

EFFECT OF FRUIT MATURITY ON BACKSCATTERING PARAMETERS

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Abstract: This paper reports monitoring maturity in bananas using backscattering parameters. Bananas at different maturity stages 2 to 5 were stored at 13 °C. Light backscattering of intact fruit was measured using laser diode emitting at wavelength 660 nm. The effect of maturity on full width at half maximum (FWHM), radius of saturation (RSAT) and inflection point (IP) were analysed. There was an increase in the backscattering parameters as the maturity level increased. It was concluded that backscattering imaging is potentially useful in estimating maturity in bananas.

Keywords: Laser-induced light; banana; backscattering imaging; maturity.

INTRODUCTION

Fruits are a complex environment presenting different size distributions of molecules depending on the maturation level. Green fruits are rich in starch chains ($C_6H_{12}O_5$)_n which are relatively large (0.1 to 200 microns), as well as pectin, organic acids and amino acids. During fruit maturation process, starch and amino acids are hydrolyzed to carbohydrates such as glucose $C_6H_{12}O_6$ (Cordenunsi and Lajolo, 1995). Unlike starch, these are small molecules, on the order of few nm. Any modification of the fruit inner constituents affects its optical properties, specially the absorption and the scattering coefficients.

Maturity at harvest is the most important factor that determines shelf-life and fruit quality. Immature fruits when harvested are more prone to shriveling and mechanical damages and results in inferior flavor quality when ripe. Over-ripe fruits are more likely to become mealy with insipid flavor soon after harvest and often soft. Fruits picked either too early or too late in their season are more prone to postharvest physiological disorders than fruits picked at the proper maturity (Kader, 1999).

All fruits with a few exceptions such as pears, avocados and bananas, reach their best eating qualities when allowed to ripen on the plant. However, some fruits are usually picked mature but unripe so that they can withstand postharvest handling system. Most currently used maturity indices are based on a compromise between those indices that would ensure the best eating quality to

the consumer and those that provide the needed flexibility in marketing (Kader, 1999).

Harvesting bananas can be done 75 to 80 days after the opening of the first hand, when it is 75% matured while the fruits are still green (Morton, 1987; Aurore et al., 2009). Bananas must be stored at a temperature of 13-14° C to increase shelf life and decelerate ripening process (Zhang et al., 2010).

Laser light in the visible light might provide a low cost effective solution to estimate moisture information non-destructively from yellow/white-colored product tissue such as banana, apple and bell pepper (Romano et al, 2008; 2011; 2012). Laser backscattering imaging in the VIS/NIR spectrum has been found to be an inexpensive method to predict simultaneously firmness and soluble solids content of apple under different environmental growing conditions (Qing et al, 2007; 2008). Thus, the goal of this paper is to determine the effect of fruit maturity on some backscattered parameters.

MATERIALS AND METHODS

Fruit samples

Musa cavendishii bananas in ripening stages two (R2-unripe), three (R3), four (R4), and five (R5-overripe) were obtained from a commercial banana ripening facility. For each ripening stage 30 fruits (n = 120) were analyzed.

Laser-induced backscattering imaging system

Backscattering images of bananas were obtained by an in-house developed laser-induced backscattering