IJMEHD
INTERNATIONAL JOURNAL OF MANAGEMENT AND EDUCATION IN HUMAN DEVELOPMENT
International J. of Management & Education in Human Development
ISSN: 2775 - 7765
web link: http://www.ijmehd.com

Effect of Sugar Cane Harvest Age on Organoleptic Quality of Cane Palm Sugar Produced

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Received: 12/08/2020 Accepted: 24/09/2020 Published: 25/03/2021

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ABSTRACT

Cane palm sugar is one of the derivative products from sugarcane juice which has high economic value and is very prospective for development. This is because the demand for palm sugar has never decreased and so far the need has not been fulfilled both for export and domestic needs.

The objectives of this study were (1) To determine the effect of harvesting age on the quality of cane palm sugar produced, (2) To determine the effect of cooking methods on the quality of cane palm sugar produced, (3) To determine the appropriate treatment that gave the best quality of the palm sugar.

Based on the results of the analysis and data interpretation, the conclusions are as follows: (1) The age of the palm sugar harvest is very influential on the success of the formation of sugar crystals produced (2) The harvest age has a very significant effect on the yield of palm sugar and Brix from the cane palm sugar produced (3) Brix and yield. : (a) 8 months harvest age Brix reaches 12.5%, field yields 4.25%, and real/final product yield 3.91% (b) 10 months harvest age Brix reaches 19.7%, field yields 7.85% and yields real / end products 7, 85%. (c) Harvest age 12 months Brix reached 23.6% field yield 9.80% and real/final product yield 9.80% (4) Based on the organoleptic test, panelists assessed: (a) Color: researchers gave an assessment of 4.4 (like) at the harvest age of 8 months, 4.6 and 4.8 (very fond) at the harvest age of 10 months and 12 months. (b) Aroma: the researcher assessed 4.5 (likes) at the age of harvest at 8 months, 4.7 (very like) at the age of harvest at 10 months, and 12 months. (c) Texture: the researcher assessed 4.3 (likes) at the age of harvest at 8 months, 4.6, and 47 (very fond) at the ages of 10 months and 12 months. (d) Taste: the researcher assessed 4.3 (likes) at the age of 8 months of harvest, 47 (very likes) at the age of 10 months, and 12 months. (e) Making cane palm sugar should be done without delay in grinding and avoiding sunlight directly so that the yield does not shrink, (f) The best harvesting age for cane palm sugar is 12 months of harvest.

Keywords: *Palm sugar, Harvest Age, Cane Palm Sugar, Organoleptic*

I. INTRODUCTION

Sugarcane (Saccharum officinarum, L) is a type of plant that can be grown in areas with tropical climates. In Indonesia, the development of a harvested area, production, and productivity of sugarcane in the 2010-2019 period was relatively fluctuating but tended to be stagnant with an average of 0.67% per year. Sugarcane production growth averaged only 0.03% per year. In 2010, sugarcane production of 2.29 million tons fluctuated to become 2.45 million tons in 2019. (Ministry of Agriculture 2019).

Sugarcane plants containing sap are used to make sugar. Some of the components found in sugar cane are monosaccharide's 0.5-1.5%, 11-19% sucrose, 0.5-1.5% organic substances, 0.15% inorganic substances, 11-19 coir %, water 65-75%, and other materials 12% (Misran, 2005).

Sugar is one of the strategic commodities in the Indonesian economy. With an area of around 440 thousand ha in the 2014-2018 period, the sugarcane-based industry is a source of income for more than 700 thousand farmers with the workforce involved reaching more than 250 thousand people. Sugar is also one of the basic needs of society and a relatively cheap source of calories. Because it is a basic need, the dynamics of sugar prices will have a direct effect on the inflation rate. With its important position, and in line with the revitalization of the agricultural sector, the sugarcane-based industry also needs to make various efforts so that it is in line with the revitalization of the agricultural sector (Ministry of Agriculture 2019).

However, sugar production has decreased recently, while the national sugar demand is estimated to reach 5.7 million tons, consisting of 2.8 million tons of white crystal sugar for public consumption and 2.9 million tons of refined sugar for the needs of the food and beverage industry. Meanwhile, the current problem is the difficulty of obtaining large amounts of new land suitable for planting sugarcane. This can be seen from the need for a sugar factory unit with a capacity of 10,000 tons of sugarcane per day requiring a sugar cane plantation area of around 20,000 ha (Brown sugar indonesia's business), is palm sugar, which is crystallized, called cane palm sugar must be

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made from palm sap, can be coconut (*Cocos nucifera*), palm sugar (*Arenga*), or lontar (*Borassus flabellifer*). However, sugar can also be made from sugar cane. Derived from sugar cane. Brown sugar cane, mostly absorbed by the soy sauce industry. Brown sugar crystals (brown sugar crystals) from pallone plants become preferred because they are considered purer, without by-products that are harmful to health.

Based on the description, the problems (1) Is there an effect of harvesting age on the quality of the cane palm sugar produced, (2) Is there an effect of harvesting age on changes in yield and organoleptic cane palm sugar produced, (3) Which harvest age gives the best effect to changes in yield and organoleptic cane palm sugar produced.

II. MATERIALS AND METHODS

Materials and Tools

The materials used in the study were sugarcane stalks obtained from sugarcane plantations in South Konawe as the main raw material, quicklime, coconut milk, and other supporting materials. The tools used include a hand refract meter, sugar cane grinder, jerry cans, digital scales, earthen stoves, gas stoves, stainless steel pans, saucers, oven-dryer wood spatulas, and digital cameras.

Research methods

The research method used was experimental (Experimental Method), namely by experimenting with making cane palm sugar and then carrying out an organoleptic test to analyze the level of acceptance of the researchers both on color, taste, aroma, and texture.

Research procedure

The stages of the process of making sugarcane are carried out as follows:

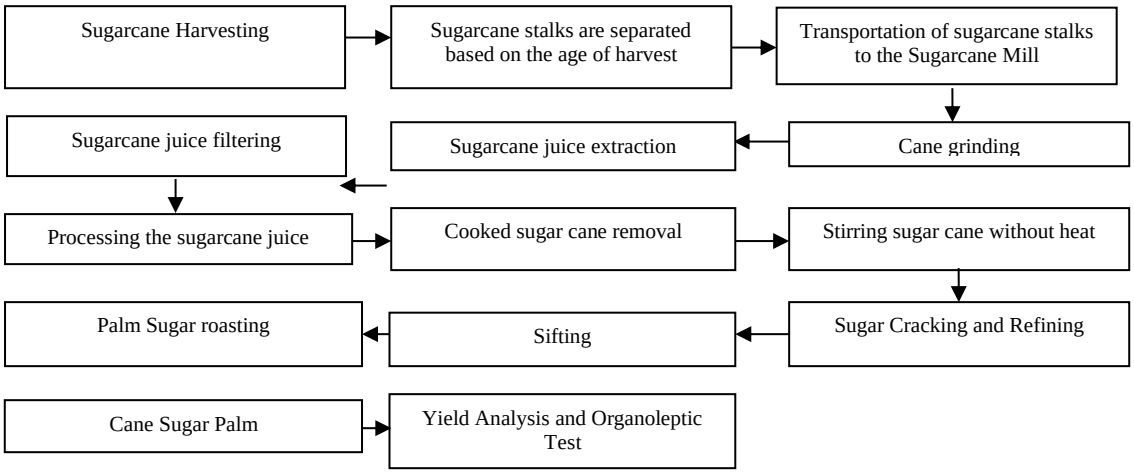


Figure 3.Stages of research implementation (Author, 2020)

III. RESULTS AND DISCUSSION

Brix

The results of the analysis of sugarcane brix used as research samples are as follows:

Table 3. Sugarcane sampling and yield activities

No.	Test type	Harvest age (Month)		
		8	10	12
A	**Sugarcane raw materials and sugar cane processing results**			
1	Amount of milled sugarcane (stem)	15	15	15
2	Weight of sugarcane juice after milled (grams)	4.460	3.009	3.166
3	Results of cane palm sugar (gram)	174,5	236,25	310
4	Cooking time (hours)			
B	**Analysis result**			
1	Brix (%)	12,5	19.7	23.6
2	Yield (%) :			
	a. Field	4,25	7.85	9.8
	b. Real / Final result product	3,91	7,85	9,8
3	Organoleptic Test:			
	a. Colour	4,4	4,8	4,6
	b. Aroma	4,5	4,7	4,7
	c. Texture	4,3	4,6	4,7
	d. Flavour	4,3	4,7	4,7

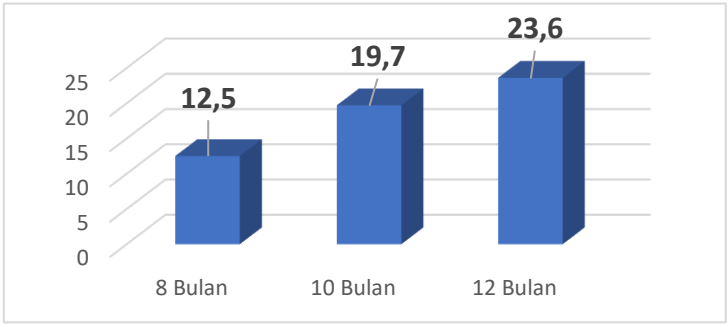
Source : Author result data 2020

The storage of sugarcane stalks during the post-harvest process affects the quantity and quality of the cane palm sugar produced. The delay in milling time can cause weight loss of sugarcane. In this study, storage was not carried out because after cutting, sugarcane stalks were stored in a place that was not exposed to direct sunlight to wait for the time to extract the sap. The results showed that the yield in the field was 4.21% with Brix 12.5%.

Because there is no delay in grinding, there is no change in the weight of the stem weight because the stems do not experience a delay in grinding. The things that cause the weight to shrink due to the delay in grinding time, temperature, humidity, storage method, and cutting time conditions. This is by Santoso et.al. (1996) which states that after the sugarcane cut, evaporation will occur automatically on the sugarcane stalks. This percentage of weight loss depends on temperature, humidity, storage method, and conditions when harvested.

Brix is a total dissolved solid containing sucrose, fructose, and glucose found in sugarcane juice. The results of the analysis of the sugarcane Brix sampled based on Figure 6, the Brix result is around 12.5%. The highest Brix value was obtained from the treatment of 12 months of harvest. This is due to the delay time for milling on sugarcane stalks, as it is known that the longer the stems are stored, the Brix produced will decrease, this is by Risvan (2012) which states that the delay in milling time very affects the level of sugar loss, as it is known that shortly after cutting the stem can be infected by microbes and bacteria. Even in small numbers, microbes and bacteria use the sugar found in sugarcane stalks as their energy source.

Brix content (%)



Harvest age (month)

Figure 6.Effect of factor of harvest age on Brix content cane palm sugar

Based on the previous explanation which that the decrease in Brix in sugarcane occurs because of storage. In addition to storage, the presence of irradiation during the stems is stored also affects the decrease in Brix. The results showed that the stems stored under the sun would experience a decrease in weight and weight compared to the stems that were not exposed to sunlight. This is by Kawulo (2009) which states that the influence of sunlight during the waiting period results in the evaporation of the stem and spurs the activation of wild yeast in the fermentation process, such conditions when milked will produce sap with a pH below 4 and means acid. Based on the results obtained, it is known that the position of the internodes on the stem greatly affects the sweetness level and Brix content, the higher the sweetness level will decrease. Following by Cakti (2011) that, the sweetest part of the sugarcane stalk starts from the bottom which is close to the root, with increasing age the sugar cane also increases and spreads further to the top of the stem. The ripeness factor provides data on the increase in sugar content in sugarcane stalks (from base to shoot). So, hat if the sugarcane is ripe the ripeness factor will be lower.

1.2 Rendement

Sugarcane yield is the sugar content in the sugarcane stalks. By definition, the yield is the number of kilograms of crystal formed from each quintal of milled sugarcane. For example, a yield value of 10% means that 10 kg of sugar is produced from 100 kg of sugar cane (Supriyadi, 1992). For the record, during the Dutch colonial era, the highest yield ever achieved in Indonesia was 17% with the highest average of more than 14% (Muria, 2005).

The high and low sugar content/yield is influenced by 3 factors, namely the cultivation factor (On-farm), the cutting and transport factor, and the processing factor (Off-farm). Cultivation factors include land preparation, use of seeds, fertilization, maintenance, and harvesting. All of which require management support, both in regulating the timeliness of handling activities and in maintaining human resources (Supriyadi, 1992).

In general, the mechanism for determining sugarcane yield takes place in three points. The first is weighing sugar cane, the second is the sample analysis, and the third is weighing sugar.

The yield observed in this study was divided into 2 (two) parts, namely:

a. Field yield: the yield is calculated based on the results of the brix analysis divided by two and subtracted by two and expressed in percent (%).
b. Real/final product yield: Cane palm sugar yield is calculated based on the ratio between the volume of sugar (grams) produced and the weight of the material (grams) milled and expressed in percentage units.

The results of the analysis of sugarcane yield used as research samples are as follows:

1.3 Organoleptic Analysis (BSN 2006)

The Assessment of the texture, taste, and taste of a food product (Ayustaningwarno, 2014). The factor that is very acceptable to accept or not a product is its sensory nature. The organoleptic assessment test is subjective because

it is based on subjective human responses as a measuring tool (Soekarto, 1990). This sensory assessment consists of six stages. The first step is receiving the material, namely the material, clarifying the properties of the material, recalling the observed material, and deciphering the sensory properties of the product.

A. Color

Color is one of the determinants of consumer preference for the products produced. Color can determine whether a product is attractive or not (Setyaningrum, 2010). Determining the quality of food ingredients before other factors are taken into consideration, sometimes very decisive, a food material that has nutritional value, tastes good, and has a very good texture, is less reduced if it has a color that does not give the impression or gives the impression that it has deviated from the color it should be. (Winarno, 1997).

The food quality attribute that consumers pay the most attention to is external appearance, the cane palm sugar that is visible at the beginning is the color of the cane palm sugar produced. From the test results using descriptive statistical analysis, it can be seen that of the 15 panelists who did the demand test, the panelists who gave orders liked and really liked.

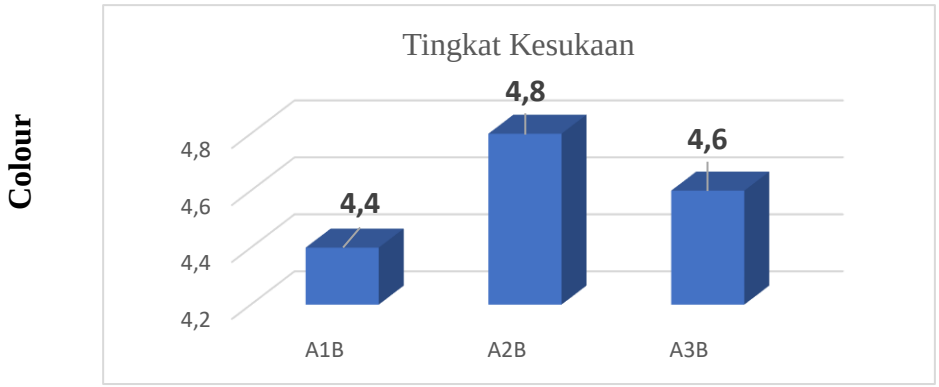


Figure 7.The influence of the harvest age on the preference level of the Cane palm sugar color.

Based on Figure 7 shows that the average value of the results of the author's assessment of the color of cane palm sugar, the highest was obtained in treatment A2 with a value of 4.8 (very fond), while the lowest assessment was obtained in treatment A1 with a value of 4.4 (Like), this indicates that it is getting closer maximum harvest age, the level of panelists' assessment of the color is increasingly preferred. This is because during the process of harvesting and cooking sugar that is carried out undergoes a caramelization process or the formation of brown color (Nurhartati et al. 2011) states that the heating process causes the sugar to form caramel and causes the formation of brown pigments.

The greatest value from the organoleptic test results of 15 panelists is that the panelists prefer dark brown color. The process of making cane palm sugar from sugar cane juice is a cooking process that is very influential on the color that will be produced. Besides, the browning reaction due to a chemical reaction between amino acids and reducing sugars (Maillard reaction) also affects the color produced by the cane palm sugar. This is in line with what Guddadamath et al. (2014) brown sugar cane made from 10 sugarcane clones has different colors, namely brownish yellow, light brown, and brown. In this case, the sugarcane used in the manufacture of cane palm sugar produces different colors of sugar. The color of brown sugar is determined by the quality of the sap (Utami 2008). Each variety of sugarcane has a different color of sap. The color of sugarcane juice comes from the pigment of the sugarcane stalks that are carried in the sap when the sugarcane stalks are ground (Varina 1990). Food color is caused by natural pigments or dyes added by natural pigments are a class of compounds found in products derived from natural animals and plants including pigments that are already present in food and pigments that are formed during storage cooking or during the processing of one of the pigments formed during the heating process is a brown pigment that is produced from sugar as a result of the caramelization process which can affect the color of food.

Based on what has been done, making cane palm sugar from different colors of the sap produces cane palm sugar with different colors. The color of the pigment dissolved in the sap is possible during the cooking process to make the color of the sap darker because it is thought to experience a change in pigment color (degradation) during the heating process. Apart from the different color characters of the sap, the formation of the cane palm sugar colour occurs during the heating process. Weerawatanakorn et al. (2016) reported that apart from the color of the sap, the colour of cane palm sugar was also influenced by chemical reactions (browning) during the heating process, especially the Maillard reaction. The Maillard reaction is a non-enzymatic browning reaction between amino acids and reducing sugars that occurs during the processing process (Asikin et al. 2014). The brown color of brown sugar is formed from the Maillard reaction and caramelization which produces melanoidin pigment (brown pigment) (Dewi et al. 2014).

Based on the one-way ANOVA calculation (Appendix 1) the significance value (o.084) is smaller than alpha, which means that H0 is rejected. The results of this analysis show that there are differences between the

treatments samples tested on the panelists. Based on the results of the LSD test on the color of cane palm sugar there is a difference between A1 and A2 and there is no difference between A2 and A3.

Based on the results of the analysis, it can be seen that the use of sugarcane raw material with a maximum harvest age always increases the panelists' interest, because the cane palm sugar that the panelists like has a color that is not too dark and not too pale, namely in the sample code A2. Based on research conducted, the color of cane palm sugar decreases or gets darker due to a caramelization reaction, and the caramelization process can occur in acidic or alkaline conditions. During the heating process, the caramelization process produces a brown pigment precursor in the dehydration stage. The high-temperature cooking process can remove a water molecule from each sugar molecule to form glucose molecules, which are molecules analogous to fructosan. The browner the caramelized results, the darker the cane palm sugar will so that the brightness value decreases (Zuliana, 2016).

B. Aroma

The aroma is a reaction from food that will affect consumers before they enjoy the food, consumers can smell the food. Based on the calculation of anava, the ratio of palm sap and liquid brown sugar affects the aroma of cane palm sugar. Aroma characteristics are added value to a product, by smelling the aroma, one can recognize the deliciousness of a product

Based on Figure 8, it shows that the average value of the results of the author's assessment of the sugarcane aroma of the highest cane was obtained in treatment A2 and A3 with a value of 4.7 (very fond), while the lowest assessment was obtained in treatment A1 with a value of 4.5 (Like).

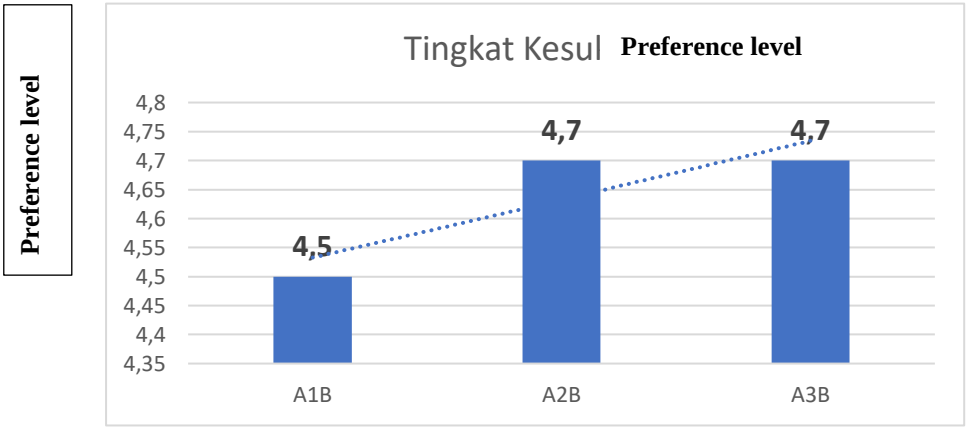


Figure 8.The effect of the harvesting age factor on the preference level of the cane palm sugar aroma

Based on the picture above, it shows that the average value of the panelists' assessment of the highest cane palm sugar aroma was obtained in A2 and A3 treatments with an average value of 4.7, while the lowest assessment was obtained in treatment A1 with a value of 4.5. this shows that the older the sugarcane harvest, the yield of sugar produced will increase and the resulting aroma is also getting better.

Annex 2 shows the results that are not significantly different in the aroma of the cane palm sugar. The results of ANOVA and the LSD (Least significant difference) follow-up test with a confidence interval of 95% or 0.05, it is known that the significant results are <0.05 based on the results of calculations using SPSS for windows version 17. Level of preference for the aroma of the product.

Based on the one-way ANOVA calculation (Appendix 2), the significance value (0.307) is greater than alpha, which means H1 is accepted. The results of this analysis indicate there is no difference between the treatments samples tested on the panelists. Based on the results of the LSD test on the color of the cane palm sugar, there is a difference between A1 and A2 and there is no difference between A2 and A3.

Based on the ANOVA data in Appendix 2., it can be seen that cane palm sugar produced with a harvest age of 12 months do not always increase the panelists' interest, because the cane palm sugar that panelists like between 10 months and 12 months of harvest have the same distinctive aroma. Based on research conducted, the appearance of the distinctive aroma of cane palm sugar is caused by the caramelization process and the Maillard reaction so that the aroma that is generated is the caramel aroma.

C. Texture

The texture characteristics of the sugar can be tested by tasting or touching it. The texture is one aspect of assessment in product appearance. The results of testing three samples with texture characteristics produced the average preference for cane palm sugar products. The average level of preference for the panelists to the texture of the selected cane palm sugar products is in the sample code A3 with a value of 4.7 (Very Like) as shown in the picture.

Appendix 3 shows the results that are not significantly different in the texture of the cane palm sugar. The results from ANOVA and the LSD (Least significant difference) follow-up test with a confidence interval of 95% or 0.05, it is known that the significant result is> 0.05 based on the results of calculations using SPSS for windows version 17.

Based on the one-way ANOVA calculation (Appendix 3), the significance value (0.083) is greater than alpha, which means H1 is accepted. The results of this analysis indicate there is no difference between the treatment samples tested on the panelists. Based on the results of the LSD test on the texture of the cane palm sugar there was no difference between A1, A2, and A3.

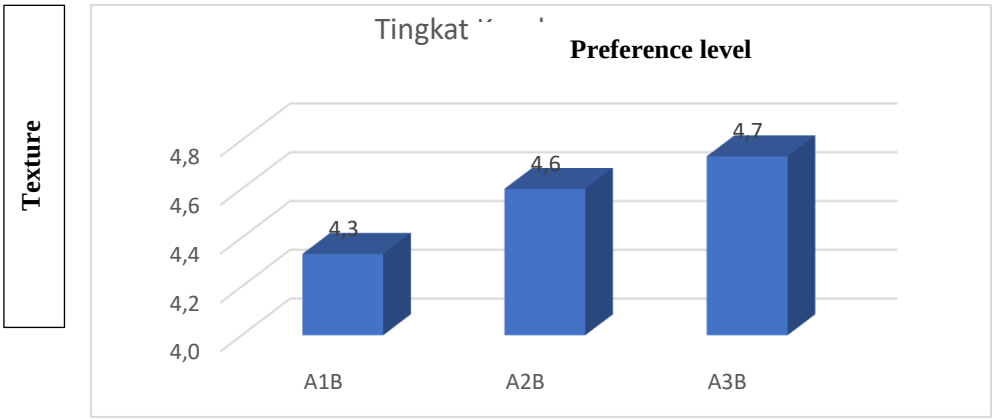


Figure 9.The effect of the factor of harvesting age on the preferred level on the texture of the cane palm sugar

The results of testing three samples with texture characteristics produced the average preference for cane palm sugar products. The level of preference for the texture of the selected cane palm sugar product is STKU1, the ratio of 100%: 10% is the result of ANOVA and the LSD (Least significant difference) test with a confidence interval of 95% or 0.05. It is known that a significant result> 0.05 indicates that the product is not significantly different.

Based on the ANOVA results from the research conducted, the higher the cooking temperature, the greater the water that is evaporated so that the water content will be lower. The low water content results in a tougher or drier texture. The longer it is cooked, the lower the water content and the lower the water content will result in a tougher texture. Sugar texture is influenced by several factors, namely the quality of sap, water content, fat content, and pectin and protein content (Sudarmadji, 1989).

D. Taste

Taste is a sensory response to nerves, such as sweet, bitter, sour, and salty. The taste of the product is very influential on one's preferences. The results of testing three samples resulted in average taste preference for the cane palm sugar. Level of liking for the taste of the cane palm sugar products. The samples selected are A2 and A3, as shown in Figure 10.

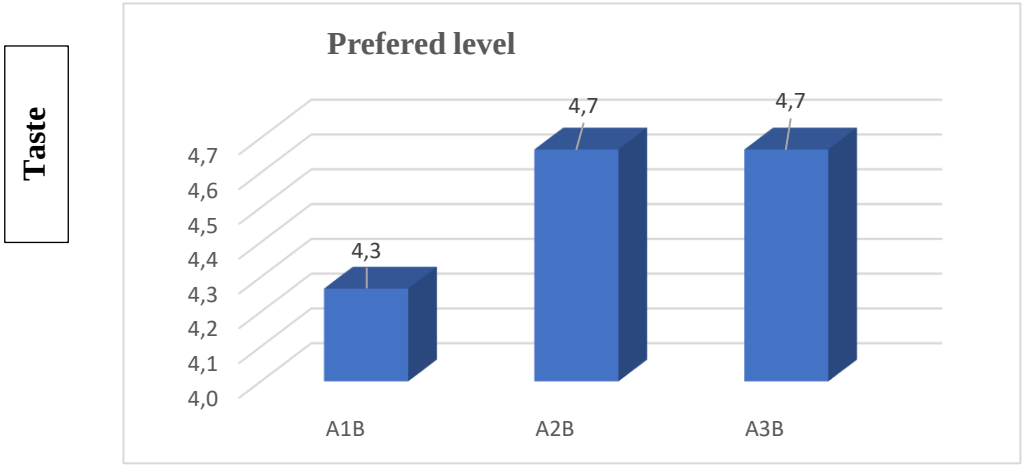


Figure 10. Effect of the factor of harvest age on preferred level taste of cane palm sugar

Based on the one-way ANOVA calculation (Appendix 4), the significance value (0.039) is greater than alpha, which means that H0 is accepted. The results of this analysis indicate that there are differences between the treatment samples tested on the panelists. Based on the Post Hoc Tests analysis, when compared between A1 with A2 and A3 there is no difference, whereas when compared between A2 and A3 or vice versa there is a real difference from the treatment given.

IV. CONCLUSION

Based on the results of research conducted in making cane palm sugar, it can be concluded as follows:

1. Sugarcane harvest age greatly affects the success of the resulting sugar crystals.
2. Sugarcane harvest age has a very significant effect on the yield of sugar cane and Brix from the cane palm sugar produced.
3. Brix and yield:
   a. Harvest age 8 months brix reaches 12.5%, field yields 4.25%, and real/final product yields 3.91%
   b. Harvest age of 10 months brix reaches 19.7%, field yields 7.85% and real/final product yields are 7.85%.
   c. Harvest age 12 months brix reaches 23.6% yield 9.80% field and real/final product yield 9.80%
4. Based on the organoleptic test, the researcher assessed:
   a. Color: Researchers rated 4.4 (liked) at the harvest age of 8 months, 4.6, and 4.8 (very liked) at the harvest age of 10 months and 12 months.
   b. Aroma: the researcher gave an assessment of 4.5 (like) at the age of harvest at 8 months, 4.7 (very like) at the age of harvest at 10 months, and 12 months.
   c. Texture: the researcher gave an assessment of 4.3 (liked) at the age of 8 months of harvest, 4.6, and 47 (very liked) at the age of 10 months and 12 months.
   d. Taste: the researcher gave an assessment of 4.3 (liked) at the age of 8 months of harvest, 47 (very liked) at the age of 10 months, and 12 months.
5. Making cane palm sugar must be done without delay in grinding and avoiding direct sunlight so that the yield does not shrink.
6. The best harvesting age for cane palm sugar is 12 months of harvest.

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