Characterization of vegetable fruit (*Diospyros Kaki* L. F) local Garut commodities using carboxy methyl cellulose (CMC) as a penstables during cold storage

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**Abstract.** Persimmon (*Diospyros kaki* L.) is one type of subtropical fruit plant which is classified as rare in Indonesia. Mature persimmon has a good taste, which is sour, sweet and fresh. Persimmon fruit tends to have perishable properties. Processing persimmon fruit into velva fruit can extend shelf life. Velva fruit is said to be good if it has a smooth texture and low melting speed, so stabilizers need to be added to produce good quality velva products. This study aimed to determine the characteristics of velva persimmon by adding Carboxy Methyl Cellulose (CMC) as a stabilizer during cold storage. Based on the results of the study showed that the concentration of CMC and the length of storage had a significant effect on increasing levels of vitamin C, the higher CMC was added, the higher vitamin C levels in velva persimmon and the longer stored vitamin C levels in velva persimmon decreased. The length of storage time also has a significant effect on total dissolved solids, the longer the storage, the greater the dissolved solids obtained will be. CMC concentration has an effect on velva overrun value, the higher the CMC concentration level is added, the overrun value will decrease further. CMC concentration and storage time significantly affected viscosity, texture and preference test. The best formula for viscosity is K3T1 with CMC concentration of 1.5% and storage time for 3 days. The best formula for texture is K1T1 with 0.5% CMC concentration and storage time for 3 days. The most preferred formula for panelists is the K1T1 sample with a combination of 0.5% CMC stabilizers and 3 days storage time.

**Keywords:** CMC, persimmon, cold storage, velva

1. **Preliminary**

Indonesia is one country that is rich in plant genetic resources and has specific advantages. Two of the plant genetic resources that can be found in Garut Regency, West Java are persimmon and breadfruit. Persimmon (*Diospyros kaki* L.) is one type of subtropical fruit plant which is classified as rare in Indonesia and has the potential to be developed [1]. Mature persimmon has a good taste, which is sour, sweet and fresh.

Persimmon contains a lot of phytochemicals, especially polyphenols, tannins, carotenoids, vitamin C, etc. Persimmon has good antioxidant activity, which is assessed through DPPH, Reduces power, Total phenol, Hydroxyl radical activity, Lipid & FRAP peroxidation. In addition, Persimmon also has anticancer properties, which become clear from the antiproliferative effects of persimmon fruit extract on the human brain cancer cell line [2].
This product tends to have perishable properties. Processing persimmon fruit into velva fruit can anticipate excessive yields and extend shelf life. Natural fibrous food is needed by the human body. Natural fiber foods are foods that have a chemical structure that does not change or last until the large intestine. One alternative to processing fruit is making Velva. Velva is a fruit diversified product which is included in frozen dessert foods [3, 4].

Velva fruit is said to be good if it has a smooth texture and low melting speed, so stabilizers need to be added to produce good quality velva products. The role of stabilizer in velva is to bind water in the dough to form a smooth ice crystal. The stabilizing material serves to maintain the body and texture of the product during storage. The use of stabilizers is determined by the character of the fruit processed into velva [5].

In making velva persimmon, Carboxy Methyl Cellulose (CMC) is needed as a stabilizer to produce quality velva persimmon. According to Dewi (2010), the addition of CMC (Carboxy Methyl Cellulose) as a stabilizer in making guava fruit velva, can produce high overrun values and low melting speeds. CMC is a synthetic stabilizer obtained from the treatment of cellulose with sodium hydroxide which is reacted with sodium monochloroacetic. A type of natural stabilizer and can be added to the manufacture of velva fruit is pectin. Pectin is a hydrocolloid compound that is reversible and functions as a gelling agent in food products [6].

Stabilizers are used to prevent the formation of rough ice crystals, form a soft texture, produce uniform products, provide good resistance to the melting process, have no effect on freezing but tend to limit the development of the dough.

Freezing is the best way that is now commonly used for food preservation in the long term. The preservative working power of freezing is that in a frozen state carried out at -100°C or less, microorganisms cannot multiply.

This study aimed to determine the characteristics of velva persimmon by adding Carboxy Methyl Cellulose (CMC) as a stabilizer during cold storage.

2. Methodology

2.1. Time and place
This research was conducted in May-July 2019 in Kampung Baru RT. 13 / RW. 04 Cisarua Village, Samarang District, Garut Regency, West Java Province, at the Integrated Laboratory of the Faculty of Agriculture at the University of Garut and at the Laboratory of the Faculty of Agriculture Industrial Technology, Padjadjaran University, Bandung.

2.2. Materials and tools
The raw materials used are persimmon from the Samarang area of Garut Regency, West Java Province. The chemicals used were Carboxy Methyl Cellulose (CMC), aquadest, 1% starch solution, Iodine 0.01 N. The tools used are beaker glass, broochfield viscometer, handrometer, refrigerator, penetrometer, biuret, statif, erlenmeyer, funnel, tweezers, scales, filter paper, pH meter, plastic/cup, drop pipette, measuring cup and measuring flask.

2.3. Stages of research

2.3.1. Making persimmon velva fruit (Diyospory foot. L). The stages of the process of making persimmon fruit velva are, sorting, stripping, cutting, washing, crushing, mixing and freezing using Ice Cream Maker with the addition of CMC according to the amount of treatment, packaging. Packaging used for velva persimmon is a plastic or cup container.

2.3.2. Analysis of raw materials and persimmon velva products. The basic material used in the study was Persimmon fruit (Diyospory kaki. L) obtained from Garut Regency. Additives and stabilizers used
in the manufacture of velva fruit products are sugar, water, and CMC Materials used for analysis, namely; iodine 0.01 N, starch 1%.

2.3.3. Viscosity of dough. Velva dough viscosity was measured using a brofield field viscometer by inserting a sample of 400 ml Velva dough into a 600 ml beaker glass. Then install a spindle that has been determined and put into a glass beaker containing the sample until submerged. Reading the results of the measurement of the viscosity of the dough is shown on the viscometer screen. Viscosity is a rheological property of dough that can significantly affect the process of making frozen products [7].

2.3.4. Overrun. Velva volume (Overrun) development is done by weighing beaker glass for velva dough container first. The initial velva mixture before fertilization is put into a measuring cup of 50 ml and weighed, so that the volume of the mixture is obtained. Velva mixture after fertilization was put into a measuring cup with the same volume of 50 ml and measured the weight. % Overrun velva fruit can be calculated as follows:

\[
\% \text{ Overrun} = \frac{((b-a) - (c-a))}{((c-a))} \times 100\%
\]

Information:
\(a =\) velva container weight
\(b =\) initial dough weight
\(c =\) velva dough weight after fertilization

2.3.5. Total solids. Determination of total dissolved solids using a refractometer is to direct the tool towards the light source and rotate the ring until a clear reading source is obtained. Zero adjustment: Open the cover plate and place one or two drops of distilled water on the prism. Close the cover plate and press lightly, then adjust the correction screw to make the light/dark border coincide with the zero line. Open the cover plate and clean the prism surface with a tissue, then drop the velva mixture. Close the cover plate and read the scale according to the light and dark limits. After measurement, clean the surface of the prism and cover plate.

3. Results and discussions

3.1. Viscosity
In table 1, it can be seen that the addition of variations in the concentration of CMC stabilizers and variations in the length of storage showed significant differences in the parameters of velva persimmon texture. In the table it can be seen that the higher the concentration of CMC stabilizers, the higher the velva persimmon value, while the longer storage factor can be seen that the longer the storage time the lower the viscosity value. From the data of the viscosity value, the highest value is in the K3T1 formula with 1.5% CMC concentration and storage time for 3 days, while the lowest value is in the K1T3 formula with a stabilizing concentration of 0.5% CMC and a storage period of 9 days.

According to Kamal (2010) [8] who mapped that the presence of CMC in solutions tends to form cross bonds in polymer molecules which cause solvent molecules to be trapped inside them so that immobilization of solvent molecules can form a rigid and resistant molecular structure to pressure. The higher the CMC level, the greater the formation of cross bonds and the higher immobilization of solvent molecules, which causes a tendency for viscosity to increase.

From the results of table 1, the longer the storage value of viscosity decreases, this is due to the occurrence of syneresis. Sineresis causes the value of viscosity in the product to decrease because it occurs as a result of weakening of pectin and water so that the water is free to come out and fill spaces between cells.
Table 1. Results of analysis of velva persimmon physical properties.

| Formula | Total solids | Overrun | Viscosity |
|---------|--------------|---------|-----------|
|         | CMC Concentration | Long Storage | CMC Concentration | Long Storage | CMC Concentration | Long Storage |
| K1T1    | 28.5889<sup>a</sup> | 28.2111<sup>a</sup> | 5.1083<sup>b</sup> | 3.2172<sup>a</sup> | 40.7556<sup>a</sup> | 63.2667<sup>a</sup> |
| K2T1    | 28.4000<sup>a</sup> | 28.2111<sup>a</sup> | 3.4629<sup>a</sup> | 4.2010<sup>a</sup> | 57.6222<sup>b</sup> | 63.2667<sup>a</sup> |
| K3T1    | 28.2778<sup>a</sup> | 28.2111<sup>a</sup> | 3.2163<sup>a</sup> | 4.3693<sup>a</sup> | 68.5667<sup>b</sup> | 63.2667<sup>a</sup> |
| K1T2    | 28.5889<sup>a</sup> | 27.8889<sup>a</sup> | 5.1083<sup>b</sup> | 3.2172<sup>a</sup> | 40.7556<sup>a</sup> | 48.4444<sup>a</sup> |
| K2T2    | 28.4000<sup>a</sup> | 27.8889<sup>a</sup> | 3.4629<sup>a</sup> | 4.2010<sup>a</sup> | 57.6222<sup>b</sup> | 48.4444<sup>a</sup> |
| K3T2    | 28.2778<sup>a</sup> | 27.8889<sup>a</sup> | 3.2163<sup>a</sup> | 4.3693<sup>a</sup> | 68.5667<sup>b</sup> | 48.4444<sup>a</sup> |
| K1T3    | 28.5889<sup>a</sup> | 29.1667<sup>b</sup> | 5.1083<sup>b</sup> | 3.2172<sup>a</sup> | 40.7556<sup>a</sup> | 55.2333<sup>a</sup> |
| K2T3    | 28.4000<sup>a</sup> | 29.1667<sup>b</sup> | 3.4629<sup>a</sup> | 4.2010<sup>a</sup> | 57.6222<sup>b</sup> | 55.2333<sup>a</sup> |
| K3T3    | 28.2778<sup>a</sup> | 29.1667<sup>b</sup> | 3.2163<sup>a</sup> | 4.3693<sup>a</sup> | 68.5667<sup>b</sup> | 55.2333<sup>a</sup> |

Notes:
*: K1T1: velva persimmon with a combination of 0.5% CMC stabilizer and 3 days storage time, K2T1: velva persimmon with a combination of 1% CMC stabilizer and 3 days storage time, K3T1: velva persimmon with a combination of 1.5% CMC stabilizer and 3 days storage time, K1T2: velva persimmon with a combination of stabilizers CMC 0.5 and storage time for 6 days, K2T2: velva persimmon with a combination of 1% CMC stabilizer and 6 days storage time, K3T2: velva persimmon with a combination of 1.5% CMC stabilizer and 6 days storage time, K1T3: velva persimmon with a combination of 0.5% CMC stabilizer and 9 days storage time, K2T3: velva persimmon with a combination of 1% CMC stabilizer and 9 days storage time, K3T3: velva persimmon with a combination of 1.5% CMC stabilizer and 9 days storage time, **: Data marked with different letters in the column shows a significant difference in each treatment at the level of 5%.

3.2. Overrun

Overrun is the percentage ratio of the development of the product volume to the initial volume of the dough because of the air trapped in the velva. Overrun can be generated from stirring (agitation) during the freezing process, without overrun the product will form a hard mass lump. Based on the analysis of variance of the 5% level it can be seen that the concentration of CMC (Carboxy Methyl Cellulose) has an effect on velva overrun.

CMC (Carboxy Methyl Cellulose) concentration has an effect on velva overrun value, the higher the CMC concentration level is added, the overrun value will decrease further. This is because the velocity overrun value is influenced by the viscosity of the dough. According to Bahramparvar and Tehrani (2011) [9] the higher the viscosity of the dough the higher the surface tension of the dough. As a result, the air is difficult to penetrate the surface of the dough so that the velva will be more difficult to expand. As is the case with Velva's research with pectin stabilizers, because the dough viscosity is high it will cause the overrun value to be low with increasing pectin concentration [10].

3.3. Total solids (° brix)

Total solids are all solid components in a food that serves to prevent clumping of the texture and maintain small and stable air bubbles at velva. Based on variance analysis data in table 1, it is known that the storage time significantly affects the total dissolved solids. The longer the storage, the greater the total dissolved solids obtained and according to the literature [11] the longer the storage time, the total dissolved solids will increase. The increase in total dissolved solids in persimmon velva in line with the length of storage takes place due to the breakdown of the long chains of carbohydrate compounds into sugar, which causes the total dissolved solids to increase.
4. Conclusion
CMC concentration and storage time significantly affected the increase in vitamin C levels, the higher the CMC, the higher the vitamin C levels in persimmon velv and the longer stored vitamin C levels in the velva persimmon decreased. The length of storage time also has a significant effect on total dissolved solids, the longer the storage, the greater the dissolved solids obtained will be. CMC concentration has an effect on velva overrun value, the higher the CMC concentration level is added, the overrun value will decrease further.

From the results of the research that has been done, it can be concluded that the variations in the concentration of stabilizers and storage time significantly affect the viscosity, texture and preference test. The best formula for viscosity is K3T1 with CMC concentration of 1.5% and storage time for 3 days. The best formula for texture is K1T1 with 0.5% CMC concentration and storage time for 3 days. The most preferred formula for panelists is the K1T1 sample with a combination of 0.5% CMC stabilizers and 3 days storage time. The longer the storage will be a decrease in quality and the level of preference of the panelists for the product decreases.

5. Suggestion
To produce good quality persimmon velva, use persimmon which is also of good quality. Use persimmons that are physiologically mature and persimmon that is still fresh.

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