THE OCCURRENCE OF POLYPRENOLS IN EUPHORBIACEAE

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ABSTRACT

The distribution and occurrence of polyprenols in leaves of 19 species belonging to the Euphorbiaceae family were investigated. Polyprenols comprising 11 and 12 isoprene units were the dominant ones in the majority of the plants investigated. Out of the 19 species studied the highest concentration of polyprenols was observed in *Phyllanthus amarus* (0.1-0.3%, dry wt.).

KEY WORDS: Euphorbiaceae, polyprenols.

INTRODUCTION

Polyprenols (Fig. 1) with the longest chain are those known as natural rubber composed of hundreds of isoprene units (Tanaka 1989).

Fig. 1. Polyprenol.

The polyprenols composed of 10, 11 and 12 isoprene units were described by the Liverpool group in the late 1960s (Stone et al. 1967) and their content in leaves of *Ficus elastica* was found to be high (ca. 1-2%, dry weight). The complex character of polyprenol spectrum was demonstrated for various representatives of gymnosperms by Ibata et al. (1984) and further documented by studying a large number of Cycadopsida and Coniferopsida (Świeżewska and Chojnacki, 1988) and species belonging to the Rosaceae family (Świeżewska et al. 1992). The chain length of polyprenols in green leaves may vary from ca. 10 to several dozen of isoprene units (rev. by Świeżewska et al., 1994). In the present paper were port the characteristic polyprenol patterns and the approximate concentration of polyprenols in

the leaves of 16 plants belonging to the Euphorbiaceae family. The study was undertaken with a view to find whether there are common features of the polyprenol spectrum within genera, that may serve as chemotaxonomic markers. Additional aims were to extend the number of the species belonging to the Euphorbiaceae family that were already checked for polyprenols (Świeżewska et al. 1994) and to study plant species originating from the same natural geographic area (South of India, Kerala).

MATERIAL AND METHODS

Plant material

Leaves of 19 species of plants listed in Table 1 were collected from different parts of Kerala in the period September-October 1999 and identified by Sri Dhruvan Tandyekal of the Tropical Botanic Garden and Research Institute. Voucher specimens of all the species were deposited at the TBGRI Herbarium. Healthy leaves were selected, shade-dried and stored.

TLC analysis of polyprenols

Dry leaves (0.5 g) were homogenized in a mortar and pestle with 2 ml of acetone/hexane (1:1, v/v). The extracted polyprenols were at first analyzed by adsorption chromatography on silica gel thin-layer plates (Merck, Darmstadt, Germany) using ethyl acetate: benzene (1:19, v/v) as the solvent and visualized with iodine vapors. Plant extracts which showed polyprenol esters on TLC were subjected to strong alkaline hydrolysis (Stone et al. 1967).

Qualitative evaluation of the polyprenol spectrum was performed by comparing on RP-18 plates developed in acetone, the chromatographic patterns of the studied polyprenols with those

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TABLE 1. Polyprenols in leaves of plants of the Euphorbiaceae family.

Plant species	Polyprenols	
	Content (% dry wt.)	Dominating prenologues (no. of isoprene units)
1. <i>Antidesma ghaesembilla</i> Gaertn.	0.005-0.010	11, 12, 13, 16
2. <i>Aporosa acuminata</i> Thw.	0.005-0.010	10, 11
3. <i>Bischofia javanica</i> Bl.	0.005-0.010	11, 12
4. <i>Breynia retusa</i> (Dennst.) Alst.	0.100-0.200	11, 12
5. <i>Breynia vitis idaea</i> (Burm. f.) Fish.	0.050-0.100	11, 12
6. <i>Cleistanthus travancorensis</i> Jabl.	0.010-0.050	10, 11, 12, 13
7. <i>Croton caudatus</i> Giesel	0.010-0.020	11, 12
8. <i>Croton malabricus</i> Bedd.	--	--
9. <i>Givotia moluccana</i> (L.) Screem.	--	--
10. <i>Jatropha curcas</i> Linn.	0.010-0.020	11, 12, 16, 17
11. <i>Jatropha gossypifolia</i> Linn.	0.005-0.010	11, 12
12. <i>Kirganella reticulata</i> (Poir.) Baill.	0.050-0.100	11, 12
13. <i>Mallotus philippinensis</i> (Lam.) Muell. Arg.	0.020-0.050	11, 12
14. <i>Mallotus rumnifolius</i> Muell. Arg.	0.050-0.100	10, 11, 12
15. <i>Mallotus atrovirens</i> Hook. f.	0.020-0.050	11, 12, 13
16. <i>Manihot glaziovii</i> Muell. Arg.	0.020-0.050	10, 11
17. <i>Phyllanthus amarus</i> Schum. and Thonn.	0.100-0.300	10, 11, 12
18. <i>Securinega virosa</i> (Roxb. ex Willd) Baill.	--	--
19. <i>Suregada angustifolia</i> (Muell.) Airy Shaw	0.050-0.100	11, 12

-- ; not detected

of the standard mixtures of polyprenols obtained from The Collection of Polyprenols, Inst. Biochem. Biophys., Polish Academy of Sciences, Warszawa, Poland. Semiquantitative determination of polyprenols was performed by comparing the size and intensity of the detected spot observed on adsorption chromatography with that of a known amount of standard substance (Wellburn and Hemming 1966).

RESULTS AND DISCUSSION

The results of semiquantitative estimation of polyprenol content and of qualitative evaluation of chain length of polyprenols in leaves of species belonging to the Euphorbiaceae family are shown in Table 1. The prenologues composed of 11, 12 isoprene units were the dominating ones in this family. In three plant species polyprenols were undetectable by thin-layer chromatography (*Securinega virosa*, *Croton malabaricus*, *Givotia moluccana*). In three of the studied plants, *Jatropha curcas*, *Antidesma glasebilla*, *Cleistanthus travancorensis*, prenologues of longer chain length, C₁₄ – C₁₇ could be detected. Among the 19 species studied, *Phyllanthus amarus* had the highest polyprenol content (0.1-0.3%, dry wt.). The plants examined in this paper were taken from their natural habitation in the South of India (Kerala). In the previous studies carried out in the period 1979-1993 in which 16 species of the Euphorbiaceae family were examined, the plants originated from living collections in various botanic gardens (Świeżewska et al. 1994). The chain length of polyprenol molecules in the earlier studies on a different set of plants was similar to that reported in the present paper. The plant species studied in this paper have not been examined previously; they have not been met in botanical gar-

dens to which we had access. In all studied plants of the Euphorbiaceae family the content of polyprenols was in general similar to that found earlier in this family. The highest amount found in this paper in leaves of *Phyllanthus amarus* was within the range 0.1-0.3%, while in earlier studies the highest contents recorded in e.g. *Aleuritis cordata*, *Exoecaria bicolor*, etc. were in the range 0.2-0.5% (per dry weight) (Świeżewska et al. 1994).

The results of the present studies confirm the existence of a characteristic pattern of chain length of polyprenols in leaves of Euphorbiaceae in which the polyprenols composed of 10, 11 and 12 isoprene units are dominating. Only very rarely small amounts of longer polyprenols (composed of 16, 17 units) in addition to the typical prenologues can be detected. It should be mentioned that the characteristic pattern, though very similar to that found in Euphorbiaceae, was documented for the Sapindaceae family in which polyprenols are composed mainly of 12, 13 isoprene units (Jankowski and Chojnacki 1995).

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LITERATURE CITED

- IBATA K., KAGEYU A., TAKIGAWA T., OKADA M., NISHIDA T., MIZUNO M., TANAKA Y. 1984. Polyprenols from conifers: multiplicity in chain length distribution. *Phytochem.* 23: 2517-2521.

- JANKOWSKI W. J., CHOJNACKI T. 1995. The occurrence and characteristics of long chain polyprenols from leaves of *Sapindaceae*. J. Plant Physiol. 147: 289-293.
- STONE K.J., WELLBURN A.R., HEMMING F.W., MORTON R.A. 1967. The characterization of ficaprenol-10, -11 and -12 from leaves of *Ficus elastica* (decorative rubber plant). Biochem. J. 102: 313-324.
- ŚWIEŻEWSKA E., CHOJNACKI T. 1988. Long-chain polyprenols in gymnosperm plants. Acta Biochim. Polon. 35: 131-147.
- ŚWIEŻEWSKA E., CHOJNACKI T., JANKOWSKI W. J., SINGH A.K., OLSSON J. 1992. The occurrence of long chain polyprenols in leaves of plants of *Rosaceae* family. Biochem. Cell Biol. 70: 448-454.
- ŚWIEŻEWSKA E., SASAK W., MAŃKOWSKI T., JANKOWSKI W., VOGTMAN T., KRAJEWSKA I., HERTEL J., SKOCZYLAŚ E., CHOJNACKI T. 1994. The search for plant polyprenols. Acta Biochim. Polon. 41: 221-260.
- TANAKA Y. 1989. Structural characterization of naturally occurring *cis* and *trans* polyisoprenes by ^{13}C -NMR spectroscopy. J. Appl. Polym. Sci. Polym. Symp. 44: 1-9.
- WELLBURN A.R., HEMMING F.W. 1966. The occurrence and seasonal distribution of higher isoprenoid alcohols in the plant kingdom. Phytochem. 5: 969-975.

WYSTĘPOWANIE POLIPRENOLI U EUPHORBIACEAE

STRESZCZENIE

Zbadano typ i zawartość poliprenoli w liściach 19. gatunków roślin z rodziny Euphorbiaceae pochodzących z naturalnych siedlisk w stanie Kerala na południu Indii. Stwierdzono, iż poliprenole zbudowane z 10., 11. i 12. reszt izoprenoidowych są charakterystyczne dla gatunków tej rodziny.

SŁOWA KLUCZOWE: Euphorbiaceae, poliprenole.