Cyanidin Dye Isolated from Mangosteen Peel Waste: Higher Performance Efficiency in Dye-Sensitized Solar Cells

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Mangosteen(*Garcinia mangostana* L.) is a species that contains significant levels of anthocyanins (0.1-1 % of dry weight), which exhibits promising electron-donating and electron-accepting abilities. A key anthocyanin in mangosteen peel is cyanidin-3-glucoside having a glucosyl substitution at 3-position. However, other major bioactive compounds such as phenolic acids and xanthone derivatives reduce the photovoltaic measurements to a considerable extent. Hence, purification of an acidified methanolic anthocyanin extract was carried out using preparative chromatographic techniques such as silica and Sephadex LH-20 columns. Moreover, cyanidin-3-glucoside was identified as the major anthocyanin in the purified fraction based on LC-MS and UV-visible absorption spectra. The results demonstrated a molecular cation, [M+H]+ at m/z = 448.9 Da (1+) and a fragmentation at m/z = 286.8 Da (1+) at t_R=34.08 min and also a visible maximum wavelength of λ_{max} at 516 nm implying that the isolated fraction is cyanidin-3-glucoside. Hydrolyzation of anthocyanins to anthocyanidins was achieved under acidic (2 M HCl) conditions and at a temperature of 100^{0}C. The resulting cyanidin, was characterized using LC-MS analyses exhibiting a molecular cation (M^+) at m/z = 322.70 Da (1+) at t_R=16.96 min and a visible maximum wavelength λ_{max} at 535 nm implying that the isolated fraction is in the form of cyanidin chloride. A solar cell prepared exhibited an efficiency of 0.99 %, short circuit photocurrent density of 0.256 mA cm^{-2} and an open circuit voltage of 387 mV implying that further modifications in the donor structure could lead to enhanced results.

Keywords: Anthocyanin, mangosteen, cyanidin, dye-sensitized solar cells