Journal of Social Research

P-ISSN: 2827-9832
E-ISSN: 2828-335x
http://ijsr.internationaljournallabs.com/index.php/ijsr

EFFECT OF FALL HEIGHT ON VOLATILES (VOCS) OF SAWO (ACHRAS ZAPOTA L.) USING ELECTRONIC NOSE

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ABSTRACT

Sapodilla fruit is one of the tropical fruits that are widely cultivated in Indonesia, especially West Sumatra. During post-harvest, especially during the *grading* process, sapodilla fruit will be dropped into the basket at a certain height so that it has the potential to cause mechanical damage that is not visible at the beginning of the drop. This study aims to evaluate the potential use of *e-nose* technology to detect mechanical damage to sapodilla fruit non-destructively at the beginning of dropping during the *grading* process. The method used is an experimental method by looking at changes in the VOCs content of sapodilla fruit through mics 5524 sensor readings. The results showed that *e-nose* technology was able to detect mechanical damage to sapodilla fruit at the beginning of dropping with *a sig* value of < 1% in ANOVA analysis, meaning that there was an influence of height at the beginning of dropping on changes in the VOCs content of sapodilla fruit. The results of grouping using *k-means clusters* show that the height of the fall of 0 cm and 20 cm is included in the category of undamaged sapodilla fruit and is in cluster 1, while the height of the fall of 40 cm is included in the category of damaged sapodilla fruit and is in *cluster* 2.

Keywords: *buah sawo, electronic nose, grading, k-means cluster*.

INTRODUCTION

Sapodilla fruit (Achras zapota L.) is one of the fruits that flower throughout the year and is widely found in lowland areas to the highlands of Indonesia, so sapodilla fruit can be an alternative to other fruits during the little fruit harvest season (Huda, Trisnowati, et al., 2015; Idrus, 2019) Sapodilla fruit contains quite complete nutrients including protein, vitamin A, vitamin B, vitamin C, iron, calcium, phosphorus and fat (Dembitsky et al., 2011). The content of tannins, alkaloids and flavonoids that are useful as antibacterial and antiseptic makes sapodilla fruit can be used to treat several diseases, one of which is digestive disorders (Fatimah et al., 2015). Sapodilla fruit has been widely developed into processed products such as jam and sapodilla chips (Setyawan et al., 2013). This is done because sapodilla fruit has a fairly good potassium and sodium content, where the potassium content reaches 193 mg / 100 g and sodium 12 mg / 100 g or with a ratio of 16: 1 so that it makes sapodilla fruit good enough for heart and blood vessel health and can be used as daily snacks in the form of chips and jam (Jufriyanto, 2019).

According to Unuigbe & Onuoha (2013), fruit damage occurs due to improper post-harvest handling. During the post-harvest handling process, usually during the grading process, the fruit will be thrown from a certain height resulting in impact and vibration. This has the potential to cause mechanical damage that is not visible at the beginning of the drop during the grading process. Research using e-nose was also conducted by Rao et al (2020), where the study showed that the potential use of e-nose non-destructively can quickly predict the level of damage to strawberries due to vibration (vibration). Based on the explanation above, the author is interested in conducting research using e-nose technology by identifying mechanical damage to sapodilla fruit that is not seen at the beginning of the drop during the grading process by looking at changes in the VOCs content of sapodilla fruit (Bhunia, 2016). This study aims to

evaluate the potential use of e-nose technology in detecting mechanical damage to sapodilla fruit non-destructively at the beginning of dropping during the grading process.

METHOD

This research was carried out from June 2022 to August 2022 at the Food and Agricultural Products Processing Laboratory, Agricultural and Biosystems Engineering Study Program, Andalas University, Padang.

The tool used in this study was a fruit-dropping tool with a measuring rod of 5 cm x 6 cm x 150 cm made of square-shaped iron. The measuring instrument used for the analysis of changes in VOCs content is a set of electronic nose technology using the mics 5524 sensor. The material used in this study was 3 sapodilla fruit (Achras zapota L.) varieties of manila sawo from the Guguak Malalo area, Padang Laweh nagari, South Batipuah District.

The research procedure is carried out through 4 stages as follows:

1. Preliminary research, aims to determine the height of the fall to be used during the study. The dropping height is selected based on the output distance of some existing fruit grading tools. Based on observations made during preliminary research, the height of the fall was chosen 0 cm, 20 cm and 40 cm because it did not cause mechanical damage seen on the surface of the sawo at the beginning of the fall.
2. Preparation of research materials, sapodilla fruit is first cleaned with water using a foam sponge to remove microorganisms attached to the surface of the fruit, after that the fruit is dried and dropped after the surface of the fruit is fully dry.
3. Testing using e-nose, observation of changes in VOCs content of sapodilla fruit using e-nose was carried out for 3 hours for each height of the fall. As for the data collection process, the sapodilla fruit will be put into a sample room that has been sterilized from outside air using oxycan and the sample room has been connected to the e-nose pump. The pump will then suck the aroma of VOCs released by the sapodilla fruit. The scent of these VOCs will later be read by the sensor. The results of the sensor readings are displayed on the monitor screen in the form of numbers.
4. Data analysis, the results of the e-nose data obtained were analyzed using ANOVA analysis to determine the effect of falling height on changes in the VOCs content of sapodilla fruit. Sapodilla fruit is also grouped in 2 clusters using k-means clusters, namely in the category of damaged and undamaged fruits. Analyze data by using Microsoft excel.

RESULTS AND DISCUSSION

Pattern of Changes in VOCs Content of Sapodilla Fruit

The sensor pattern formed shows the sequence of increases in the VOCs content of sapodilla fruit at each fall height (Sebastiani et al., 2017). The results of the pattern obtained show that e-nose technology has been able to detect patterns of changes in the VOCs content of sapodilla fruit due to initial dropping during the grading process. The results of changes in the pattern of VOCs content of sapodilla fruit can be seen in Figure 1.

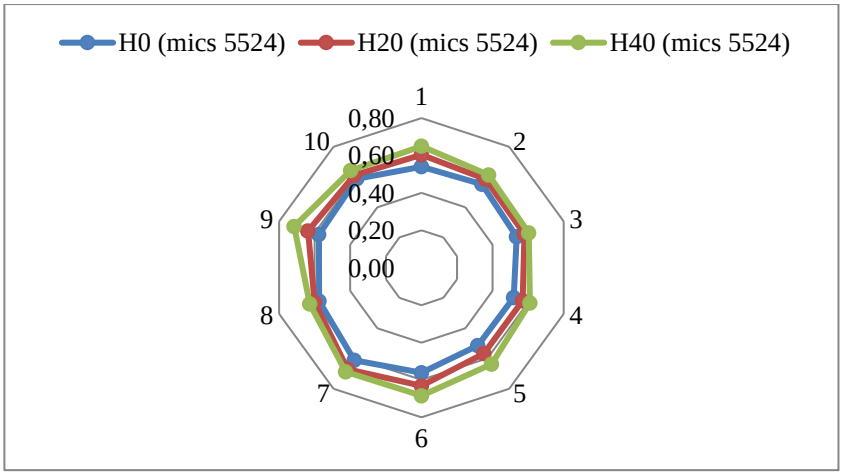

Figure 1. Radar Diagram of Changes in VOCs Content of Sapodilla Fruit

The results showed that the pattern of changes in the VOCs content of sapodilla fruit at a fall height of 0 cm (control) had a lower VOCs value compared to the fall height of 20 cm and 40 cm. This pattern of changes in VOCs content shows that the greater the level of mechanical damage at the beginning of the drop during the grading process, the greater the change in VOCs content in sapodilla fruit. This is in line with the research of (Yang et al., 2020)

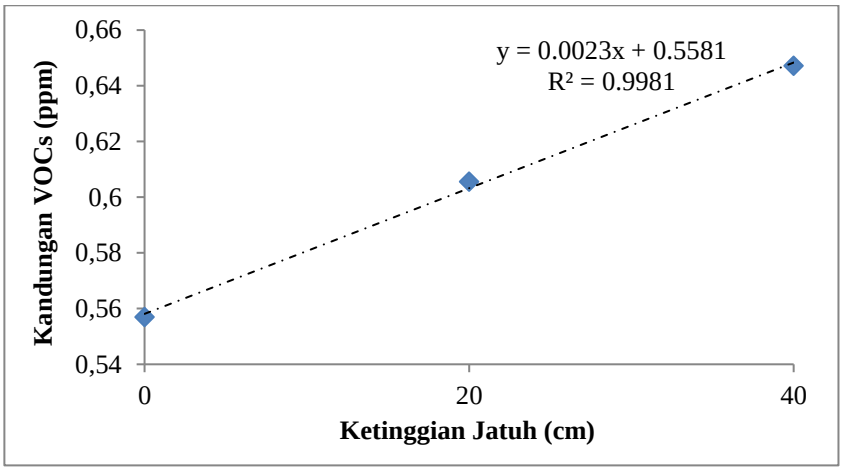

Figure 2. Graph of the Relationship of Falling Height Treatment to Changes in VOCs Content of Sapodilla Fruit

The graph of the results shows the relationship between the height of the fall and changes in the VOCs content of sapodilla fruit formed linear with the equation y = 0.2366x + 58.522 with an R2 value obtained of 0.9981. The R2 value indicates that the distance of the fall height has a close relationship with the increase in changes in the VOCs content of sapodilla fruit (Kumar et al., 2016). ANOVA analysis of the value of changes in VOCs content of sapodilla fruit can be seen in Table 1.

Table 1. Anova Analysis Value of Sapodilla Fruit VOCs

Sources of Diversity	JK	.DB	KT	Fcalculate	*Sig.*	*Ftabel*
Treatment	0	2	0.00	19.80	0.00	10.92
Error	0	6	0.00			
Total	0	8				

The results of ANOVA analysis showed a significant value obtained in the relationship of falling height treatment to changes in the VOCs value of sapodilla fruit, namely sig < 1%. Because a decision can be made to reject H0, it means that there is an influence of falling height treatment on changes in the VOCs value of sapodilla fruit (Nalinik & Ambika, n.d.). This is in accordance with the statement (Yi et al., 2016).

Table 2. Duncan Test VOCs Value of Sapodilla Fruit

Height (cm)	N	*Subset for alpha* = 0.01	
		1	2
0	3	0.29	
20	3	0.31	0.31
40	3		0.33

The results of the duncan test show that the VOCs value of sapodilla fruit is in 2 different subsets. The values of VOCs at a fall height of 40 cm have markedly different subset values. It is characterized by a considerable difference in average values at a fall height of 0 cm and 20 cm with a fall height of 40 cm.

Clustering Sapodilla Fruit Using K-Means Cluster

Sapodilla fruit is grouped into 2 clusters, namely damaged and undamaged fruits. Sapodilla fruit is grouped through the results of e-nose data obtained. The results of grouping sapodilla fruit data can be seen in Table 2.

Table 2. Division of Sapodilla Fruit Groups in Damaged and Undamaged Categories

Drop Height (cm)	*Centroid* 1	*Centroid* 2	Closest Distance	*Cluster*
0	0.03	0.08	0.03	1
20	0.03	0.13	0.03	1
40	0.11	0	0	2

The results of the k-means cluster grouping showed that sapodilla fruit at a fall height treatment of 0 cm (control) and 20 cm fell height into the category of undamaged sapodilla fruit and was in cluster 1, while sapodilla fruit at a fall height of 40 cm was included in the category of damaged sapodilla fruit and was in cluster 2. This proves that the maximum permissible dropping height for the initial drop during the grading process is 20 cm. This grouping of sapodilla fruit has been carried out 2 times with the same results. Previous research using k-means clusters has also been conducted by Furqan et al (2022), on grouping the

maturity of citrus fruits based on 2 clusters, namely ripe and immature, where it was found that the k-means algorithm is effective for grouping citrus fruit maturity segments.

CONCLUSION

The conclusion of this study is that the analysis of mechanical damage of sapodilla fruit in a non-destructive manner using electronic nose has been able to test mechanical damage at a height treatment of 0 cm, 20 cm and 40 cm during the initial drop during the grading process. The results showed that e-nose technology was able to detect mechanical damage to sapodilla fruit at the beginning of dropping with a sig value of < 1% in ANOVA analysis, meaning that there was an influence of height at the beginning of dropping on changes in the VOCs content of sapodilla fruit. The results of grouping using k-means clusters show that the height of the fall of 0 cm and 20 cm is included in the category of undamaged sapodilla fruit and is in cluster 1, while the height of the fall of 40 cm is included in the category of damaged sapodilla fruit and is in cluster 2.

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