CHEMICAL SYSTEMATICS OF FAMILY GENTIANACEAE

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ABSTRACT

In the present paper an attempt is made to adduce more chemical evidence for better understanding of the taxonomy of Gentianaceae. Flavonoids, xanthones, saponins, tannins and phenolic acids have been used as markers. This chemical work on 10 members of the Gentianaceae tend to justify elevation of the two sub-families to family level, as Gentianaceae *senu lato* and Menyanthaceae. The work also indicates chemical distinctiveness of the tribe Exacineae which is proposed to be raised to a family Exacaceae.

INTRODUCTION

GENTIANACEAE, a small herbaceous family, is peculiar, because of the presence of Xanthones—a group of yellow pigments—in many of its members. This family is usually sub-divided into two sub-families, the Gentianoideae, having opposite decussate leaves with twisted or imbricate corolla and septicidal dehiscence of the capsule and Menyanthoideae with alternate leaves, induplicate or valvate corolla and irregularly dehiscing capsule. The Gentianoideae are variously sub-divided into tribes, by characters based on, the length of the style, the size and the importance of placentas in the sub-division of the ovary, the development of the anther connective and in more recent arrangements, the nature of the pollen[12]. The Menyanthoideae have been separated from Gentianaceae and elevated to a separate family status—Menyanthaceae—by Engler[3], mainly based on anatomical and morphological findings of Lindsey[10]. Hutchinson[9] not only supports this view but also separates Gentianaceae and Menyanthaceae to a distinct bifamilial order Gentianales. Based on the available chemical data Gibbs[4] also supports such a contention.

The phenolic chemistry of the family is known only by a few reports on the Xanthones. The known flavonoid data are glycoflavones from *Swertia japonica*[9] and *Gentiana cruciata*[5].

In the present work 10 plants belonging to this family are qualitatively analysed for leaf phenolics, saponins and tannins with a view to bringing out additional chemical evidences with regard to the taxonomy phylogeny of the groups.

MATERIALS AND METHODS

Excepting *Swertia corymbosa* and *Halenia perrottetii* (leaf samples from Herbarium specimens), all other plants have been collected fresh. Voucher specimens are deposited in the Herbarium, Department of Botany, The M.S. University of Baroda, Baroda, India.

The procedures adopted for the analysis of leaf phenolics have been mentioned elsewhere[2]. Xanthones include all the yellow pigments having orange yellow colour in u.v. light, changing to fluorescent yellow with ammonia vapour and spectral properties, exhibiting maxima at 230–245, 250–265, 305–330 and 340–400 mμ[6,7]. Saponins and tannins were tested using known procedures[1,11].

RESULTS

The distribution of various flavonoids, xanthones, saponins, tannins and phenolic acids is presented in Tables I and II.

All the plants except *Swertia corymbosa* and *Halenia perrottetii* possess flavonoids in the leaves (for these two plants experiments could not be repeated due to non-availability of more plant material). The flavones apigenin, luteolin and diosmetin (4′-methyl ether of luteolin) as *o*-glycosides are present in both the species of *Exacum*. The glycoflavones (*c*-glycosides of flavones) are present in *Enicostemma, Hoppea* and *Canscora*. The various glycoflavones are isovitexin, iso-orientin and *c*-glycoside of genkwanin (evidenced by the absence of spectral shift in band II with anhydrous sodium acetate and band I same as with sodium methoxide). The flavonol, quercetin and its methyl ethers are detected only in the two species *Nymphoides*. Leucoanthocyanin test is strongly positive in both the species of *Nymphoides* only. In *N. cristatum* free anthocyanin also could be located (which may be due to mild acidic conditions of extraction).

Xanthones have been located in *Enicostemma Hoppea, Canscora, Swertia* and *Halenia* (Identification of various Xanthones has not been attempted).

TABLE I

Flavonoids, Xanthones, Saponins and Tannins in Gentianaceae

	Flavonoids										
	Apigenin	Luteolin	Diosmetin	Quercetin	Q-3-OMe	Isorhamnetin	Leucoantocyanins	Glycoflavones	Xanthones	Saponins	Tannins
Sub-family Gentianoideae											
Exacum bicolor Roxb.	+	+	..	..	..	–	..	..	..	..	..
E. penduncu1atum Linn.	..	+	+	..	..	..	..	..	..	..	..
Enicostemma hyssopifolium Verdoorn	..	..	..	..	..	..	..	+	+	..	..
Hoppea dichotoma Willd	..	..	..	..	..	..	..	+	+	..	..
Canscora decurrens Dalz.	..	..	..	..	..	..	..	+	+	..	..
C. diffusa R. Br.	..	..	..	..	..	..	..	+	+	..	..
Swertia corymbosa Wt.	..	..	..	..	..	..	..	..	+	..	..
Halenia perrottetti Griseb.	..	..	..	.	..	..	..	..	+	..	..
Sub-family Menyanthoideae											
Nymphoides indicum O. Kuntze	..	..	..	+	+	+	+	..	..	+	..
N. cristatum O. Kuntze	..	..	..	+	+	+	+	..	..	+	..

TABLE II

Phenolic acids in Gentianaceae

	Vanillic	Syringic	*p*-hydroxy benzoic	Protocatechuic	2-OH, 4-OMe, benzoic	2-OH, 6-OMe, benzoic	*p*-Coumaric	Ferulic	Sinapic
Sub-family Gentianoideae									
Exacum bicolor Roxb.	+	..	+	+	..	..	+	..	..
E. pedunculatum Linn.	+	+	+	+	+	..	+	+	..
Enicostemma hyssopifolium Verdoorn.		+	+	+	..	..	+	+	..
Hoppea dichotoma Willd	+	..	+	..	..	..	..	..	..
Canscora decurrens Dalz.	+	+	+	+	..	..	+	+	..
C. diffusa R. Br.	+	+	+	+	..	..	+	+	..
Swertia corymbosa Wt.	+	+	+	..	..	+	..	..	..
Halenia perrottetti Griseb.	+	+	..	..	..	+	..	..	..
Sub-family Menyanthoideae									
Nymphoides indicum O. Kuntze	+	..	+	..	+	..	..	+	+
N. cristatum O. Kuntze	+	..	+	..	+	..	..	+	+

Saponin test is strongly positive in *Nymphoides cristatum* only. In *N. indicum* the test is slightly positive. All the plants analysed failed to show the presence of tannins.

Of the various phenolic acids encountered syringic, protocatechuic and *p*-conmaric acids are present only in the sub-family Gentianoideae and sinapic acid in the Menyanthoideae.

DISCUSSION

The distribution of various secondary metabolites definitely keep the two sub-families chemically very distant. Flavones (as *o*- and *c*-glycosides), xanthones, syringic acid, photocatechuic acid and *p*-coumaric acid are present only in Gentianoideae, whereas Menyanthoideae possess flavonols, leucoanthocyanins and saponins. These chemical evidences strongly justify the elevation of these two sub-families to family level, as Gentianaceae *sensu lato* and Menyanthaceae; as already practised by Engler[3] and Hutchinson[8]. Other chemical evidences listed by Gibbs[4] (hot-water test, cyanogenetic glycosides and some other data on saponins) and also the abundance of L-(+)-bornesitol in Gentianoideae[13] lend further support to this view.

In the Gentianaceae *sensu stricto*, flavone-o-glycosides are restricted to the tribe Exacineae (Type genus *Exacum* is screened here). The xanthones and glycoflavones so abundant in the rest of the Gentianaceae are conspicuously absent in the Exacineae. L-(+)-bornesitol which is very common in the Gentianaceae also eludes this tribe[13]. The bilocular ovary of the tribe, in the otherwise unilocular Gentianaceae, is a characteristic, morphological feature.

The available morphological and chemical data, therefore, evoke a few pertinent queries.

(1) Do all these formidable evidences suggest raising of the tribe Exacineae to a family or a sub-family level?

(2) If the morphological and chemical differences of the same magnitude could warrant a family status for Menyanthaceae, would it not be in the fitness of things to segregate the tribe Exacineae and elevate it to the family category?

Answers to these queries are apparently in the affirmative. The tribe Exacineae, in our opinion should be raised to family Exacaceae. However, chemical data on the remaining genera of Exacineae in particular and the Gentianaceae in general, are necessary to draw valid conclusions based on sound taxonomic judgement.

1. Arthur, H. R. and Chau, P. K. R., *Trop. Sci.*, 1962, 4, 147.
2. Daniel, M. and Sabnis, S. D., *Curr. Sci.*, 1977, 46 (14), 472.
3. Engler, A. and Melchior, H., A. Engler's *Syllabus der Pflanzen Familien*, Gebr. Borntraegr, Berlin, 1964, 2 Band, 408.
4. Gibbs, R. D., *Chemotaxonomy of Flowering Plants*, McGill, Queens, London, 1974, 3, 1332.
5. Goetz, M., Hostettmann, K. and Guillarmod, A. J., *Phytochemistry*, 1976, 15 (12), 2015.
6. Harborne, J. B., *Comparative Biochemistry of the Flavonoids*, Academic Press, London, 1967.
7. —, *Phytochemical Methods*, Chapmann and Hall, London, 1973.
8. Hutchinson, J., *Evolution and Phylogeny of Flowering Plants*, Academic Press, London, 1969.
9. Komatsu, M. and Tomimori, T., *Tetrahedron Letters*, 1966, p. 1611.
10. Lindsey, A. A., *Am. J. Bot.*; 1938; 25, 480.
11. Persinos, G. J., *Econ. Bot.*, 1964, 18, 4.
12. Rendle, A. B., *The Classification of Flowering Plants*, 2nd ed., Cambridge, 1938, 2.
13. Shilling, N., *Phytochemistry*, 1976, 15 (5), 824.

INFLUENCE OF SEX ON HEPATOPANCREATIC GLYCOGENOLYSIS OF SCORPION *HETEROMETRUS FULVIPES* (C. KOCH)

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ABSTRACT

The levels of haemolymphatic glucose, hepatopancreatic glycogen were shown to differ between male and female scorpions. The hepatopancreatic phosphorylase '*a*' and '*ab*' activity levels were higher in males than in the females. The higher levels of phosphorylase activity in males have been correlared with higher glycogenolysis and haemolymphatic glucose. The sex-based differences in glycogenolysis have been discussed.

INTRODUCTION

THE sex of the animals has been indicated to play a vital role in various physiological activities[1-4]. The differences in morphological features and the tissue somatic indices have been clearly established between the two sexes of different animals[1-5]. There seem to be metabolic differences at the enzymatic levels between male and female scorpions[6]. In comparison to other groups of animals, there is less work on the scorpions in relation to sex. Hence an attempt has been made to study the sex-based differences in glycogenolysis to understand the probable cause

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