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USING IMAGING ANALYSES TO PREDICT CHEMICAL PROPERTIES OF ORANGE FRUITS

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Abstract

At different ripening stages the color of orange varies from nature green, yellow, to intense orange color. Sometimes, instead of chemical analysis, color measurement may be used if a correlation is present between the presence of the colored component and the chemical in the food since color measurement is simpler and quicker than chemical analysis. The aim of this research:(a)Study possibility of using computer vision and for as a suitable technique to predict of orange chemical properties fruit maturity according to their image analysis for color changes during maturity stage.(b)The relationships between hue and saturation of images in this research revealed that to find a sensitive relation between some different chemical properties. The results showed significant correlation between RGB, hue and saturation indices and some chemical properties such as total soluble solid (Tss), ph, acidity and percentage of liquid.

Key words**:** *chemical composition, image indices, orange, maturity*

INTRODUCTION

At different ripening stages the color of orange varies from nature green, yellow, to intense orange color. Sometimes, instead of chemical analysis, color measurement may be used if a correlation is present between the presence of the colored component and the chemical in the food since color measurement is simpler and quicker than chemical analysis. Citrus fruits and juices generally serve as primary sources of human daily requirement of vitamin C, their demand for and acceptance depending mainly on their nutritional value, flavour, aroma and then on colour, texture and cloudiness. It is well-known that the orange is one of the most abundant sources of vitamin C, however, it also contains considerable amounts of sugar, carotenoids, flavonoids, essential oil and some minerals. The computer vision systems have been used increasingly in industry for inspection and evaluation purposes as they can provide rapid, economic, hygienic, consistent and objective assessment [1]. The common image processing system conguration including the five components: image acquisition, pre-processing image segmentation, object measurement, classification [2]. Several physical and nutritional properties of four orange varieties (Alanya, Finike, W. Navel, and Shamouti) such as Water soluble dry matter were 10.9 , 12.4, 12.1 and 11.8 (˚Bx) respectively, pH were 3.19, 3.64, 3.62 and 3.84 respectively and Titratable acidity were 1.375, 0.841, 0.687 and 0.875 (g/100 ml) respectively [8]. The orange maturity in three degrees (raw, ripe and overripe) by using system consists of a color CCD camera for image acquisition and a computer for image processing. The ISH color model is used and decision rules are derived from the hue color [7]. The average characteristics under study were assessed by determining the total soluble solid content (TSS=11.75±0.14°Brix), using the Abbey refractometer, and titratable acidity (TA=1.52±0.16% w/vcitric acid equivalent), using 0.1 M NaOH standard solution, on the juices expressed from five fruits randomly selected from the experimental lot, these data being replicated four times. This allowed their maturity index (MI=TTS/TA) to be estimated as 7.8±0.8 °Brix/(% w/v) [5]. An image analysis technique was found to serve as a

suitable and accurate method for external orange fruit inspection. Relationships were determined between R/G ratio band, average of RGB bands and VARI index with chlorophyll a and b and carotenoids [3]. stated that there are relationship between hue and chemical properties with three applications of nutrition minerals and with growth substance hue increased from 0.64 to 0.76 when while percentage of liquid, pH and total soluble solid (Tss), 38.46 to 48.22 %, from 2.97 to 3.15, from 8.07 to 9.07 (Brix,%) [6].

MATERIALS AND METHODS

An experiment was carried out in winter 2011 at a farm in Wadi Elnetron , Bohira governorate , Egypt to detect the relationship between some chemical properties of orange fruits by using image indices and its maturity . The results revealed that, some chemical properties of orange fruits.

***Valencia* orange**:

Fruits samples were collected for identifying different biochemical measurements for determination of maturity.

Imaging box:

An imaging box was constructed with dimensions of 30*30*30 cm (length*width*depth) to put the fruits inside. A non reflective black cloth was put on the inside sides of the box to keep the reflectance from them at a minimum to avoid interference. A digital camera was installed at the top of the box to acquire images has the following specification:

- Image device: 7.75mm (1/2.3 type) color CCD, primary color filter.
- Total pixel number of camera: Approx. 16.4 Megapixels.
- Effective pixel number of camera: Approx. 16.1 Megapixels.

Envi programme:

After acquiring images for different treatments the images with JPEG were changed to TIFF files to be imported to Envi programme then can find three bands (RGB) which were used to derive indices fig.1. The correlation relationship was investigated between different chemical properties and derived indices.

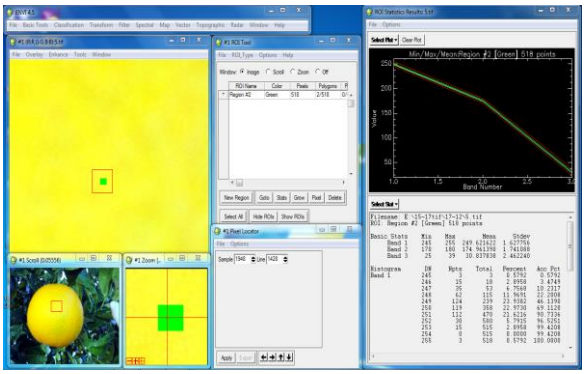

Fig. 1 window of ENVI programme software

Color indices: Using the most popular color model RGB color space. The color was presented with R, G and B, the amount of information is tripled. RGB system is sensitive to lighting or other conditions. To evaluate the color of captured images of fruit, the acquired RGB color information was transformed to HSI:

These equations used to transform RGB color to HIS color as follows:

$$H = COS^{-1}\left\{\frac{(2R-G-B)/2}{\left[(R-G)^2+(R-B)(G-B)\right]^{1/2}}\right\}$$

$$S = 1 - \frac{3}{(R+G+B)}[\min(R,G,B)]$$

Orange chemical properties:

Different chemical properties of orange fruits were determined after the applications of nutrition minerals and the application of growth substance. The following properties of orange fruits were measured and/or determined:

-Following extracting orange juice the total soluble salts (TSS) was estimated using a single digital refractometer.

- TSS was estimated by using a digital refractometer.
- pH value was measured by using pH meter as an indicator of juice acidity.

RESULTS AND DISCUSSIONS

Relationship between orange chemical properties and maturity time

Results in (fig. 2) shows that during maturity

time from 17 December to 24 December with some chemical properties such as the total soluble solid (Tss) increased from 8.20 to 10.06 (Brix,%) , ph increased from 2.84 to 3.07, percentage of liquid increased from 41.54 to 49.83 % and (Tss/acidity) increased from 6.7 to 9.00 while acidity decreased from 1.25 to 1.07 %.

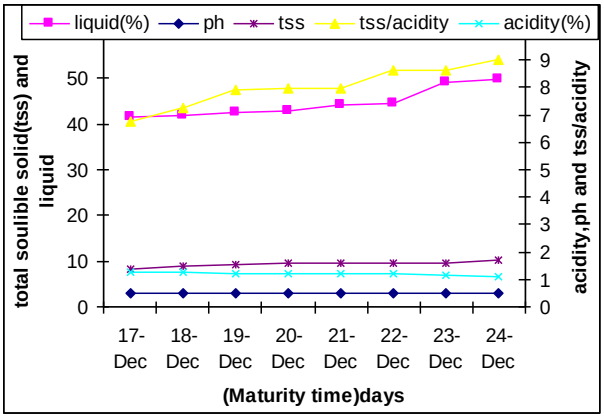

Fig 2.The relationships between the maturity time (days) total soluble solid (tss), ph, acidity, percentage of liquid and tss/acidity.

The results showing the relationships between hue and saturation and total soluble solid (Tss), ph, acidity, percentage of liquid and (Tss/acidity) at different maturity days.

Relationship between color indices and chemical properties

There are the relationships between hue and acidity, percentage of liquid, ph and also total soluble solid (Tss) shown in Fig.3 when acidity decreased from 1.25 to 1.07 % the hue indices increased from 00.65 to 00.78 while percentage of liquid, ph and also total soluble solid (Tss) increased from 41.54 to 49.83 %, from 2.84 to 3.07 and from 8.20 to 10.06 (Brix,%) respectively.

The following equation forms were satisfied for predicting acidity, percentage of liquid, ph and also total soluble solid (tss) by hue during maturity time.

$y = -14.725x^2 + 19.817x - 5.4166$

$R^2 = 0.8751$

$y = 443.86x^2 - 570.84x + 225.18$

$R^2 = 0.8297$

$y = -1.889x^2 + 4.0852x + 1.0372$

$R^2 = 0.7316$

$y = -45.358x^2 + 76.142x - 21.81$

$R^2 = 0.893$

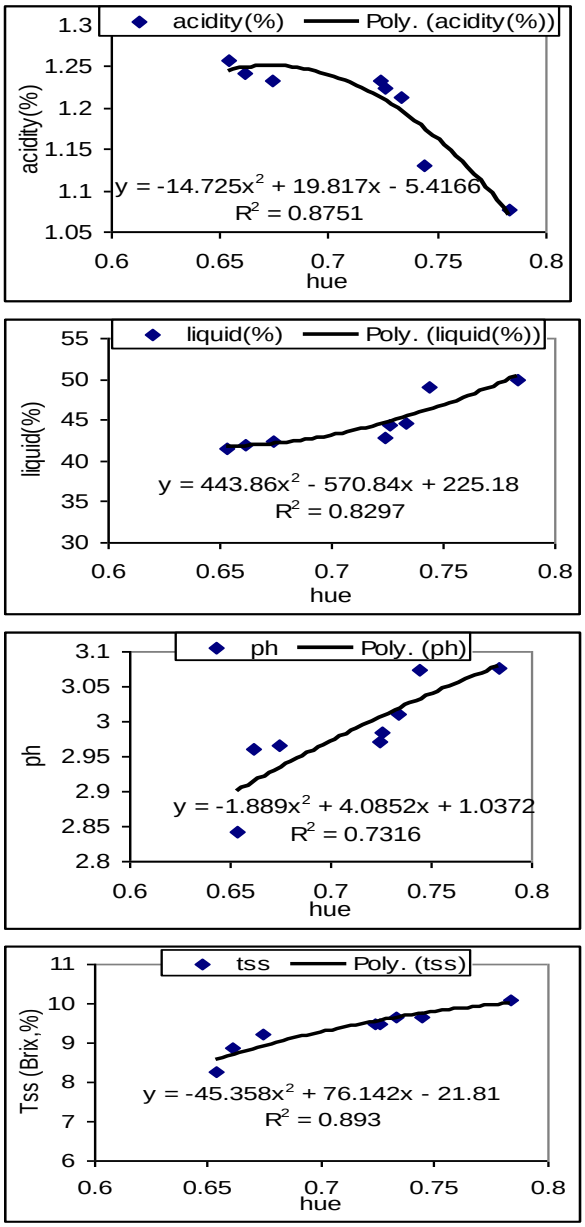

Fig. 3.The relationships between the hue and acidity, percentage of liquid, ph, total soluble solid (Tss)

In Fig. 4 the data showed there are the relationships between saturation and acidity, percentage of liquid, ph and also total soluble solid (tss) when acidity decreased from 1.25 to 1.07 % while saturation increased from 00.98 to 00.99 while percentage of liquid, ph, total soluble solid (tss), and also tss/acidity increased from 41.54 to 49.83 %, from 2.84 to 3.07 and from 8.20 to 10.06 (Brix,%) respectively.

The following equation forms were satisfied for predicting acidity, percentage of liquid, ph and total soluble solid (Tss) by saturation during maturity time.

$y = -34819x^2 + 68973x – 34156$
$R^2 = 0.7225$
$y = 2E+06x^2 - 4E+06x + 2E+06$
$R^2 = 0.8051$
$y = 20426x^2 - 40428x + 20007$
$R^2 = 0.8977$
$y = 189257x^2 - 37466x + 185434$
$R^2 = 0.9931$

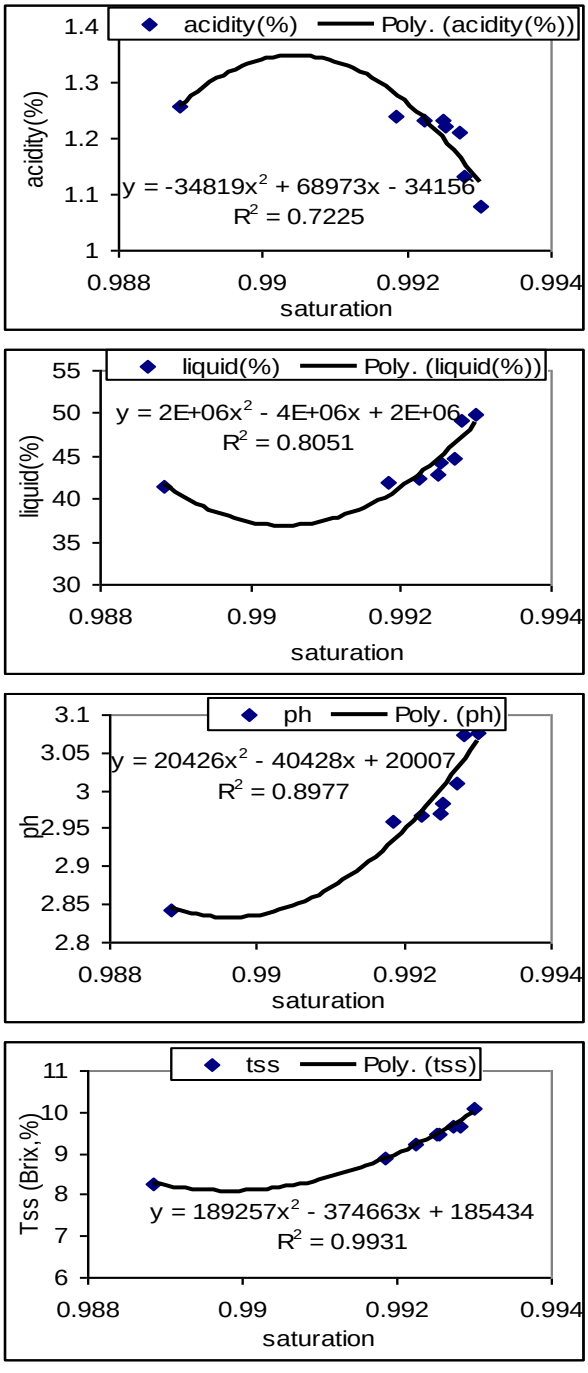

Fig. 4. The relationships between the saturation and acidity, percentage of liquid, ph and also total soluble solid (Tss)

CONCLUSIONS

In this research we test a computer vision and image analysis program as a suitable technique for external orange fruit inspection. The results show the relationships between hue and saturation and total soluble solid (Tss), ph, acidity and percentage of liquid. The multiple regression analysis and correlation coefficient was used to test the association between some chemical properties different hue and saturation to ranked the more suitable maturity indices. The results obtained in this research demonstrated that hue and saturation indices gives understanding about between total soluble solid(tss), ph, acidity and percentage of liquid. The coefficient of determination at all properties equation of saturation indices more than with hue indices.

REFERENCES

[1]Brosnan, T., Sun, D., 2002, Inspection and grading of agricultural and food products by computer vision systems a review. Computers and Electronics in Agriculture , 36: 193-213
[2]Du, C.J., Sun, D.W., 2004, Recent developments in the applications of image processing techniques for food quality evaluation. Trends in Food Science and Technology 15:230–249
[3]Fouda, T., Derbala, A., Elmetwalli A. H., Salah, S., 2013, Detection of orange color using imaging analysis. Scientific Papers Series Management, Economic Engineeringin Agriculture and Rural Development, Vol.13(2)/2013
[4]Khojastehnazhand, M., Omid, M., Tabatabaeefar, A., 2010, Development of a lemon sorting system based on color and size. African Journal of Plant Science, 4(4): 122-127
[5]Ladaniya, M. S., 2008, Citrus fruit: biology, technology and evaluation San Diego: Academic. (p. 198)
[6]Salah, Sh. E., 2013, Using image analysis to predict orange fruits maturity. Ms.c. Thesis, Agric. Eng. Dept. Fac. of Agric., Tanta Univ.
[7]Sirisathitkul, Y., Thumpen, N., Puangtong, W., 2006, Automated Chokun Orange Maturity Sorting by Color Grading. Walailak J. Sci and Tech, 3(2): 195-205
[8]Topuz, A., Topakci, M., Canakci, M., Akinci, I., Ozdemir, F., 200, Physical and nutritional properties of four orange varieties. Journal of Food Engineering, 66: 519–523