Destructive Maturity Indicators of Coconut (*Cocos nucifera* L.) and RGB-Based Non-Destructive Information

Mohammad Fikri Pomalingo
Okayama University, Japan

Kazuhiko Namba
Okayama University, Japan

Mitsuji Monta
Okayama University, Japan

Kenichiro Yasuba
Okayama University, Japan

Abstract

Accurate determination of coconut (Cocos nucifera L.) maturity is essential for optimizing product quality and harvest efficiency. Conventional destructive methods, such as measuring water content and flesh thickness, are time-consuming and cause sample loss. This study proposes a non-destructive RGB (Red, Green, Blue) image analysis to estimate fruit maturity and establish its correlation with physical parameters for automated harvesting applications. A total of 200 coconuts representing four maturity stages (Timbulungo, Kolokobu, Ulimo, and Bongo) were analyzed through physical measurements and digital imaging processed using Python. Water content decreased while flesh thickness increased with ripening, indicating the transition from liquid to solid endosperm. RGB analysis revealed a gradual decrease in green (G) values and an increase in red (R) and blue (B), producing a distinct reddish-brown tone at full maturity (Bongo: R = 44.3%, G = 42.9%, B = 12.7%). The results showed strong correlations between morphometric parameters and fruit age ($r \approx 0.93–0.98$). These findings confirm that RGB-based colour analysis is a reliable non-destructive indicator of coconut maturity. Integrating this approach into a computer vision–based robotic system enables real-time detection of harvestable fruits, improving precision, efficiency, and sustainability in coconut production.

Keywords

Coconut, fruit maturity, RGB analysis, robotic harvesting.