUYA, T. FUJITA, P. O. CRADWICK, A. D. U. HARDY and G. A. SIM, *J. Am. Chem. Soc.* **93**, 4914 (1971).
- ⁶ H. SCHINDLER, *Arzneimittel Forschung* **3**, 541 (1953).
- ⁷ J. M. CASSADY, T. B. C. TOMASSINI and A. M. KNEVEL, *Lloydia* **32**, 522 (1969).
- ⁸ X. A. DOMINGUEZ, M. GUTIERREZ and A. NORMA, *Planta Med.* **18**, 51 (1969).
- ⁹ X. A. DOMINGUEZ, M. E. GOMEZ, P. A. GOMEZ, A. N. VILLARREAL and C. ROMBOLD, *Planta Med.* **19**, 52 (1971).
- ¹⁰ H. WAGNER, M. A. IYENGAR, E. MICHAELLES and W. HERZ, *Phytochem.* **10**, 2547 (1971).

Key Word Index—*Eupatorium* spp.; Compositae; 3-glucosides and 3-rutinosides of kaempferol and quercetin.