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Instrumented Color Determination and Sensory Analysis of Tomato Fruits (*Lycopersicum Esculentum* Mill)

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ABSTRACT

*This research work reports the evaluation of tomato fruits (*Lycopersicum esculentum *Mill) by means of sensory analysis as well as through instrumented color determination aiming of establishing some correlations between the results yielded by the two methods. Nowadays tomato fruits selection and sorting are based on the uniformity of physiological maturity which is considered adequate for harvesting. The sensory analysis was carried by selecting a group of trained volunteers applying a non-structured scale. The instrumental readings were carried using a "Macbeth" HUNTERLab equipment at five selected points on the transversal fruit axis. The sensory color determination indicated no significant differences ($p \leq 0.05$) between the following groups of days: 1, 3 and 5; 5 and 8; 10 and 12; and 12, 15, 17 and 19, however it indicated the occurrence of differences between the groups. Tomato fruits showed moderately characteristic colors between the 10^{th} and 12^{th} days and very characteristic colors from the 12^{th}day.*

KEYWORDS

Fruit Instrumented Color Determination, Instrumented Tomato Fruits Color Determination, Sensory Tomato Color Analysis, Tomato Fruit Maturity

1. INTRODUCTION

The preliminary judgment of fruit quality relies on its general appearance including color, surface structure and shape. Color, in particular, is an important sensory attribute, and this is the main reason why instrumental methods for color measurement are indicated for use under standardized conditions. In cases where color is an important quality indicator, a color evaluation can provide a commercial criterion for certain climacteric vegetables. The tomato fits well into this application, the color giving an indication of both the original fruit quality as well as the efficiency of the maturation process. The tomato is a climacteric and perishable fruit, which requires adequate storage conditions in order to delay the ripening process, minimizing losses and increase the shelf life (Brackmann et al., 2007). Only fruits meeting expected qualities by the consumers will be considered for commercialization. Color is an important quality attribute closely associated with maturity, and together with shape, size, firmness, bruising and defects, affects the choice of the consumer.

Tomato is considered as a horticultural crop with major worldwide commercial interest. As reported by FAO (2014), the world consumption of fresh tomato fruits guarantees it second place in importance. The tomato is cultivated in different zones of Brazil in all seasons and under a variety

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of crop handling systems. These details promote high production, placing the country amongst the greatest tomato producers in the world, together with China, USA, Italy, Turkey, Spain, Egypt and Mexico (Cardoso et al., 2010). The total cultivated area occupied by the tomato crop in Brazil covers 66,418 hectares, producing 4,146,466 metric tons a year, yielding 62.616 kg/ha (IBGE, 2011).

Pangborn (1967) stated that 'In foods, colors are identified with previously experienced quality and serve as instant indicators of good or bad, according to the product and its intended use.' Consumers associate an acceptable color with acceptable flavor, safety, nutrition and satisfaction level (Christensen,1983).

The perception of fruit color is associated with some characteristics such as the combination of certain pigments. Small changes in fruit color are connected with certain factors, such as maturity, exposure to radiant energy, size, burning, tanning, etc. (Little, 1973). Color is a rather subjective fruit quality and therefore it is not easy to quantify. Indeed, in the past the color of a particular fruit was scored based on comparison with a color chart. In 1976, the last version of the Munsell book of color was published, this being the result of many improvements as from its first creation in 1915. The book of color allowed one to assign a number to 1500 color standards (Munsell Color, McBeth Division of the Collmorgen Corporation, Baltimore, Maryland, U.S.A). In the Munsell book, color was classified based on its Hue (Munsell Hue), lightness (Munsell Value) and Saturation (Munsell Chroma). However, due to the particular change in color for each fruit, there was a special chart for each fruit. These charts were so useful that even today many of them are still in use.

When the color of solid opaque foods, such as whole fruits or thick slices of red meat, is measured, the specimen field should be flat and uniform. If a natural flat surface is not available, then it is sometimes acceptable to obtain such a surface by cutting or even rotating the food sample in front of the instrument viewing port (Francis, 1952). Solid foods often show directionality. When the directionality is obvious, the specimen should be measured with the same orientation for each test. When the directionality is haphazard or undefined, one useful technique is to turn the sample through 90º between the two readings, and average the results.

As reported by Nickerson and Lozano (1978), color can be determined by way of an appropriate system based on tonality, luminosity and the chromaticity of our sensations. Instead of describing them, MUNSELL developed a system which established the three-color dimensions, and measuring each one by referring to an appropriate scale.

Therefore, the following variables must be included for a precise color definition: saturation and hue which are given by the variables *"a"* and "*b*", and brightness, which are given by the variable "*L*". In this way, it is possible to precisely quantify all the attributes that can define a color by referring to the color space "*L*", *"a"* and "*b*" (also referred to as CIELAB). The methods currently available to express color numerically generated the development of algorithms for tomato fruit classification based on color, color homogeneity, defects and shape, as well as an analysis of the stem (Laykin et al., 2002).

As reported by Setser (1984), due to variation, the surface characteristics have to be standardized before being submitted to a color determining instrument. In the case of non-homogeneous distribution, the readings should be repeated in order to increase data reliability. Hobson et al. (1983) reported an objective method to define compositional changes during the maturation process, by evaluating tomato fruits at varying degrees of maturation. Initially, the authors restricted the test to one cultivar, and used a HUNTER Lab system spectrophotometer. The color was measured during fruit maturation after carrying out a sensory analysis in a color sequence. The authors' conclusions referred to the applicability of the proposed method to other cultivars in a variety of maturation levels.

Measurements of whole fruits were carried out by Nagle et al. (1979) and Reeves (1987) for capsicums, Shewfelt et al. (1989) for fresh tomatoes and Lin et al. (1989) for apples. In all these cases, the fruits were measured directly on the instruments, taking a number of readings around the circumference of each specimen. High correlations were obtained between the color values of the whole fruits.