Phytochemistry, 1980, Vol. 19, pp. 2757–2758. © Pergamon Press Ltd. Printed in England. 0031-9422/80/1201-2757 $02.00/0

ABSENCE OF CYANOGENESIS FROM DROSERACEAE

ADOLF NAHRSTEDT

Institut für Pharmazeutische Biologie, Technische Universität, D-3300 Braunschweig, W. Germany

(*Revised received* 23 *April* 1980)

Key Word Index—Droseraceae; cyanogenesis; Guignard Mirande-test; plumbagin; naphthoquinone.

A number of members of the Droseraceae have been reported to be cyanogenic [1–5]. All these observations were based on the well known picrate paper (GM) test [6]. In the presence of HCN the yellow paper turns to orange, red or brown through the formation of an isopurpuric acid with a chelated carbonyl group [7]. From several observations, it is known that this test is not entirely specific for HCN [8–10]. A screening for cyanogenesis of supposedly-positive members of Droseraceae showed contradictory results: some of the plants tested exhibited a positive GM-test, whereas all plants reacted negatively in the more sensitive and more specific Feigl–Anger-test [11] (FA-test) (see Table 1). Furthermore, methanolic extracts from lyophilized plant material of *Drosera binata* and *Dionea muscipula* which were positive in the GM-test (Table 1) showed no cyanogenic activity when hydrolysed by β-glucosidase or phosphoric acid using the method of Aldridge [12].

When the GM-test paper was replaced by a strip moistened with 1 N NaOH formation of a red colour upon the paper was observed again. The red substance was extractable by NaOH yielding a pink solution which became yellow after acidification. The substance was isolated from the paper strip as well as from leaves of *Dionea muscipula* and peduncles of *Drosera binata* and identified as plumbagin (5-hydroxy-2-methyl-1,4-naphthoquinone) by co-chromatography, IR and ^{1}H NMR spectroscopy.

Thus, the cyanide indicating substance in the GM-test is plumbagin. Plumbagin is volatile in steam and gives a red colour in alkaline solution, as do all 1,2- or 1,3-hydroxyketones [15]. Consequently a GM-test with plumbagin itself instead of with plant material gave a positive result. The distribution of plumbagin in the Droseraceae (see Table 1) correlates well with the positive GM-test results although there are some exceptions. Nevertheless, from these results the GM-test in this case obviously has been false positive. In support of these conclusions, R. Hegnauer and coworkers (personal communication) have always failed to detect cyanide in

Table 1. Tests for cyanogenesis and the frequency of plumbagin records in the Droseraceae

Species	Cyanide present: Literature (GM-test)	Cyanide present: Our own investigations GM-test	Cyanide present: Our own investigations FA-test	Presence/absence of plumbagin	(Lit.)
Dionea muscipula Ell.	[1, 3, 4, 5]	+ +	–	+	13
Drosera affinis		–	–		
D. aliciae Hamet.		–	–	–	13
D. binata Labill.	[1, 3, 4, 5]	+ +	–	+	13
D. burkeana Planch.		–	–	–	13
D. burkmannii		–	–		
D. capensis L.		(+)	–	(+)	13
D. cappillaris Poir.		–	–	+	14
D. intermedia Hayne	[1, 3, 4, 5]	nt	nt	+	14
D. montana		–	–		
D. natalescens		–	–		
D. peltata Sm.	[2, 4]	nt	nt		
D. rotundifolia L.	[1, 3, 4, 5]	nt	nt	+	14
D. spathulata Labill.	[2, 4, 5]	–	–	–	13
D. whittakeri Planch.	[5]	nt	nt	+	13
Drosophyllum lusitanicum Link.	[1, 3, 4]	nt	nt	+	13

Cyanogenesis is based on the Guignard - Mirande-test (GM) as reported in the literature and our own results from 0.5–1 g fresh plant material using the GM-test as well as the Feigl–Anger-test (FA). For comparison the presence or absence of plumbagin is indicated. Key: + = positive; (+) = weak positive; – = not detected; nt = not tested; blank = no information.

members of the Droseraceae using the FA-test. Thus, the Droseraceae seem to be free of cyanogenic compounds.

Acknowledgements—I am grateful to Prof. Dr. M. H. Zenk, University of Bochum, for an authentic sample of plumbagin and to Mr. M. Eberle, Botanical Garden of the University of Freiburg, for growing the plants.

REFERENCES

1. Greshoff, M. (1909) *Bull. Misc. Inf. R. Bot. Gard.* 397.
2. Petrie, J. M. (1912) *Proc. Linn. Soc. N.S.W.* **37**, 220.
3. Rosenthaler, L. (1919) *Schweiz. Apoth. Ztg.* **57**, 307.
4. Hegnauer, R. (1966) *Chemotaxonomie der Pflanzen*, Vol. 4. Birkhäuser Verlag, Basel.
5. Gibbs, R. D. (1974) *Chemotaxonomy of Flowering Plants*, Vol. III. McGill-Queens Univ. Press, Montreal.
6. Mirande, M. (1909) *C. R. Acad. Sci.* **149**, 140.
7. Auterhoff, H. and Heinzelmann, M. (1971) *Arch. Pharm.* **304**, 624.
8. Mitchell, N. D. and Richards, A. J. (1978) *New Phytol.* **81**, 189.
9. Larsen, L. M. (1978) Paper Presented at the EMBO-Workshop on Cyanide Metabolism. Canterbury, August 14–18.
10. Walt, van der, S. J. (1944) *Onderstepoort J. Vet. Sci. Anim. Ind.* **19**, 79.
11. Tantisewie, B., Ruijgrok, H. W. L. and Hegnauer, R. (1969) *Pharm. Weekbl.* **104**, 1341.
12. Kröller, E. (1965) *Z. Lebensm. Unters. Forsch.* **127**, 130.
13. Zenk, M. H., Fürbringer, M. and Steglich, W. (1969) *Phytochemistry* **8**, 2199.
14. Durand, R. and Zenk, M. H. (1974) *Phytochemistry* **13**, 1483.
15. Kakác, B. and Vejdelek, Z. J. (1974) *Handbuch der Photometrischen Analyse*, Vol. I, p. 314. Verlag Chemie, Weinheim.