Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 181 (2017) 466 – 471

Procedia Engineering

www.elsevier.com/locate/procedia

10th International Conference Interdisciplinarity in Engineering, INTER-ENG 2016

Detection of Sugar Content in Citrus Fruits by Capacitance Method

Ajit A. Bhosale*

Cummins college of engineering for women Pune,411052, Mahatashtra, India.

Abstract

The production of Citrus fruits viz. Lemon (Citrus x Limon), Oranges (Citrus x Sinensis) and Mosambi (Citrus x Limetta) in India is around 13% in overall production of fruits. Wastage in post harvesting is around 20% of its production as they are not ripened. Non-climacteric fruits, once harvested, never ripen further. The biochemical process involved is a non-climacteric fruit give little or no ethylene gas.
To reduce wastage in post harvesting stage it is necessary to predict its maturity by non-destructive method. For measuring the sugar content of citrus fruits (oranges) the technology of relative permittivity changes or capacitance is used. The relation between capacitance per weight to (sugar index) brix in % exists and shows linear correlation with coefficient of regression of around 92%.

Peer-review under responsibility of the organizing committee of INTER-ENG 2016

Keywords: Citrus fruits; capacitance; Brix.

1. Introduction

The fruits are generally classified on the behavior of ripening, as climacteric and non-climacteric. Non Climacteric fruit once picked from tree does not ripen further. These fruits generate very small amount of ethylene (C2H4) as well as they do not respond to ethylene treatment. They also do not show any distinctive sign of increased rate of respiration or production of carbon dioxide in ripening stage. The ethylene introduction might be useful in degreening in citrus fruits and Pineapple. In ripening process, climacteric fruits produce much larger ethylene than non-climacteric fruits. Examples of non-climacteric fruits are citrus, pineapple, grape, strawberry, pomegranate, lichi, watermelon and cherry. The reason of checking sugar content in orange fruits is that, orange fruit is non-

* Corresponding author. Tel.: +91-99-70061409.
E-mail address: aabhosale@rediffmail.com

1877-7058
Peer-review under responsibility of the organizing committee of INTER-ENG 2016
doi:10.1016/j.proeng.2017.02.417

climacteric fruit that means they do not ripen after harvesting process. So it is necessary to check the internal quality of fruits before purchasing/ consuming or processing to avoid the wastages of fruits.

Quality and safety is the key factor in modern food industry. Rapid industrialization & massive rural –urban migration lead the necessity of agriculture mechanization. Post-harvest sorting & grading of agricultural products is difficult & labor intensive. Manual sorting is costly & unreliable since human decision in identifying quality factor such as appearance, flavor, and nutrient, texture etc. Currently conventional food measurement methods are destructive and inefficient; therefore development of non-destructive and efficient measurement tool is important. Non-destructive measuring techniques are desirable for fruits & vegetable. However these methods should be reliable and economical. Newer developed techniques such as optics, x-ray, ultrasonic, near infrared & magnetic resonance have been applied for the same.

Nomenclature

nD	refractive index
pF	Pico Faraday
% brix	sugar content in fruit

1.1. Electrical Technology for fruit properties measurements

Nelson studied [1] electrical characteristics of agricultural materials have been of interest for many years and are being utilized in one or the other form. Electrical properties such as electrical conductance, resistance, capacitance, dielectric properties, pulsed electric fields, ohmic heating, induction heating, radio frequency, and microwave heating are important to develop instruments for determination of various quality parameters. Venkatesh et al., [2] found that dielectric properties of various agricultural foods and other biological materials are finding increasing application in their respective industries and research laboratories.

However, using capacitive sensing method is a simple, express and economical technique that can be used to estimate the moisture content, firmness prediction shelf life prediction of agricultural materials. Because of these benefits, capacitive sensor techniques are applied in agriculture. Jarimopas et al. [3] designed and developed an electronic device with a cylindrical capacitive sensor to measure the volume of selected fruits and vegetables. Afzal et al. [4] estimated leaf moisture content by measuring the dielectric constant of leaves in five different types of crops. Soltani et al. [5] designed and developed an electronic device with a capacitive sensor for evaluating banana ripening status. A. A. Bhosale et al. [6] correlated firmness of apple with capacitance using whetstone bridge method. Júnior [7] designed a capacitive moisture meter for combines. Trabelsi et al. [8] measured the dielectric properties of shelled peanuts to estimate the moisture content. Weidong [9] designed and developed an on-line monitoring system to measure the moisture content of grain during the drying process. Rai et al. [10] designed and developed a capacitive moisture meter for grain (wheat, paddy, sunflower, mustard and soybean). Soltani and Alimardani [11] designed and developed an electronic device for determining corn and lentil moisture content. A. A. Bhosale et al. [12] predicted ripeness of papaya by using capacitance method.

Certain limitations are found by Gradinarsky et al. [13] that the measured complex dielectric constant of the material is dependent on number of additional factors, some of which are as follows: the varying density of the material seen by the sensor and the varying temperature of the material.

On the basis of these findings, the main aim of this research was to establish a non-destructive and rapid measuring method using a capacitive sensor for predicting sugar content in oranges. This work was conducted in order to find out whether a relationship exists between the sugar content in orange and the cylindrical capacitance sensor and its output signal.

2. Experimentation

Oranges of Kinnows variety transported from the warehouse were used. The orange fruits are randomly selected from boxes from market yard of Pune city. The orange fruits have been stored at room temperature. The experiment