Banana Quality Attribute Prediction and Ripeness Classification Using Support Vector Machine

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Abstract—**Five laser diodes of 532, 660, 785, 830 and 1060 nm laser light backscattering imaging (LLBI) were employed for quality attribute prediction and ripening stage classification of banana. A support vector machine (SVM) was tested to establish the theoretical prediction and classification models to predict chlorophyll, elasticity and soluble solids content (SSC) and also to classify the bananas into six ripening stages. The classification was set up with six ripening stages 2-7. Wavelengths of 532, 660 and 785 nm gave high correlation coefficients both for banana quality prediction and ripeness classification. The results show that the highest correlation coefficients of 0.912, 0.945 and 0.872 were obtained for chlorophyll, elasticity and SSC at 785, 660 nm respectively. An overall classification accuracy of 92.5 % was recorded at 830nm. These results show that LLBI with the SVM model can be used for non-destructive estimation of banana quality attributes and the subsequent ripeness classification.**

Index Terms—**laser diodes, banana, elasticity, ripeness, chlorophyll, quality**

I. INTRODUCTION

Banana, which originated from India in Eastern Asia, has over 1000 varieties and has been cultivated in approximately 135 countries in the world with the Cavendish banana as the most cultivated and common variety. Banana is one of the world's top leading food crops apart from rice, maize and wheat [1]. It is widely consumed with about ninety percent of production consumed in or around the production areas in Asia, Latin America and Africa [1], [2]. Banana has been used in other forms such as in the production of puree, jams, wines, pastries, desserts, sorbet ice-creams and cream products [3], [4].

Since attention is at present focused on quality and safety of fruit for consumption, concerted efforts in technologies that will estimate the qualities of banana become a vital concern [5], [6]. Currently, banana sorting is done manually using colour as the main quality attribute [7]. Banana is a climacteric fruit which is harvested at the optimum stage of maturity to achieve effective ripening and good eating quality [8], [9]. Many methods are currently employed to determine these qualities. However these methods are mostly destructive and also subjective because their operation is human dependent which could give inconsistent results. To address these shortcomings, non-destructive optical-based methods are receiving greater consideration.

Laser light backscattering imaging (LLBI) is an emerging technology that is non-destructive and suited for measurement of fruit quality attributes. Its operation is fast, requires less sample preparation and allows for multiple measurements of various attributes concurrently [10]-[12]. Some research works has been reported using LLBI, for example; Ref. [11] reported the use of LLBI to discriminate decaying citrus from sound ones; Ref. [13] reported the application of LLBI to predict the mechanical properties of selected horticultural crops; Ref. [14] reported a work on the potential of LLBI to monitor chilling injuries in banana. Although quite a few numbers of works have been done using LLBI in postharvest handling, an extension of the research works is still required in order to verify its potential. Thus, the objective of this work is to determine the application of LLBI to predict the elasticity, SSC and chlorophyll and ripening stages of banana by using support vector machine (SVM) as a prediction and classification model.

II. MATERIALS AND METHODS

A. Sample Preparations

Banana at ripening stage 2 were collected at a ripening facility in Potsdam, Germany. The bananas were stored at 14 ℃ which was the recommended temperature for