Distribution Pattern of Anthocyanidins and Anthocyanins in Polygonaceous Plants

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Forty-six polygonaceous plants were examined regarding the nature and amount of anthocyanidins which were obtained as the HCl-hydrolyzate of leaf proanthocyanidins. All of the plants examined contained cyanidin in common in their hydrolyzed leaf-extracts. From this survey, at least three groups of plants may be distinguished; the first containing only cyanidin, the second delphinidin in addition to cyanidin and the third an unknown anthocyanidin (called PA-X) and cyanidin. Of the plants examined, Polygonum cuspidatum leaves yielded cyanidin in the largest amount. There were no geographical and seasonal variations of the distribution pattern of pigments in the plants, and also no variation of anthocyanidin-types was observed in young and mature leaves.

A further survey of anthocyanins in the plants revealed that delphinidin glycosides are present in the sepals of Polygonum nepalense and P. thunbergii.

Key words: Anthocyanidins — Anthocyanins — Distribution pattern — Proanthocyanidin — Polygonaceae.

Proanthocyanidins are widely distributed in various plants, especially woody plants. Some plants belonging to the family Polygonaceae also have been known as a rich source of proanthocyanidin, so that some of them have been used as medicinal herbs. In the previous papers (Yoshitama et al., 1984 ; Kawasaki et al., 1986), it was shown that the glycosides of cyanidin and quercetin are most widely distributed in the family Polygonaceae, and that the occurrence of the methylated derivatives of those pigments is confined to the plants of the sections Echinocaulon and Persicaria belonging to the genus Polygonum. In the present study, anthocyanidins obtained as the HCl-hydrolyzate of proanthocyanidin from the leaves of polygonaceous plants were examined from the chemotaxonomical point of view, to allow discussion of the species relationships in the family. Furthermore, anthocyanins in some polygonaceous plants were also examined so as to complement the results of the earlier survey (Yoshitama et al., 1984.)
Materials and Methods

Plant sources

The plant materials were collected in Nagano, Niigata and Kumamoto-prefectures, except that Coccoloba uvifera, Rheum rhaponticum and R. palmatum var. tanguticum were collected from the Botanical Garden of The University of Tokyo, Polygonum tinctorium and P. bistorta from The Botanical Garden of Kyoto City, and Polygonum weyrichii and Rheum rhaponticum from The Botanical Garden of Hokkaido University. The identification of the species were performed by Dr. T. Shimizu (Faculty of Liberal Arts, Shinshu University). Voucher specimens are deposited in SHIN.

Extraction and analytical procedures of anthocyanidins

Fresh green leaves (ca. 3 g) of each plant were cut into small pieces, placed in a test tube, and covered with 7 ml of 2N-HCl. The tube was then heated in a boiling water bath for one hour. After hydrolysis, the cooled red-hydrolyzate was filtered, extracted thoroughly with ethyl ether and aerated to remove remaining ethyl ether. Anthocyanidins were transferred to iso-amyl alcohol, which was beforehand saturated with 5% HCl. Anthocyanidins in the alcohol extract were identified by comparison with authentic anthocyanidins by TLC using the solvents Forestal (acetic acid/HCl/H₂O, 30 : 3 : 10, v/v/v) and FHW (formic acid/HCl/H₂O, 5 : 2 : 3, v/v/v). The pigments purified chromatographically were also identified spectrophotometrically by direct comparison with authentic specimens, using a Hitachi 201 double beam spectrophotometer. Finally, the amount of pigment on the basis of fresh weight of leaf tissues was determined at 535 nm by comparison with the standard curve of the authentic cyanidin.

Extraction and identification of anthocyanins

The extraction procedures and the identification of anthocyanins were performed as described earlier (Yoshitama et al., 1984).

Results and Discussion

Distribution of anthocyanidins derived from the leaf proanthocyanidin in polygonaceous plants is summarized in Table 1. All of the plants examined contained cyanidin in common in their leaf-hydrolyzates, so that procyanidin is distributed widely in the leaves of polygonaceous plants. The present result well coincided with that of the preliminary survey of Bate-Smith (1961). Moreover, Nonaka et al. (1981, 1982) have recently isolated dimeric and trimeric procyanidins acylated with gallic acid from the roots of Rheum undulatum and Polygonum multiflorum.

In the present survey, it was found that there are three types of distribution patterns of anthocyanidins deriving from proanthocyanidins in polygonaceous plants. The plants of the first type produced only cyanidin on acid hydrolysis. All plants of the genus Rumex and some of the genus Polygonum belong to this type. The second type yielded cyandin and delphinidin which were found in all plants of the genus...