International Journal of ChemTech Research
CODEN (USA): IJCRGG, ISSN: 0974-4290, ISSN(Online):2455-9555
Vol.10 No.9, pp 1032-1037, 2017

# Delayed Organoleptic Maturation of Tomato Variety Milano (*Lycopersicum esculentum* Mill) Using Giberelina

**Baldiris-Navarro I.[1]*, Marrugo-Ligardo Y.[2], Severiche-Sierra C.[1,2], Jaimes-Morales J.[2], Fong-Silva W.[2], Vargas-Ortiz L.[1], Bedoya-Marrugo E.[1], Cohen-Padilla H.[1]**

**[1]University Foundation Technological Comfenalco, Department of Occupational Health and Safety, Engineering Campus. Cartagena of indias, Colombia.**
**[2]University of Cartagena, Department of Environment, Food and Health, Campus Zaragocilla- Area of Health Sciences. Cartagena of indias, Colombia.**

**Abstract:** The use of Giberelina was evaluated to delay the organoleptic maturation of the tomato variety Milano (Lycopersicum esculentum Mill). Two concentrations of gibberellic acid (100, 250, 500, 1000 ppm) were applied by immersion in two stages of maturity (green and pint). The results indicate that from the changes in physical, chemical, physiological and enzymatic properties (Pectinmethylesterase) and in order to control the loss of firmness, calcium chloride was used as a texture enhancer. Chemical properties such as acidity and soluble solids content, differ significantly with the ripeness stage of the cv Milano tomato. The gibberellin allows to exert a retarding control both in the green and in the paint, on the physicochemical characteristics of color, firmness in both skin and pulp, development of pigments (chlorophyll and lycopenes), acidity, pH, ° Bx and humidity, As well as in physiological (respiration and transpiration) and enzymatic (pectinmethylesterase activity) characteristics. The development of organoleptic maturation in tomato cv. Milano, can be regulated or delayed to an additional 20 days under storage conditions of 22 ° C with the application of gibberellin at 1000 ppm in combination with 1% calcium chloride.
**Keywords :** Organoleptic maturation, Conservation methods, Post - harvest losses, Vegetables.

## Introduction

The increase in the world population mainly forces the agricultural sector to generate new technologies in order to increase the horticultural yield per unit area and the quality of foodstuffs for the demanding market. One of the most widespread vegetables in the world and of greater economic value is tomato[1,2]. Its demand increases continuously and with it increased production and trade. The annual increase of production in the last years is mainly due to the increase in the yield per unit planted and to a smaller proportion to the increase of the cultivated area[3,4].

The tomato (Lycopersicon esculentum, Mill) is one of the most important vegetables in several countries, mainly due to its high economic value reflected in its high demand, with markets for fresh or industrialized consumption[5]. The table tomato (Solanum lycopersicum L.) at national and international level is the vegetable with the highest cultivated area and greater consumption. In 2011, 4,734,356 ha were planted worldwide with a production of 159,023,383 t, while in Colombia, for 2010, the cultivated area was 7,263 ha

with a production of 271,895 t [6].

One of the techniques that allows to increase the size of the fruits is the application of gibberellic acid, but in the study area, the dose that generates the most favorable results is unknown, therefore, fruits of the expected size and / Or the fruit does not mature normally in postharvest and loses its commercial quality. The growth and development of tomato fruit[7]. Gibberellins as tetracyclic diterpenoid hormones essential for the normal development of plants. Giberelic acid is a plant hormone that controls developmental processes such as germination, stem elongation, tuberization, flowering, fruit growth, growth in various species [8,9,10].

Trujillo et al.[11] points out that tomato harvesting is a very important activity on which the final quality of the fruit depends to a great extent. The most suitable moment for the harvest is determined by market preferences, an aspect that must be taken into account when choosing the degree of maturity to harvest the fruits.

In the same sense, Benito et al.[12], highlights that during the maturation of the fruits occur physiological, biochemical and structural changes that influence the production of chemical compounds that generate the corresponding flavor and aroma. The softening of the tissues varies according to the species and variety of the fruit, and is due to the degradation of pectins and hemicelluloses of the cell wall by the action of different hydrolytic enzymes.

## Experimental

### Characterization of tomato maturity stages

The fruit and vegetable products are of a complex nature and possess unique qualities that determine the quality of this type of products[11]. These qualities are defined by physical characteristics; Which describe them in their color, size, weight, roundness, maturity, health, homogeneity, etc.[7].

The analyzes performed for the characterization of the physical properties were: weight, size, volume, specific weight, seed-pulp-seed ratio, firmness, color and pigments (chlorophyll, lycopene). It is important to evaluate characteristics such as humidity, pH, acidity, soluble solids, etc. in horticultural products due to the fact that during maturation there are biochemical reactions that change its composition affecting the percentages of carbohydrates, organic acids, pigments and volatile compounds among others, modifying The organoleptic characteristics that show their total quality[6,13,14].

The determination of pectinesterase activity for each of the evaluated maturity stages was determined using the static pH method[12].

### Determination of the effect of gibberellin on tomato quality and shelf life

The Milan variety tomato was used as plant material in the states of green and pintle maturity. The effectiveness of gibberellin was evaluated from the physicochemical, physiological and enzymatic quality of the Milan variety tomato for a period of thirty (30) days in bulk storage at atmospheric conditions[15,16].

Samples were treated by immersion with gibberellin at four concentrations (100, 250, 500, 1000 ppm) in a 1: 2 ratio for a time of 5 min, then the samples were dried, and bulk storage at Room temperature (18-20 ° C).

The effect of gibberellin in the two maturity stages of the Milano variety tomato was evaluated during storage days 0, 3, 5, 7, 15, 20, 30 at atmospheric conditions, in order to establish its possible use by immersion in The conservation of physicochemical characteristics.

The physical characteristics evaluated were color, firmness and pigments (chlorophyll and lycopene). The acidity, pH, soluble solids and moisture content were analyzed as chemical characteristics.

For a more objective evaluation of the quality and shelf life of the Milano variety tomato during the storage time, a batch of the samples was carried out. Thus, a batch of 1 kg of the treated and untreated plant

material (control) with gibberellic acid was randomly selected, in order to monitor the respiration rate, transpiration index and color evolution in The 30 days.

**Selection of the organoleptic retardant maturation treatment with gibberellin**

A calcium chloride ($CaCl_2$) texture improver was applied, as recommended by Ortega et al.[5] calcium is involved in important functions within fruits, mainly in the stabilization and rigidity of membranes and cell walls. The treatment with gibberellic acid in the best maturity stage of the cv Milano tomato was then selected. Subsequently, the samples were treated with 1% $CaCl_2$ and gibberellin by immersion, evaluating their effect on the physicochemical, physiological and enzymatic characteristics on storage days 0, 3, 5, 10, 20, 30 at room temperature. At these same conditions a control sample (without treatment with gibberellin and $CaCl_2$) was prepared and stored to evaluate and compare the efficiency of the treatment.

**Statistic analysis**

Different analyzes of variance are performed to observe the behavior of the physiological characteristics (Acidity, pH, SST,% of moisture, chlorophyll and lycopenes), physiological and enzymatic (Firmness in skin, firmness in pulp, respiration and enzymes) With respect to different concentrations of glycerin, to determine the appropriate dose to help preserve tomato properties. The analyzes are done for tomatoes in state in green and pintón state.

The doses considered were 100ppm, 250ppm, 500ppm and 1000ppm, which were applied on day 0 to 12 tomatoes and then observed the average of the different characteristics after 30 days, also taking into account a group of tomatoes Witness for Observe the effect of the doses.

All the results were analyzed using the statistical package SPSS version 17.

## Results and discussion

Next, the results of the different characteristics considered for the cv tomato of the variety Milano in the green state are presented.

**Table 1. Analysis of variance the physico-chemical characteristics of the cv Milano tomato in treated and untreated green**

| Concentration | Acidity | pH | S.S.T | % Humidity |
|---|---|---|---|---|
| Initial | 0,1952±0,00 | 4,67±0,03 | 4,10±0,14 | 95,09±1,30 |
| Witness | 0,2938±0,16 | 4,93±0,22 | 4,02±0,58a | 94,08±1,14 |
| 100ppm | 0,2810±0,12 | 5,01±0,41 | 3,53±0,59ab | 94,41±1,47 |
| 250ppm | 0,2576±0,12 | 4,89±0,29 | 3,62±0,44 | 94,89±0,54 |
| 500ppm | 0,2794±0,11 | 4,89±0,29 | 3,98±0,46b | 94,13±0,54 |
| 1000ppm | 0,2842±0,15 | 4,96±0,29 | 3,90±0,63 | 94,36±1,04 |
| p-value | 0,943 | 0,751 | 0,154 | 0,491 |

According to the obtained in Table 1, it is observed that there is no significant difference between the different concentration levels for each one of the physicochemical variables considered, except for soluble solids (SST), for which the average statistical results indicate that there is a difference Significant at a level of significance of 16%, between the treatment at 100ppm, the control and 500ppm, the sample at 100ppm having the lowest average value of soluble solids (3.53). The above indicates that the levels of glycerin concentration do not influence the acidity, pH, and humidity of tomatoes.

**Table 2. Analysis of variance for the characteristics associated with the pigment of the cv Milano tomato in the green state**

| Concentration | Chlorophyll | Lycopenes |
|---|---|---|
| Initial | 0,005±0,016a | 0,11±0,006 |
| Witness | 0,08±0,07b | 0,08±1,69 |
| 100ppm | 0,122±0,09 | 0,89±2,50 |
| 250ppm | 0,08±0,05c | 0,37±1,90 |
| 500ppm | 0,10±0,10 | (-)0,23±1,45 |
| 1000ppm | 0,20±0,23abc | (-)0,07±1,46 |
| p-value | 0,131 | 0,727 |

With respect to the characteristics associated with the pigment (Chlorophyll and Lycopenes), it is observed that there is a significant difference (at a significance level of 15%) between the concentration 1000mg and the initial value, control and concentration of 120ppm with respect to chlorophyll, Being observed that the average level of chlorophyll higher is in the level of concentration of 1000ppm. For Lycopene there is no significant difference in the different concentrations (p-value = 0.727).

Table 3 contains the analysis of variance for the physiological variables of tomato cv Milano in the green state, in which it is observed that there is a significant difference between the firmness of the flesh and skin of the respiration (p-value of 0.00 respectively), being The concentration of 1000ppm the highest values for firmness and respiration (17.66, 13.28 and 9.61 respectively). For Enzyme no significant difference between the enzyme content of the different levels of concentration (p-value = 0.621) was observed.

**Table 3. Analysis of variance for the physiological and enzymatic characteristics of tomato cv Milano in the green state**

| Concentration | Firmness in skin | Firmness in pulp | Respiration | Enzyme |
|---|---|---|---|---|
| Initial | 23,68±2,97abcde | 27,74±8,56abcde | 4,15±4,33a | 4,50±0,000 |
| Witness | 13,03±6,96a | 9,80±5,92afgh | 2,62±1,30b | 4,83±0,5982 |
| 100ppm | 15,65±7,77b | 11,47±9,39b | 3,76±1,47c | 4,41±0,7613 |
| 250ppm | 15,79±8,81c | 12,88±9,05cf | 4,10±1,35d | 4,41±1,0570 |
| 500ppm | 15,14±7,33d | 12,94±8,93dg | 7,42±5,13bcd | 4,38±0,8642 |
| 1000ppm | 17,66±8,58e | 13,28±7,66eh | 9,61±5,49abcd | 4,30±0,9361 |
| p-value | 0,001 | 0,000 | 0,000 | 0,621 |

Next, the results of the analysis of variance realized in tomatoes in state pintón are observed. According to Table 3, it is observed that there is no significant difference between acidity, pH and S.S.T at different concentrations of glycerin; While for the percentage of moisture a significant difference is observed at 5% (p-value = 0.029), where the lowest percentage of moisture is found for the concentration of glycerine 1000ppm.

**Table 4. Analysis of variance for the physico-chemical characteristics of tomato cv Milano in pintón state**

| Concentration | Acidity | pH | S.S.T | % Humidity |
|---|---|---|---|---|
| Initial | 0,16±0,009 | 4,87±0,049 | 4,35±0,07 | 91,62±1,06**a** |
| Witness | 0,16±0,04 | 5,02±0,3125 | 4,08±0,57 | 94,22±0,47**a** |
| 100ppm | 0,18±0,05 | 4,97±0,2021 | 4,07±0,74 | 94,03±0,98**a** |
| 250ppm | 0,16±0,02 | 4,97±0,1799 | 4,22±0,49 | 93,96±1,14**a** |
| 500ppm | 0,18±0,03 | 4,96±0,2731 | 4,05±0,65 | 94,08±0,57**a** |
| 1000ppm | 0,18±0,03 | 4,99±0,2020 | 3,95±0,58 | 93,90±1,28**a** |
| p-value | 0,741 | 0,976 | 0,908 | 0,029 |

With regard to the tomato pigment, it is observed that there is no significant difference between chlorophyll and lycopenes of the different glycemia concentrations (p-values of 0.994 and 0.307 respectively).

**Table 5. Analysis of variance for the characteristics associated to the pigment of the tomato cv Milano in pintón state**

| Concentration | Chlorophyll | Lycopenes |
|---|---|---|
| Initial | 0,12±0,00 | 1,29±0,00 |
| Witness | 0,70±1,97 | 0,44±1,41 |
| 100ppm | 0,89±2,29 | 0,73±1,88 |
| 250ppm | 1,11±2,75 | (-)0,31±0,86 |
| 500ppm | 0,89±2,24 | 0,04±1,24 |
| 1000ppm | 0,79±1,99 | (-)0,03±0,98 |
| p-valor | 0,994 | 0,307 |

With regard to the physiological and enzymatic characteristics for the tomato in the pintine state, there is a significant difference between the different concentrations with respect to respiration, enzyme and firmness of skin and pulp (p-values below 10%). According to the results, the average firmness is more maltas in the concentration 1000ppm in both skin and pulp (15,49 and 12,79 respectively); While the mean levels of respiration and enzymes are lower for the 1000ppm concentration (3.22 and 4.85 respectively).

**Table 6. Mean statistical results of the physiological and enzymatic characteristics of the tomato cv Milano in pintón state**

| Concentration | Breathing | Enzyme | Firmness in skin | Firmness in pulp |
|---|---|---|---|---|
| Initial | 6,05±1,83 | 4,00±0,000abc | 18,14±3,06abcd | 14,15±4,79abc |
| Witness | 5,04±3,13 | 5,68±0,38ade | 10,47±5,46aefg | 9,14±5,72ad |
| 100ppm | 6,24±3,49a | 5,21±0,83b | 13,28±6,87be | 11,24±5,35 |
| 250ppm | 5,90±4,72b | 4,95±0,50d | 11,53±5,39ch | 9,28±6,15be |
| 500ppm | 3,31±2,12a | 5,43±0,77c | 12,76±5,02dfi | 11,22±6,80 |
| 1000ppm | 3,22±1,99ab | 4,85±1,06e | 15,49±8,23ghi | 12,79±8,53cde |
| p-valor | 0,097 | 0,016 | 0,000 | 0,009 |

In general, for tomatoes in the green state, the effect of glycerin concentration on characteristics such as soluble solids, chlorophyll, skin firmness, pulp and respiration is observed.

While for tomatoes in the painted state, effects are observed on variables such as humidity, respiration, firmness in skin and in pulp and enzymes. Accordingly, the level of enzyme concentration that provides the best results for control effects of tomato maturation is the 1000ppm concentration. It can also be evidenced that the effect of the concentration of glycerin is greater for tomatoes in the green state than in the state of pintón, that is to say, better results are obtained with tomato in this state.

It is also observed that the levels of lycopene, pH and acidity are not affected by the presence of the different levels of glycerin concentration, so that this treatment does not control the changes of these characteristics in tomato maturation.

## Conclusions

Analyzed data obtained in the experimental phase of this research, we can conclude that the physiological, enzymatic, physical characteristics such as lycopene content; Chemical properties such as acidity and soluble solids content, differ significantly with the ripeness stage of the cv Milano tomato. The gibberellin allows to exert a retarding control both in the green and in the paint, on the physicochemical characteristics of color, firmness in both skin and pulp, development of pigments (chlorophyll and lycopenes), acidity, pH, ° Bx

and humidity, As well as in physiological (respiration and transpiration) and enzymatic (pectinmethylesterase activity) characteristics. The development of organoleptic maturation in tomato cv. Milano, can be regulated or delayed to an additional 20 days under storage conditions of 22 ° C with the application of gibberellin at 1000 ppm in combination with 1% calcium chloride.

## References

1. Ortega, L.; Sánchez, J.; Díaz, R. y Ocampo, J. (2010). Efecto de diferentes sustratos en el crecimiento de plántulas de tomate (Lycopersicum esculentum MILL). Ra Ximhai. 6(3): 365-372.
2. Siddiqui, M. y Al-Whaibi, M. (2014). Role of nano-SiO2 in germination of tomato (Lycopersicum esculentum seeds Mill.). Saudi Journal of Biological Sciences. 21(1): 13-17.
3. Silva, M.; Yasuor, H.; Ben-Gal, A.; Yermiyahu, U.; Saranga, Y. y Elbaum, R. (2015). Salinity induced fruit hypodermis thickening alters the texture of tomato (Solanum lycopersicum Mill) fruits. Scientia Horticulturae. 192(31): 244-249.
4. Alharby, H.; Metwali, E.; Fuller, M. y Aldhebiani, A. (2016). The alteration of mRNA expression of SOD and GPX genes, and proteins in tomato (Lycopersicon esculentum Mill) under stress of NaCl and/or ZnO nanoparticles. Saudi Journal of Biological Sciences. 23(6): 773-781.
5. Ortega, L.; Ocampo, J.; Martínez, C.; Pérez, A. y Sánchez, J. (2013). Efecto de las giberelinas sobre el crecimiento y calidad de plántulas de tomate. Biotecnia. 15(3): 56-60.
6. Fraile, A.; Álvarez, J. y Deaquiz, Y. (2012). Efecto de las giberelinas en la propagación de tomate (Solanum lycopersicum L.) bajo diferentes sustratos enriquecidos con fertilizante. Revista Colombiana de Ciencias Hortícolas. 6(1): 41-54.
7. Laiton, G.; Almanza, P.; Balaguera, H. (2012). Producción y calidad poscosecha de tomate (Solanum lycopersicum L.) larga vida sometido a la aplicación de ácido giberélico. Revista Colombiana de Ciencias Hortícolas. 6(2) 183-195.
8. González, M., Caycedo, C., Velásquez, M., Flórez, V. y Garzón, M. (2007). Efecto de la aplicación del ácido giberélico sobre el crecimiento de coliflor Brassica oleraceae L.) var. Botrytis DC. Agronomía Colombiana. 25(1): 54-61.
9. Arias, Y.; González, I.; Rodríguez, M.; Rosales, C.; Suárez, Z. y Peteira, B. (2009). Aspectos generales de la interacción tomate (Solanum lycopersicon L.) _ Meloidogyne incognita. Revista de Protección Vegetal. 24(1): 1-13.
10. Bettini, P.; Baraldi, R.; Rapparini, F.; Melani, L.; Mauro, M.; Bindi, D. y Buiatti, M. (2010). The insertion of the Agrobacterium rhizogenes rolC gene in tomato (Solanum lycopersicum L.) affects plant architecture and endogenous auxin and abscisic acid levels. Scientia Horticulturae. 123(3): 323-328.
11. Trujillo, Y., Cáceres, L., Durán, D. (2013). Influencia del uso poscosecha de retardante en el color del tomate (Lycopersicum esculentum Mill) variedad Chonto. @LIMENTECH Ciencia y Tecnología Alimentaria. 11(1): 72-78.
12. Benito, P.; Arellanes, N. y Pérez, M. (2016). Color y estado de madurez del fruto de tomate de cáscara. Agronomía Mesoamericana. 27(1): 115-130.
13. Saldívar, P.; Laguna, A.; Gutiérrez, F. y & Domínguez, M. (2010). Ácido giberélico en la Germinación de semillas de Jaltomata procumbens (Cav.) J. L. Gentry. Agronomía Mesoamericana. 21(2): 327-331.
14. Domínguez, I.; Lafuente, M.; Hernández, P. y Gavara, R. (2016). Influence of modified atmosphere and ethylene levels on quality attributes of fresh tomatoes (Lycopersicon esculentum Mill.). Food Chemistry. 209(15): 211-219.
15. Haliński, L.; Kalkowska, M.; Kalkowski, M., Piorunowska, J.; Topolewska, A. y Stepnowski, P. (2015). Cuticular wax variation in the tomato (Solanum lycopersicum L.), related wild species and their interspecific hybrids. Biochemical Systematics and Ecology. 60): 215-224.
16. Novizar, N. y Reza, M. (2016). The Improvement Lycopene Availability and Antioxidant Activities of Tomato (Lycopersicum Esculentum, Mill) Jelly Drink. Agriculture and Agricultural Science Procedia. 9: 328-334.

*****