

SHORT COMMUNICATION

ANTHOCYANIN FROM A MALAYAN MEMBER OF THE PODOCARPACEAE

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Abstract—The identification of delphinidin-3,5-diglucoside in *Podocarpus polystachus* R.Br. extends the known occurrence of anthocyanins to two families of the Gymnospermae.

INTRODUCTION

ANTHOCYANINS, although characteristic of Angiosperms, are certainly not conspicuous pigments among members of the Gymnospermae. Until recently there was some doubt as to whether any had been unequivocally identified in this section of the plant kingdom.¹ Subsequently it has been shown that cyanidin-3-glucoside, cyanidin-3-rhamnoside and delphinidin-3-glucoside occur in certain tissues of many members of the family Pinaceae.²

We now wish to report the identification of delphinidin-3,5-diglucoside in *Podocarpus polystachus* R.Br.

RESULTS AND DISCUSSION

During the post-monsoon dry period in Selangor, Malaysia, an adult tree of the above species was observed to undergo a short interval of rapid leaf development. The new leaves were much lighter in colour than the mature foliage, and the youngest leaves showed a definite pink tint which remained for about 1 week. Preliminary examination of this coloured tissue showed the presence of considerable amounts of leucodelphinidin. Isolation of the pigment was therefore carried out under very mild conditions, in order to avoid obtaining delphinidin as an artefact.

The solution obtained by macerating the pink-tinted leaves with cold 0.2% methanolic hydrogen chloride was concentrated *in vacuo* at room temperature. After repeated chromatography on columns of cellulose powder there was obtained from this extract a red solution with chromatographic and spectral absorption properties showing the presence of anthocyanin. Acid hydrolysis yielded delphinidin and glucose, each identified by chromatography against authentic samples. In order to determine the pattern of sugar combination, solutions resulting from partial acid hydrolysis were examined by two-dimensional chromatography. These showed the presence of two intermediate hydrolysis products including one with R_f

¹ J. B. HARBORNE, in *Comparative Phytochemistry* (edited by T. SWAIN), p. 274, Academic Press, London and New York (1966).

² F. SANTAMOUR, *Forest Sci.* 12, 429 (1966); *Morris Arboretum Bulletin* 17, 50 (1966) and 18, 41 (1967).

values agreeing with those of delphinidin-3-glucoside.³ This result and the absence of a marked shoulder at *ca.* 450 nm in the absorption spectrum, indicated that the anthocyanin was likely to be a 3,5-diglycoside.⁴ Finally, the original anthocyanin had *R_f* values in two solvent systems that agreed with published values for delphin (delphinidin-3,5-diglucoside).³

Apart from its wider systematic interest, the occurrence in this plant of delphin in particular is quite surprising. Leaf pigments tend to be simpler than flower or fruit pigments, both in the anthocyanidin and in the pattern of glycosidation;⁵ in the vast majority of cases the compound responsible is cyanidin-3-glucoside. The anthocyanin of *Podocarpus polystachus* is thus somewhat unusual in both respects.

Juvenile leaf coloration is a conspicuous feature of the tropical rain forest,⁶ but as a physiological phenomenon it appears to have attracted little attention. The manifestation of this effect in a tree species outside the Angiospermae appears to emphasize some relation between environment and physiology that results in anthocyanin formation. At least one other Malayan member of the Podocarpaceae has been said to show young leaf coloration,⁷ and some have the seed surrounded by a red fleshy aril. It therefore seems likely that anthocyanin formation is not uncommon in this family.

EXPERIMENTAL

Chromatography was carried out on Whatman No. 1 paper, in tanks arranged for descending flow. Solvent mixtures were those described in the references cited. Reference samples of anthocyanidin chlorides were obtained from Fluka AG.

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³ K. HAYASHI, in *The Chemistry of Flavonoid Compounds* (edited by T. A. GEISSMAN), p. 275, Pergamon Press, London (1962).

⁴ J. B. HARBORNE, *Biochem. J.* **70**, 22 (1958).

⁵ J. R. PRICE and V. C. STURGESS, *Biochem. J.* **32**, 1658 (1938).

⁶ P. W. RICHARDS, *The Tropical Rain Forest*, p. 78, University Press, Cambridge (1964).

⁷ E. J. H. CORNER, *Wayside Trees of Malaya*, p. 722, Government Printing Office, Singapore (1951).