Available online at www.sciencedirect.com
SCIENCE DIRECT
Biochemical Systematics and Ecology 34 (2006) 509–513
biochemical systematics and ecology
www.elsevier.com/locate/biochemsyseco

Unusually high quantity of 4-hydroxybenzoic acid accumulation in cell wall of palm mesocarps

Moumita Chakraborty, Kingsuk Das, Gargi Dey, Adinpunya Mitra*

Natural Product Biotechnology Group, Agricultural & Food Engineering Department, Indian Institute of Technology Kharagpur, Kharagpur 721 302, India

Received 10 June 2005; accepted 26 November 2005

Abstract

Presence of 4-hydroxybenzoic acid in the mesocarp walls of 22 genera of Arecaceae (Palmae) was investigated using a TLC/UV spectra analysis method and confirmed by HPLC and ESI-MS. The genera collected mainly belong to the Copryphoideae and Arecoideae subfamilies. All the investigated genera possess an unusually high amount of 4-hydroxybenzoic acid, which varied from 5.6 mg/g dry wt cell wall material (CWM) (*Areca catechu*) to 1.0 mg/g dry wt CWM (*Roystonea regia*). Apart from 4-hydroxybenzoic acid, ferulic acid is also found in all the genera studied along with some traces of 4-coumarate. This work presents an overview of the major wall-bound phenolics found in the mesocarp of different palms, and on the basis of this occurrence, a possible hypothesis for considering 4-hydroxybenzoic acid as a chemotaxonomic marker of this particular family can be drawn.

Keywords: Mesocarp; 4-Hydroxybenzoic acid; 4-Coumaric acid; Ferulic acid; Arecaceae

1. Introduction

4-Hydroxybenzoic acid is a natural component of plant-based foods and has been identified as an important dietary anti-oxidant (Tomas-Barberan and Clifford, 2000). Apart from its role in plant defence responses against pathogens, 4-hydroxybenzoic acid finds its application as preservatives for cosmetics, foods and drugs (McQualter et al., 2005). The biosynthesis of 4-hydroxybenzoic acid in plants remains unresolved (Abd El-Mawla and Beerhues, 2002). It is possible that there are various pathways leading to the formation of individual hydroxybenzoate that depend on the type of plant. Hence, in order to work out the biosynthetic pathway for 4-hydroxybenzoic acid, it is important to identify plants that accumulate 4-hydroxybenzoic acid in their cytosol and cell walls. In this context, while exploring cheap alternatives for isolating phenolic acids of economic use, our group discovered 4-hydroxybenzoic acid as the major phenolic compound accumulated in mesocarp wall of coconut husk (Dey et al., 2003). This observation has raised the question as to whether this high amount of 4-hydroxybenzoic acid (0.2–0.5% dry wt of biomass) occurs in the mesocarp of other species of palm (Dey et al., 2005). If so, it could then be considered a possible

* Corresponding author. Fax: +91 3222 282 244/255 303.
E-mail address: adin@iitkgp.ac.in (A. Mitra).

0305-1978/$ - see front matter © 2006 Elsevier Ltd. All rights reserved.
doi:10.1016/j.bse.2005.11.011

chemotaxonomic marker of mesocarp wall of palms. The aim of this current study was to profile phenolic acids from the mesocarp of different species of palms available in the West Bengal region of India to see if they could be used as taxonomic markers. In this communication, we report on the high quantity of 4-hydroxybenzoic acid accumulation along with ferulic acid and traces of 4-coumaric acid in the mesocarp of 22 different species of palm fruits. This accumulation of 4-hydroxybenzoic acid in the mesocarp wall is discussed in the context of a possible chemotaxonomic marker along with its ecological significance.

2. Materials and methods

2.1. Materials

Palm fruits were collected from the Indian Botanic Garden (Botanical Survey of India [BSI]), Howrah, West Bengal (India) and subsequently identified at the BSI. The voucher specimen numbers of all the plants analysed are shown in Table 1. The genera studied mainly belong to two subfamilies Arecoideae and Coryphoideae as shown in Table 1. After removal of the epicarp, mesocarp materials were separated out and subsequently used for phenolic extraction.

2.2. Extraction methods

Dry mesocarp materials (ca. 500 mg) of each sample were washed with commercial detergent Surf® (1.5–2% w/v) and rinsed thoroughly with distilled water. The mesocarp material was then subjected to sequential alkaline hydrolysis under progressively more vigorous conditions to release the wall-bound ether and ester-linked phenolics (Parr et al., 1996) as follows. The first extraction was with ca. 50 ml of 0.1 M NaOH for 12 h at room temperature in the dark to release the ester-linked phenolics. The suspension was filtered and the residue retained for further extraction with ca. 50 ml of 2 M NaOH under the same conditions to release ether-linked phenolic acids. Each of the extracts was

Table 1
Detection of 4-hydroxybenzoic acid and ferulic acid in mesocarp walls of different Arecaceae members studied here

Subfamily	Species	Voucher	Phenolic acid contents (mg/g dry wt of cell wall material)	
			4-Hydroxybenzoic acid	Ferulic acid
Arecoideae	*Areca catechu* L.	P-03/01, NPBG	5.6	1.0
	Areca triandra L.	P-04/01, NPBG	2.7	0.1
	Arenga sp.	P-03/04, NPBG	2.3	1.7
	Bentinckia nicobarica (Kurz) Becc.	P-04/02, NPBG	2.9	1.1
	Carpentaria sp.	P-03/05, NPBG	2.3	1.6
	Caryota mitis L.	P-03/08, NPBG	2.7	2.9
	Caryota urens L.	P-03/07, NPBG	3.6	2.1
	Cocos nucifera L.	P-03/02, NPBG	3.4	1.2
	Dictyospermum sp.	P-03/03, NPBG	3.1	1.3
	Elaeis guineensis L.	P-04/03, NPBG	2.1	1.4
	Roystonea regia (HBK) O.F. Cook	P-03/06, NPBG	1.0	0.8
	Veitchia sp.	P-03/10, NPBG	1.9	1.3
Coryphoideae	*Borassus flabellifer* L.	P-03/08, NPBG	3.1	2.3
	Kentia belmoreana F. Muell.	P-03/09, NPBG	2.4	2.0
	Kerriodoxa sp.	P-04/14, NPBG	1.9	1.0
	Licuala grandis Roxb.	P-03/11, NPBG	1.8	1.0
	Livistona chinensis R. Br. ex Mart.	P-03/16, NPBG	1.5	1.0
	Livistona jenkinsiana Griff.	P-03/16, NPBG	1.9	1.0
	Phoenix paludosa Roxb.	P-04/05, NPBG	1.8	1.4
	Phoenix sylvestris (L.) Roxb.	P-03/15, NPBG	1.8	1.4
	Rhapis sp.	P-03/13, NPBG	2.8	1.9
	Sabal sp.	P-03/12, NPBG	1.8	1.4

The data shown consist of means of triplicate analyses from three different samples; the standard deviations of these were within 10% and are not shown.