ABSTRACT

Cocos nucifera L. (family Arecaceae), commonly known as coconut, is considered as an important fruit crop in tropical countries. Due to extensive cross linking between phenolics, lignin and polysaccharides, the fruit mesocarp becomes hard and fibrous. Studies regarding the phenolic contents of coconut mesocarp are limited. Plant phenols are of interest because they are one of the important groups of natural antioxidants; several phenolic compounds also possess antimicrobial activities as well. Though several caffeic acid derivatives were reported from Arecaceae members, coconut was never explored. In this thesis, the occurrence of one caffeic acid derivative as the major soluble phenolics from young mesocarp of *Cocos nucifera* by HPLC and UV/ESI-MS spectroscopic analyses was reported. The chemical structure of this phenolic compound was established by ^{1}H and ^{13}C NMR as 5-*O*-caffeoylshikimic acid. The antioxidant activity of this caffeoylshikimate isomer was also demonstrated which suggests the potentiality of this bioactive compound for dietary and/or health-care utilities. The possible role of caffeoylshikimate towards the formation of lignin components in fruit wall was also discussed. Alkaline hydrolysis of the cell wall material of the mesocarpic and leaf tissues yielded *p*-hydroxybenzoic acid (*p*-HBA) as the major phenolic compound. Other phenolic acids identified were ferulic acid (FA), and *p*-coumaric acid (*p*-com), *p*-hydroxybenzaldehyde vanillic acid. No significant qualitative differences in composition were observed between leaf and mesocarp, but there were quantitative variations in the metabolite levels. In addition, 22 genera of Arecaceae (Copryphoideae and Arecoideae sub-family members) were investigated to confirm if *p*-hydroxybenzoic acid accumulated as the major wall-bound phenolics in the mesocarp walls of these palm fruits. All the investigated genera possess unusually high-amount of *p*-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 *p*-hydroxybenzoic acid, ferulic acid was also found in all the genera studied along with some traces of *p*-coumarate. Based on these findings, a possible hypothesis for considering *p*-hydroxybenzoic acid as a chemotaxonomic marker of this particular family was drawn.

To understand the association pattern of wall bound phenolic with the lignocellulosic components of the cell wall comparative analysis of the alkali soluble lignin isolated by double precipitation method and dioxan lignin was conducted. Isolated lignin was characterized using UV, Fourier transform-infra red spectroscopy (FT-IR), ^{1}H-NMR, ^{13}C-NMR, DFRC (derivatization followed by reductive cleavage) and alkaline nitrobenzene oxidation techniques. Coconut mesocarp lignin exhibited significantly low amount of syringyl unit together with noticeable quantity of guaiacyl unit and a significant amount of *p*-hydroxyphenyl unit. There was a high amount of unconjugated phenolic hydroxyl groups in the alkali soluble lignin extract and total content of alkaline nitrobenzene oxidation products were low. The most interesting features observed in the nitrobenzene oxidation is the presence of a high amount of etherified *p*-coumaric acid. Coconut mesocarp lignin contained substitution of hydroxybenzoic and hydroxycinnamic acids.

Chitosan-induced elicitation responses of dark-incubated *Cocos nucifera* (coconut) endosperm cell suspension cultures led to the rapid formation of phenylpropanoid-derivatives, which essentially mimics the defense-induced biochemical changes in coconut palm as observed under *in vivo* conditions. An enhanced accumulation of *p*-hydroxybenzoic acid as the major wall-bound phenolics was evident. This was followed by *p*-coumaric acid and ferulic acid. Along with enhanced peroxidases activities in elicited lines, the increase in activities of the early phenylpropanoid pathway enzymes such as, phenylalanine ammonia-lyase (PAL), *p*-coumaroyl-CoA ligase (4CL) and *p*-hydroxybenzaldehyde dehydrogenase (HBD) in elicited cell cultures were also observed. Furthermore, supplementation of specific inhibitors of PAL, C4H and 4CL in elicited cell cultures led to suppressed accumulation of *p*-hydroxybenzoic acid, which opens up interesting questions regarding the probable route of the biosynthesis of this phenolic acid in *C. nucifera*.

Key words: Antioxidant; 5-*O*-Caffeoylshikimate; Chitosan; Coconut endosperm; *p*-Coumaric acid; *p*-Hydroxybenzoic acid; Lignin; Peroxidases; Phenolics; Phenylalanine ammonia-lyase.