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Study on Analysis of Vitamin C and β-Carotene Levels From Tamarillo (*Solanum betaceaum Cav.*) Fruit Produced Between Shoot Grafting of Tamarillo with Lancing Plant (*Solanum mauritianum*)

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Abstract. Research on studies analysis levels of vitamin C and β-carotene of the Tamarillo fruit shoot grafting between the Tamarillo plant and Lancing plant has been conducted. Analysis of vitamin C level was performed by iodometric method, and analysis of β-carotene levels were calculated using UV-Vis spectrophotometer. The research result showed that the level of vitamin C of Tamarillo fruit was 1.596%, the level of vitamin C of Lancing fruit was 0.401%, and the level of vitamin C of Tamarillo fruit grafting outcomes was 1.202%. While the level of β-carotene of Tamarillo fruit was 208.95 ppm, the level of β-carotene of Lancing fruit was 36.11 ppm and the level of - carotene of Tamarillo fruit grafting outcomes was 253.64 ppm. It can be concluded that the vitamin C levels of Tamarillo fruit grafting outcomes decreased slightly. While the β-carotene levels of Tamarillo fruit grafting outcomes increased.

Keywords: Tamarillo, Grafting, Lancing, Vitamin C, β-carotene

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1 Introduction

Fruits have an important role in supporting health and fitness. Because the fruit contains a variety of vitamins, minerals, dietary fiber, and antioxidant components. (Anonymous, 2008).

Tamaillo is originally known as *Chypomandra betaceae Cav*., but later revised by Sendtner to *Solanum betaceaum Cav*. Which belongs to the Solanaceae family. Tamarillo fruit (*Solanum betaceaum Cav.*) is a type of Tamarillo from the Solanaceae family. Tamarillo fruit grows in Indonesia only in a few areas, especially in Berastagi, Karo district, North Sumatra. Tamarillo is a commercially valuable plant, so it needs to be developed both in terms of quality and quantity.

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Lancing plant (*Solanum mauritianum*) is a small tree or shrub from South America, including North Argentina, South Brazil, Paraguay, and Uruguay. This plant has a life span of up to 30 years and can grow up to 33 feet. This plant has large oval leaves that are green to gray in color. The flowers are purple with yellow in the middle. This plant can flower throughout the year and can grow on various types of soil. (Wikipedia, 2010)

Conventionally, biotechnology plant has been widely applied to overcome food problems such as shoot grafting. In the grafting process, there is a merger of two living tissues between the scion and rootstock. The grafted plants will have superior characteristics to those of the scion and rootstock.

Innovation and supporting science in biotechnology continue to develop. Several studies on the effect of scion on rootstock have been carried out. According to research conducted by Rieska Handayani and Ribu Surbakti (2002) who succeeded in grafting between Tomato plants and Potato plants with a success rate of 24%. According to research conducted by Evariani (2011) who conducted an analysis of carbohydrates from biosynthetic products on the fruit of Tamarillo from shoot grafting between Tamarillo plant (*Chiphomandra betaceae*) and Rimbang (*Solanum torvum swartz*). The results of carbohydrate analysis on the fruit of the new plant of Tamarillo and Rimbang showed that there was an increase in the carbohydrate content of the fruit of the new plant of Tamarillo was 40.09%. E. Safitri and Ribu Surbakti (2000) carried out the same method in making hybrids between cassava plants and poison cassava plants with a 93% success rate and the resulting cassava production level reached 3 times, with carbohydrate content also increased to 60.8% due to the addition of age so that the photosynthesis process was more perfect.

The shoot grafting method can be done between two plant varieties that are still in the same species, and it can also be performed between two plants of different species but still in the same family. Agustina (2004) between oranges and oranges to produce superior seeds. Furthermore, Makhziah and Mulyani (2008) carried out grafting of pumpkin shoots with melon to increase the glucose level of melon fruit was 7.79 % (http://repository.usu.ac.id).

In this case, shoot grafting was carried out between the Tamarillo plant and the Lancing plant because the two plants were still in the same family. The two plants that are put together each have their advantages. The Tamarillo plant which is a scion has advantages in terms of fruit density, the fruit produced is rich in nutrients needed by the body, and is responsive to manure and dry places. While the advantages of the Lancing plant has strong roots so that it can support the Tamarillo plant as its scion, drought-resistant, resistant to pests and has a long life of up to tens of years so it can be rejuvenated without cutting down old trees and do not require new seeds. Tarigan and Pintubatu (2006) have tried to connect the shoots of the Tamarillo plant with

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the Rimbang plant so the Tamarillo plant does not fall when it has a bear. Lahimsjah (2009) grafted Tamarillo plant, Tomato and Chili shoot to Rimbang stems (takokak) for reasons of the art and beauty (http://repository.usu.ac.id).

According to research conducted by Elly Suryani Harahap (2011) showed the presence of solasodine content in the Tamarillo fruit from shoot grafting between the Tamarillo plant and the Lancing plant which greatly affected the pregnancy rate of mice. In addition, Tamarillo plant also contains high levels of nutrients such as vitamin C and β-carotene. It is possible that the shoot-grafted Tamarillo plant also contains the same components so researchers are interested to know the levels of vitamin C and β-carotene in the fruit of the Tamarillo fruit from shoot grafting between the Tamarillo plant (*Solanum beteceum Cav.*) and the Lancing plant (*Solanum mauritianum*) because these components have very good properties for body health.

2 Materials and Methods

2.1 Equipment

The equipments used were analytical balance, glassware, cuvette, blender, stative and clamp, burette, and a set of UV-Vis spectrophotometer.

2.2 Materials

The materials used in this study were Tamarillo fruit, Lancing fruit, Tamarillo plant from shoot grafting, starch, and aquadest.

2.3 Procedure

2.3.1 Sampling

Tamarillo fruit was collected from Pajak Sore traditional market, Padang Bulan, Medan, North Sumatera, Indonesia. Lancing fruit was obtained from the Sibolangit Nature Reserve and Berastagi Tahura, North Sumatera, Indonesia. Tamarillo shoot grafting result was obtained from the Faculty of Agriculture University of Quality Berastagi, North Sumatra, Indonesia.

2.3.2 Preparation of Reagent Solution

2.3.2.1 Preparation of Starch Indicator 1%

As much as 1 g of starch was put into a beaker glass and added 100 mL of distilled water. Then heated on a hot plate until boiling.

2.3.2.2 Preparation of I_2 0.001N

As much as 10 mL of I_2 0.1 N solution was put into a 100 mL of volumetric flask and then added distilled water until the marked line, and omogenized.

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2.3.3 Preparation of Sample Extract

As much as 500 g Tamarillo fruit was peeled and placed into a blender and blended until smooth, and filtered. The same treatment was carried out for Lancing fruit and Tamarillo fruit from shoot grafting.

2.3.4 Determination of Vitamin C Levels

As much as 10 mL of Tamarillo extract was put into a 100 mL of volumetric flask and diluted with distilled water to the marked line, homogenized. Then, as much as 10 mL was taken using a volumetric pipette and put into a 250 mL Erlenmeyer. Then added 3 drops of 1% starch indicator. Next, Titrated with 0.01N of I_2 solution until the color changes to blue. The same treatment was repeated 3 times. The same treatment was carried out for Lancing fruit and Tamarillo fruit from shoot grafting.

2.3.5 Determination of β-Carotene Levels

As much as 0.1 g of Tamarillo fruit was put into a 25 mL of volumetric flask and diluted with distilled water to the marked line, homogenized. The solution was transferred into a cuvette. The absorbance of the solution was measured using a UV-Visible spectrophotometer at 446 nm. The absorbance of the blank was also measured using a UV-Visible spectrophotometer at 446 nm. The same treatment was repeated 3 times. The same treatment was repeated for Lancing fruit and Tamarillo fruit resulting from shoot grafting.

3 RESULT AND DISCUSSION

3.1 Result

Based on the results of the research conducted, the following results were obtained

Table 1. Data Analysis of Vitamin C Levels from Tamarillo Fruit, Lancing Fruit, and Tamarillo from Shoot Grafting

No	Sample	Average Vitamin C Level (%)
1	10 mL Tamarillo fruit extraxt	1.596
2	10 mL Lancing fruit extraxt	0.401
3	10 mL Tamarillo fruit extraxt from shoot grafting	1.202

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Table 2. Data Analysis of β-Carotene Levels from Tamarillo Fruit, Lancing Fruit, and Tamarillo from Shoot Grafting

No	Sample	Average - carotene content (ppm)
1	10 mL Tamarillo fruit extraxt	208.95
2	10 mL Lancing fruit extraxt	36.11
3	10 mL Tamarillo fruit extraxt from shoot grafting	253.64

3.2 Discussion

Based on the results of the study, it was found that the vitamin C level of shoot-grafted Tamarillo fruit was smaller than the Tamarillo fruit and greater than the Lancing fruit. Meanwhile, the β-carotene level of the Tamarillo was higher than the Tamarillo and Lancing fruit. The decreasing levels of vitamin C and increasing levels of β-carotene were caused by the merging of two different varieties. Where these varieties have each gene that differs from each other. The merging of these two types of plants will produce a new plant that inherits the genes from its parent. As stated by Mendel, namely the law of inheritance of traits in organisms.

Mendel's law is divided into two, namely the law of segregation and the law of independent assortment. The law of independent segregation states that in the formation of gametes (sex cells), the two parent genes which are allele pairs will separate so that each gamete receives one gene from its parent.

Mendel's second law states that if two individuals have two or more pairs of traits, then the trait is inherited independently, independent of the other pair of traits. In other words, alleles with different trait genes do not affect each other.

So, based on Mendel's second law, the inheritance of the Tamarillo fruit resulting from shoot grafting between the Tamarillo plant and the Lancing plant was inherited independently, so the vitamin C and β-carotene levels in the Tamarillo fruit were different from the two parents.

3.2.1 Decreasing of Vitamin C Levels in Tamarillo Fruit from Shoot Grafting

Vitamin C levels in Tamarillo fruit from shoot grafting between Tamarillo plant and Lancing plants decreased. This was because the biosynthesis of D-sorbitol into L-sorbose by the *Acetobacter soboxydans* has to use a Ni catalyst. So, it was possible that in the soil that was

grown by the Tamarillo plant, the shoot grafting was not contained nutrients in the form of Ni metal, so the process of changing to ascorbic acid will decrease. (Boudrant, 1990).

3.2.2 Increasing of β-Carotene Levels in Tamarillo Fruit from Shoot Grafting

The levels of β-carotene in shoot-grafted Tamarillo fruit increased compared to the original Tamarillo fruit and Lancing fruit. It happened because there are 3 possibilities, namely:

1. The enzyme that catalyzes the conversion of β-carotene to canthaxanthin in the hybrid plant between the Tamarillo plant and the Lancing plant was less active, increasing the level of β-carotene in the shoot-grafted Tamarillo plant.

2. The enzyme that catalyzes the conversion of β-carotene to β-cryptoxanthin in a hybrid plant between the Tamarillo plant and the Lancing plant was less active, increasing β-carotene levels in shoot-grafted Tamarillo plant.

3. The enzyme that catalyzes the conversion of β-carotene to β-carotene in the combination of the Tamarillo plant and the Lancing plant was very active, increasing the β-carotene level of the shoot-grafted Tamarillo plant (Hirschberg, 1997).

4 Conclusion

In conclusion,

1. The result of the analysis of vitamin C levels in shoot-grafted Tamarillo fruit was lower than the originally Tamarillo fruit and higher than Lancing fruit were 1.202%, 1.596%, and 0.401, respectively.

2. The results of the analysis of β-carotene levels in shoot-grafted Tamarillo fruit were higher than the original Tamarillo fruit and the Lancing fruit was 208.95 ppm, 36.11 ppm, and 253.64 ppm, respectively.

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