

Effect of Harvest Age on Skin Color Development and Total Lycopene in 5 Different Tomato Varieties

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Abstract : This study was conducted to evaluate performance of tomato [*Lycopersicon esculentum* Mill.] under distinct harvest age on skin color development when ripe and total lycopene content at Agricultural Technology Research Institute, Rajamangala University of Technology Lanna (RMUTL) in 2012. The experiment was laid out in a 5 X 3 Factorial in RCBD Design with four replications. Five varieties of cherry tomato were: 1) ATRI No# 1 - heat tolerant species collected from Doi Saket district, Chiang Mai Province; 2) ATRI No# 2 - rain tolerant species collected from Muang District, Lampang Province; 3) cherry tomatoes - E-per; 4) cherry tomatoes – Phetchompu; and 5) cherry tomatoes - Somtarn. The first and second varieties had been selected by the Agricultural Technology Research Institute and tested stability of plants grown at the Prince Chakraband Pensiri Center for Plant Development, Chiang Rai province. The third, fourth and fifth varieties were commercial varieties. Three harvest ages were: 1) 35 day, 2) 45 day and 3) 55 day after full bloom. Results revealed that the intensity of exterior color of ripened tomato fruit developed in the same direction in all varieties. At harvest age, the darker red color fruit was correlated with the total lycopene content of the tomato fruit. The dark red external color fruit varieties; i.e. E – per and ATRI No#2, contained greater total lycopene and redness value (a^*) than that with pink external color; i.e. Somtarn. The E – per and ATRI No#2 harvested at 55 days after first full bloom gave the highest total lycopene contents in the fruit.

Keywords : tomato, harvest age, skin color development, total lycopene

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1. Introduction

Tomato (*Lycopersicon esculentum* Mill.) (Mi *et al.*, 2009) are nutritious and low in calories. One medium sized tomato provides 75% of the recommended daily allotment (RDA) (Lee, 2006) Tomato contains two main types of carotenoids; lycopene which causes red and beta – carotene that gives orange, yellow and brown color. Both types are found to contribute about 7% of the total carotenoids. Lycopene can reduce the incidence of colon cancer and prostate cancer (Junprayoon, 2001). When ripe, the older fruit is red, while the younger fruit is pinkish in color, and thus may affect the total lycopene contents Therefore, fruit maturing and external skin color intensity when ripe at different harvest times would affect the amount of lycopene content.

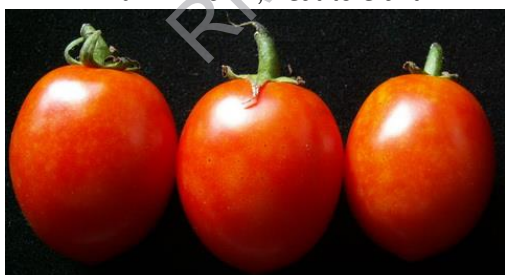
2. Materials and Methods

The samples employed for this experiment were five varieties of cherry tomato were 1) ATRI No# 1; heat tolerant species collected from Doi Saket district, Chiang Mai Province, 2) ATRI No# 2; rain tolerant species collected from Muang District, Lampang Province, 3) cherry tomatoes; E-per, 4) cherry tomatoes; Phetchompu, and 5) cherry tomatoes; Sontam. The 1 and 2 varieties had been selected by the Agricultural Technology Research Institute and stability tested of plants grown at the Prince Chakraband Pensiri Center for Plant Development, Chiang Rai province. The 3, 4 and 5 varieties were commercial varieties. (Figure 1) The experimental design used was a 5 X 3 Factorial in RCBD Design with four replications.



120ATRI No# 1; heat tolerant

ATRI No# 2; rain tolerant



cherry tomatoes; E-per



cherry tomatoes; Phetchompu



cherry tomatoes; Somtam

Figure 1: The 5 varieties of tomato fruit in treatments.

2.1 Growth Conditions. Tomato plant was grown in the field; on Loamy sand and plastic mulch at the Agricultural Technology Research Institute of the Rajamangala University of Technology Lanna (RMUTL) at Lampang. Seeds were planted in peat media in seeding tray 104 cells pick at a rate of one seed per cell with each cultivar. Seeds were germinated in room temperature with a 10 – 12 /hour florescent light period. Germination was near 100%. After germination seeding, seeding was grown for about 25 days at which point the plants were 4 – 6" tall and ready for transplanting. Plant were hand irrigated every 3 – 4 days for two weeks, then furrow irrigated roughly once per week as needed. Most planting were staked on using single bamboo poles 3. Auxiliary shoots were pinches off every 3 – 4 days. The pesticide was no applied. Tomato large weed were pulled as needs.

2.2 Sampling. Firm tomato fruit was harvested at 35, 45 and 55 day after the first full bloom. The lycopene content of the samples was measured in accordance to the method of Davis (2003), the total soluble solids and the pH using a Beckman 4 pH meter were also followed.

2.3 Determination of carotenoid content. Lycopene were determined according to the method of Davis *et al.* (2003). Weight of 0.5 g of sample were added into 20 mL of extraction solution (25% ethanol: 50% hexane: 25% acetone + 0.05% of BHT) in a dark flask. The lycopene solution was agitated at 5 speed levels for 15 min. then intermediately added 3 mL of deionized water is added. The upper red-orange solution was separated by standing for 5 min. in dark container. The absorbance of the hexane layer at 503 nm wave length was determined and the lycopene content was calculated using an extinction coefficient of 17.2×10^4 /M cm. The extraction was repeated three times. The measured utilizing PG Instrument Limited Model T80 spectrometer, China

2.4 Color measurements Color changes of fresh tomato samples were measured by a performing color meter (JS 555, Japan) evaluation, which involved the measurement of the following 3 parameters: lightness/brightness or whiteness, (L^*), in which black had no reflection and white had perfect diffuse reflection; greenness-redness (a^*), in which the negative values indicated green and positive values indicated red, and blueness-yellowness (b^*), in which negative values indicated blue and positive values indicated yellow color.

3. Results and Discussion

The lycopene content and the pH in 5 varieties of tomatoes were different significantly ($P=0.01$). Cherry tomatoes E – per and ATRI No# 2 had higher lycopene and pH than those of other varieties. Lycopene was equal to 7.00 ± 3.79 and 6.63 ± 3.94 mg/100g, pH was 4.70 ± 0.31 and 4.55 ± 0.42 . The harvested fruit at 55 days after full bloom gave the highest lycopene content was 9.32 ± 2.10 . The harvested fruit at 35 days after full bloom gave the highest total soluble solids content was 5.46 ± 0.48 and the harvested fruit at 45 days after full bloom gave the highest pH was 4.65 ± 0.43 . (table 1)

The result found that had the correlation of tomato varieties and age at harvest on Lycopene content and pH. (table 1)

Table 1: The lycopene content, total soluble solids and the pH of five tomato varieties

Treatments	Lycopene (mg/100g)	TSS (°Brix)	pH
Cultivar (A)			
ATRI No# 1	$5.33^b \pm 2.34$	4.29 ± 0.90	$4.11^d \pm 0.24$
ATRI No# 2	$6.63^a \pm 3.94$	4.45 ± 0.91	$4.70^a \pm 0.31$
E-per	$7.00^a \pm 3.79$	4.42 ± 0.88	$4.55^{ab} \pm 0.42$
Phetchompu	$5.16^b \pm 3.93$	4.37 ± 0.68	$4.28^{cd} \pm 0.55$
Somtarn	$4.11^c \pm 3.16$	4.52 ± 0.89	$4.45^{bc} \pm 0.48$
Time harvesting (B)			
35 day	$1.70^c \pm 0.97$	$5.46^a \pm 0.48$	$4.35^b \pm 0.18$
45 day	$5.92^b \pm 1.61$	$4.16^b \pm 0.10$	$4.65^a \pm 0.43$
55 day	$9.32^a \pm 2.10$	$3.61^c \pm 0.08$	$4.25^b \pm 0.57$
F – test			
Cultivar (A)	**	NS	**
Time harvesting (B)	**	**	**
Interaction (A X B)	*	NS	**

Note: * = Means within row followed by different letter is significantly different ($p < 0.05$) as determined by DMRT

** = Means within row followed by different letter is significantly different ($p < 0.01$) as determined by DMRT

NS = means non - significant as determined by DMRT

Cherry tomatoes varieties Somtarn and Phetchompu had the luminance (L^*) of the skin is the highest 33.41 ± 5.68 and 32.93 ± 6.03 , which differs significantly statistically ($P=0.01$) compared to the L^* color of tomatoes varieties ATRI No# 1, ATRI No # 2 and E-per, with the L^* equal to 31.96 ± 3.70 , 31.22 ± 3.82 and 30.26 ± 4.56 respectively. Harvested at the age of 35 days, the L^* of the

skin is the highest 37.97 ± 2.34 , followed by harvest at age 45 days, the L^* equal to 30.88 ± 2.49 . The lowest was harvested at 55 days, the L^* were 27.54 ± 1.60 . (Table 2)

The skin of tomato varieties E-per had the highest redness values (a^*) was 22.19 ± 5.74 , which differs significantly statistically ($P=0.01$) compared to the a^* of varieties ATRI No# 2, ATRI No# 1, Somtam and Phetchompu with the a^* of the skin color were 18.91 ± 7.32 , 18.67 ± 7.29 , 13.97 ± 1.367 and 12.68 ± 11.67 , respectively. Harvested at 55 days with a^* to the colored skin was 24.03 ± 1.62 second was harvested at 45 days was equal to 22.64 ± 3.06 and harvested at 35 days with the lowest was 5.18 ± 7.88 , respectively. (Table 2)

Tomato varieties ATRI No# 1, ATRI No# 2, E-per, Phetchompu and Somtam had the yellowness value (b^*) of skin color was 28.22 ± 2.92 , 27.35 ± 1.64 , 28.29 ± 1.56 , 28.99 ± 2.94 and 28.93 ± 3.66 , respectively, which did not differ significantly statistics on the comparison. Harvested at the age of 35 days, the b^* skin color is the highest 30.29 ± 2.42 minor is harvested at 45 days with the b^* equal to 28.10 ± 2.18 and harvested at 35 days with b^* are the lowest is equal to 26.67 ± 2.05 , respectively. (Table 2)

The result found that had the correlation of tomato varieties and age at harvest on luminance value (L^*), redness value (a^*) and yellowness value (b^*). (Table 2)

Table 2: The luminance value (L^*), redness value (a^*) and yellowness value (b^*) of five tomato varieties

Treatments	L^*	a^*	b^*
Cultivar (A)			
ATRI No# 1	$31.96^{bc} \pm 3.70$	$18.67^b \pm 7.29$	28.22 ± 2.92
ATRI No# 2	$31.22^{cd} \pm 3.82$	$18.91^b \pm 7.32$	27.35 ± 1.64
E-per	$30.26^d \pm 4.56$	$22.19^a \pm 5.74$	28.29 ± 1.56
Phetchompu	$32.93^{ab} \pm 6.03$	$13.97^c \pm 13.67$	28.99 ± 2.94
Somtarn	$33.41^a \pm 5.68$	$12.68^c \pm 11.67$	28.93 ± 3.66
Time harvesting (B)			
35 day	$37.97^a \pm 2.34$	$5.18^c \pm 7.88$	$30.29^a \pm 2.42$
45 day	$30.88^b \pm 2.49$	$22.64^b \pm 3.06$	$28.10^b \pm 2.18$
55 day	$27.54^c \pm 1.60$	$24.03^a \pm 1.62$	$26.67^c \pm 2.05$
F – test			
Cultivar (A)	**	**	NS
Time harvesting (B)	**	**	**
Interaction (A X B)	**	**	**

Note: ** = Means within row followed by different letter is significantly different ($p < 0.01$) as determined by DMRT

NS = means non - significant as determined by DMRT

The results showed that the characteristics of the five varieties of tomatoes when ripe had the exterior color intensity developed in the same direction for all varieties on harvest age. Color the external is dark red up (Figure 2) and is associated with the amount of lycopene External color of ripe tomatoes that have a deep red color varieties such as E – Per and ATRI No # 2 is the amount of lycopene than tomatoes with colors such as pink varieties of ripe i.e., Cherry tomatoes Somtam.

The result showed that the tomato varieties and fruit harvest time had effect on lycopene content. There was a positive relationship, the dark red when ripe variety had the highest lycopene content and a^* value. However, the less red color gave lower lycopene content while the increasing of harvest after full bloom lycopene content and a^* value due to mature tomato fruit contained pigment increase. During fruit ripening, maximum concentrations of α - and β -carotene occur at the turning to breaking stages (Meredith and Purcell 1966), after which lycopene accumulates (Davies and Hobson 1981).



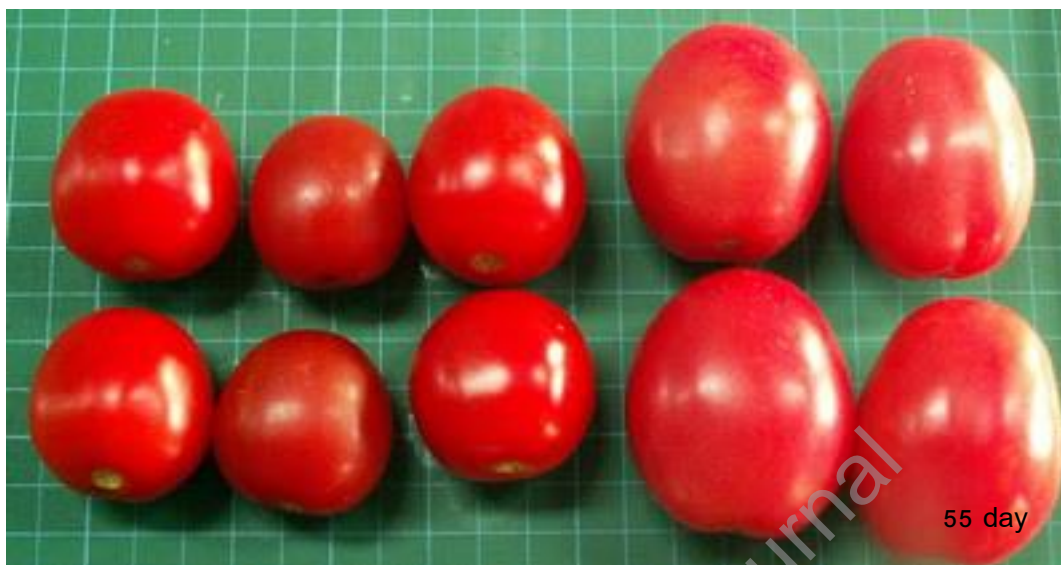


Figure 2: Changes in color of 5 varieties of tomato fruit harvested at 35, 45 and 55 days after the first full bloom.

4. References

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