Prediction of banana quality attributes and ripeness classification using artificial neural network

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Abstract

Laser light backscattering imaging (LLBI) with five laser diodes emitting at wavelengths 532, 660, 785, 830, and 1060 nm were employed for predicting quality attributes of banana fruit. The predicted attributes were chlorophyll, elasticity and soluble solids content (SSC). Classifications were done on six ripening stages from ripening stages 2 to 7. The prediction and classification models were built using an artificial neural network (ANN). The results indicated that measurement at 532 nm gave the highest correlation coefficient with 0.949 for chlorophyll prediction, while correlation coefficients of 0.862, 0.867 were the highest obtained for elastic modulus, SSC at 785 and 830 nm, respectively. 95.5% correct classification accuracy was obtained at 830 nm by use of the ANN classification model. The results showed that LLBI with an ANN can be used for non-destructive estimation of banana quality attributes and the subsequent ripeness classification.

Keywords: laser diodes, chlorophyll, soluble solid content, quality attributes, neural network

INTRODUCTION

Banana is one of the world's leading food crops apart from rice, maize and wheat (Aurore et al., 2009). It is widely consumed with about 90% of production in or around Asia, Latin America and Africa (Arias, 2003; Aurore et al., 2009). Other than fresh consumption, banana has been used in other forms such as puree, jams, wines, pastries, desserts, sorbet ice-creams and cream products (Akubor et al., 2003; Carreno and Aristizabal, 2003).

Since attention is at present focused on the quality and safety of fruit for consumption, concerted efforts are being made in technologies that will estimate the qualities of banana (Lunadei et al., 2011; Lorente et al., 2012). Currently, banana sorting is done manually using colour as the main quality attribute (Studman, 2001). However, other qualities apart from colour are elasticity, soluble solids content (SSC), flavour, which are equally important to address consumer acceptance. As a climacteric fruit, harvesting at the optimum stage of maturity is required to achieve effective ripening and good eating quality (Kader, 2002, 2008). Many methods are currently employed to determine these qualities and most of the methods are destructive and subjective which depends very much on human labour and gives inconsistent results. To address these shortcomings, non-destructive optical-based methods are receiving attention.

Laser light backscattering imaging (LLBI) is an emerging technology which is non-destructive and suited for fruit quality attribute measurements. Its operation is fast, requires less sample preparation and allows for multiple measurements of various attributes concurrently (Baranyai and Zude, 2009; Lorente et al., 2013). Research has been reported using LLBI to discriminate decaying citrus from sound fruits (Lorente et al., 2013), to predict the mechanical properties of selected horticultural crops (Mollazade et al., 2013) and to monitor chilling injuries in banana (Hashim et al., 2013).

An artificial neural network (ANN) is an information processing pattern, which is produced by imitating the way biological nervous systems, such as the way the brain processes information. An ANN learns through example and it is patterned for a definite

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