International Journal of Natural Science Studies and Development (IJOSS)
Volume 3 issue 2 2026, pp 350-359
E-ISSN: 2615-1383
DOI: https://doi.org/10.55299/ijoss. v3i2.50

Komparison of the Chemical Quality of Sidimpuan Snake Fruit (Salacca Sumatrana Becc.) Based on the Color of the Fruit Flesh

Edi Darwan[1]Rasmita Adelina[2], Sutan Pulungan[3], Nuzul Hijri Darlan[4]

[1,2,3,4]*Master of Agrotechnology Study Program, Postgraduate, Graha Nusantara University*
**Corresponding author: rasmita301271@gmail.com*

Abstract

This study aimed to determine the chemical characteristics of the sidimpuan snake fruit, including vitamin C, total acid, moisture content, tannin content, and dissolved solids (Brix) content, from three locations: Lubuk Raya at an altitude of 700 m above sea level, Batu Layan at 500 m above sea level, and Palopat Maria at 463 m above sea level. The results of the study obtained in white sidimpuan snake fruit showed that the vitamin C content of white sidimpuan snake fruit in Lubuk Raya and Batu Layan was not significantly different but based on the highest average, the vitamin C content in Lubuk Raya was higher at 41.49% and significantly different from the vitamin C content of white sidimpuan snake fruit in Palopat Maria, which was 28.06 mg/100ml. The total content of dissolved acids was significantly different in Lubuk Raya, with a value of 1.68% in Lubuk, and the tannin content was significantly different in Lubuk Raya, with a value of 0.38 %. The moisture content of white sidimpuan snake fruit was significantly different, with a value of 79.22. % on Palopat Maria. The dissolved solids content of red sidimpuan snake fruit was significantly different, with a value of 19.86% in Batu Layan. The observation of vitamin C content, total dissolved acid, water content, and tannin content in red sidimpuan snake fruit from the three locations showed no real difference between Salak Lubuk Raya, Batu Layan, and Palopat Maria.

Keywords: *Vitamin C, Total Titrated Acid, Tannin Content, Salak Sidimpuan*

1. INTRODUCTION

Sidimpuan snake fruit (*Salacca sumatrana* Becc) is a fruit that is quite well known on the islands of Sumatra and Java. Its sweet, kelat, sour, and legit taste is different from that of pondoh snake fruit and other types, so many people like it. In Padangsidimpuan, snake fruit is a local leading commodity that is nationally determined. The West Angkola District is the center of snake fruit plants in North Sumatra Province and is considered the area of origin of the sidimpuan snake fruit plant, from which it spread to other areas and all of South Tapanuli Regency. In addition to its sweet, sour, and pungent taste, sidimpuan snake fruit has characteristics such as the color of its skin which has a deep black and yellowish-brown color which has neatly arranged scales that protect the flesh of the fruit. The color of the pulp varies, including red and red and white tinges. The fruit is large in shape, oval with a mount fruit tip, and the water content is more than other types of salak.

History:
Received : June 24, 2026
Revised : July 04, 2026
Accepted : July 15, 2026
Published : July 25, 2026

Publisher: Inovasi Pratama Int. Press

Currently, there are three varieties of salak sidimpuan according to the decision of the Minister of Agriculture, namely red salak sidimpuan (SK. No.763 /Kpts/TP.240/6/99), white salak sidimpuan (SK. 764/Kpts/TP.240/6/99) and salak sibakua (SK. No.427/Kpts/ TP.240/7/2002) (BPS, 2010), and red Sidimpuan salak varieties (SK. No.763/Kpts/TP.240/6/99) is a well-known salak variety that is quite famous from the island of Sumatra, and it is popular among the public; therefore, the red sidimpuan salak variety should have a higher economic value than other snake fruitvarieties.

The problem faced in the development of the production of red sidimpuan snake fruit is the taste of a combination of sour, spicy, and sweet, so it is not preferred if it is served as a taste fruit, although in general, the color varies. This problem causes the selling price of red sidimpuan snake fruit to be low, and many people do not like it. Meanwhile, the management technique of sidimpuan snake fruit plants is still simple, by only following hereditary traditions, namely not having carried out snake fruit cultivation techniques properly and intensively. For example, fertilization application activities have never been carried out properly and intensively, and plant maintenance activities have not been carried out intensively, including frond pruning and fruit thinning activities (Adelina, et., al., 2021).

An assessment of the chemical quality of the sidimpuan snake fruit (*Salacca sumatrana* Becc) based on the color of the pulp is needed to obtain basic property data so that the chemical composition of the fruit can be known and further developed through various aspects, ranging from breeding and cultivation to post-harvest, to compete in the market and increase its added value

2. RESEARCH METHODS

This research was carried out on snake fruit farmers' land, which is the center of snake fruit cultivation, namely, Lubuk Raya Village with an altitude of 700 m above sea level, Palopat Maria Village with an altitude of 463 m above sea level, and Batu Layan Village with an altitude of 500 m above sea level. The age of the snake fruit plants conducted by the study was obtained from interviews with salak farmers, namely Lubuk Raya salak (± 33 years old), Batu Layan salak (± 35 years old), and Palopat Maria salak (± 20 years old). The research was conducted from August to September 2024.

The sampling method was based on the color of the flesh, namely white and red, and the determination of the characteristics of the research sample was adjusted to the purpose of the research. The garden owners in the field determined the sample plants. The criteria for sample plants in this study are snake fruit plants that are currently producing with criteria based on the color of the snake fruit flesh, which consists of two levels, namely:

1. Color of the flesh of snake fruit Tinge red
2. The color of the snake fruit fruit is white.

Five sample plants were selected for each of these criteria, with 5 sample plants by taking 1 snake fruit from each plant. The total sample plants for the observation of the chemical quality characteristics of snake fruit were 10 plants at each research location, and the number of sample plants from the three research locations was 30 plants.

The observed characteristics included qualitative character observations carried out on vitamin C, total titrated acid, water content, tannin content, and dissolved solids levels

conducted at the Laboratory of the Agricultural Instrument Standard Center (BSIP), West Sumatra.

In each study, it is necessary to set observation parameters as results that will be a benchmark for the future, compared to various previous studies or field conditions. The observation parameters that will be observed in this study are the chemical characterization of the sidimpuan snake fruit based on the color of the pulp that has been determined previously, namely the measurement parameters taken in this study, namely Vitamin C, Total Titrated Acid, Water Content, Tannin Content, and Dissolved Solids Content.

Data Analysis

The data obtained were statistically analyzed to determine whether there was a significant difference between the chemistry of the snake fruit in each test group. The value of the results was tested the Shapiro wilk at a 95% confidence level to determine the distribution of data for each group. The results of the analysis were in the form of normal data distribution, then analyzed with the F test at a 95% confidence level to determine the homogeneity of the group data. If the data are homogeneous and normally distributed, they are analyzed with **the "One Way Anova" test** at a confidence level of 95% and to see a significant difference between the treatment is analyzed with Duncan's follow-up test.

3. RESULTS

Chemical Comparison of White Sidimpuan Snake Fruit

Chemical analysis of the Sidempuan snake fruit was performed, including qualitative character observations of vitamin C, Total Titrated Acid, Water Content, Tannin, and Dissolved Solids Levels, at the Laboratory of the Agricultural Instrument Standard Center (BSIP), West Sumatra.

Table 1. Chemical comparison of white Sidimpuan snake fruit.

TREATMENT	Vitamin C Mg/100 ml	Total Acid %	Water Content %	Tannin Content %	Total Dissolved Solids %
700/I/WHITE	47.05	**1.99**	78.00	0.44	19.00
700/II/WHITE	33.64	1.27	77.64	0.29	22.00
700/III/WHITE	46.92	1.61	76.52	0.37	20.00
700/IV/WHITE	24.90	1.98	76.94	**0.46**	20.00
700/V/WHITE	**54.94**	1.56	76.38	0.37	**22.00**
500/I/WHITE	48.63	1.56	76.38	0.37	**22.00**
500/II/WHITE	49.30	1.66	**75.75**	0.41	**22.00**
500/III/WHITE	34.56	1.00	77.73	0.21	19.00
500/IV/WHITE	40.52	1.22	78.84	0.26	19.00
500/V/WHITE	34.05	1.44	78.46	0.31	20.00
463/I/WHITE	34.49	1.15	**81.04**	0.21	21.00
463/II/WHITE	**24.78**	**0.76**	79.75	**0.14**	20.67
463/III/WHITE	28.07	1.45	77.66	0.32	**15.00**
463/IV/WHITE	28.16	1.15	78.36	0.24	17.00
463/V/WHITE	24.84	1.14	79.31	0.23	19.00

Based on Table 1 above, it is known that the comparison of vitamin C content in white sidimpuan snake fruit from the three locations, namely the lowest vitamin C content is Palopat Maria at an altitude of 463 meters above sea level of 24.78 mg/100ml and the highest in Lubuk Raya at an altitude of 700 meters above sea level of 54.94 Mg/100ml, the lowest total acid in Palopat Maria is 0.76% and the highest in Lubuk Raya is 1.99%. The lowest moisture content in Batu Layan is 75.75% and the highest Palopat Maria is 81.04%. The lowest tannin content in Palopat Maria is 0.14% and the highest in Lubuk Raya is 0.46%. and The lowest dissolved solids content in Palopat Maria is 15% at the highest in Batu Layan and Lubuk Raya.

Characterization of Chemical Properties, White Sidimpuan Snake Fruit

The results of the one-way ANOVA analysis carried out on the parameters of vitamin C, total acidity, water content, tannin content, and dissolved solids (Brix) of the white sidimpuan snake fruit in three locations, namely, Lubuk Raya, Batu Layan, and Palopat Maria, can be seen in Table 2. below :

Table 2. Average vitamin C, total acidity, moisture content, tannin content, and soluble solids content (Brix) of white Sidimpuan snake fruit.

Treatment based on the height of the place	Komponen Parameter					
	Vitamin C Mg/100ml	TAT %	Water Content %	Tannin Content %	Total Dissolved Solids %	Ratio %
700 above sea level	41.49 b	1.68 b	77.09 a	0.38 b	20.60 a	12.69 a
500 above sea level	41.41 b	1.37 ab	77.43 a	0.31 ab	20.40 a	15.16 a
463 above sea level	28.06 a	1.13 a	79.22 b	0.22 a	18.53 a	17.44 a

Characterization of the Chemical Quality of Red Sidimpuan Snake Fruit

Based on the results of the chemical analysis of the sidimpuan snake fruit, qualitative character observations were carried out on vitamin C, Total Titrated Acid, Water Content, Tannin, and Dissolved Solids Levels at the Laboratory of the Tropical Fruit Crops Research Institute, West Sumatra. The results of the analysis of the red sidimpuan snake fruit are presented in Table 3.

Table 3. Chemical comparison of red Sidimpuan snake fruit.

TREATMENT	Vitamin C Mg/100ml	Total Acid %	Water Content %	Tannin Content %	Total Dissolved Solids %
700/I/RED	49.97	1.37	**76.87**	0.31	**21.00**
700/II/RED	**65.11**	**0.68**	79.45	**0.13**	17.00
700/III/RED	31.35	1.07	80.63	0.20	20.00
700/IV/RED	58.82	1.29	80.37	0.25	16.67
700/V/RED	39.77	1.72	78.90	0.37	13.33
500/I/RED	28.26	1.77	77.80	0.39	**21.00**
500/II/RED	37.53	1.99	77.84	0.45	19.00
500/III/RED	40.58	1.37	78.80	0.29	18.00

500/IV/RED	31.12	1.07	78.73	0.25	**21.00**
500/V/RED	27.58	1.35	77.29	0.31	20.00
463/I/RED	31.13	1.75	81.04	0.34	**12.67**
463/II/RED	58.45	0.83	77.26	0.18	17.00
463/III/RED	27.79	2.72	78.59	0.60	15.33
463/IV/RED	28.01	**3.73**	79.00	**0.79**	17.67
463/V/RED	**27.34**	0.97	**82.95**	0.16	18.33

Based on Table 3 above, it is known that the comparison of vitamin C content in red sidimpuan snake fruit from the three locations, namely the lowest vitamin C content is Palopat Maria at an altitude of 463 m above sea level at 27.34 Mg/100ml and the highest in Lubuk Raya at 65.11 Mg/100 ml. The lowest total acid in Lubuk Raya is 0.68% and the highest in Palopat Maria is 3.73%. The lowest moisture content in Lubuk Raya at an altitude of 700 m above sea level is 76.87% and the highest Palopat Maria is 82.95%. The lowest tannin content in Lubuk Raya is 0.13% and the highest Palopat Maria is 0.79%. The lowest dissolved solids content Palopat Maria is 12.33% highest in Batu Layan and Lubuk Raya at 21%.

Table 4. Average vitamin C, total acidity, moisture content, tannin content, and soluble solids content (Brix) of red Sidimpuan snake fruit.

Treatment	Komponen Parameter					
	Vitamin C Mg/100ml	TAT %	Water Content %	Tannin Content %	Total Dissolved Solids %	Ratio %
Lubuk Raya	49.00 a	**1.22 a**	79.24 a	0.25 a	17.6 ab	15.93 a
Batu Layan	**33.01 a**	1.51 a	78.09 a	0.33 a	19.86 b	13.84 a
Palopat Maria	34.54 a	2.00 a	79.76 a	0.41 a	16.6 a	11.62 a

Remarks: The Numbers followed by the same lowercase letter in the same column are not significantly different according to the DMRT at the level of 5% (α=5%).

Based on Table 4, the vitamin C, total dissolved acid, water, and tannin contents in red sidimpuan snake fruit from the three locations show no real difference between Lubuk Raya, Batu Layan, and Palopat Maria Salak. However, the average vitamin C content of red sidimpuan snake fruit in Lubuk Raya is higher, at 49.00 mg/100 ml compared to Batu Layan and Palopat Maria. The average total dissolved acid of red sidimpuan snake fruit in Palopat Maria was higher at 2.00% compared to Lubuk Raya and Batu Layan, the average water content of red sidimpuan snake fruit in Palopat Maria was higher at 79.76% compared to Lubuk Raya and Batu Layan, and the average tannin content of salak sidimpuan red in Palopat Maria was higher at 0.41%.

Discussion

i. Vitamin C

Vitamin C, also called ascorbic acid, is the simplest vitamin that is easily altered by oxidation. Its chemical structure consists of a chain of six C atoms (C6H8O6), and its position is unsta500e because it easily reacts with O2 in the air to become dehydroascorbic acid. Many vitamins are also coenzymes. In vitamin C, Lascorbic acid with the enzyme ascorbic acid oxidation is oxidized into dehydroascorbic acid

(Manurung, 2018). Vitamin C is a secondary metabolite in palnts because it is formed from glucose through the D-glucocoronic and L-gulonite acid pathways.

The results of vitamin C observation of white sidimpuan snake fruit from the three locations based on Table 1 above showed no real difference between vitamin C in Lubuk Raya (41.49) and Batu Layan (41.41) and had a real effect on Palopat Maria (28.06). This is due to environmental factors and diversity generally interacting with each other to influence plant growth. In assessing species diversity, one is always faced with the contradiction of the form of a trait over the character of the plant, such as height and low, coloration, plant age, high and low yield, and so on (Mangoendidjojo, 2007).

Vitamin C is a water-soluble vitamin that is relatively easy to obtain from fruits. The vitamin C content differed between fruits and cultivars, with Balinese and Nglumut snake fruitd showing similar but significantly higher vitamin C levels than Pondoh snake fruit.

ii. Total Titrated Acid

Acids are found in almost all types of fruits at varying levels. The acid content of the snake fruit can be used to determine the level of ripeness of the fruit, especially in climatic fruits (Novita et al. 2012). In climatic fruits, the higher the ripeness, the lower the total acid content, followed by an increase in water and sugar content (Julianti 2012). In line with the fruit ripening process, there is a process of hydrolysis of the complex components of the fruit into simple components, involving hormones and enzymes in the fruit (Burdon et al. 2016).

The results of the overhaul of the complex components cause various changes in the characteristics of the fruit, such as the level of sweetness, color changes, and changes in the texture of the fruit. The change in the sweetness level of fruit can be explained by the total value of dissolved solids and its sugar-acid ratio. The total dissolved solids showed the result of the overhaul. Complex carbohydrates become simple dissolved components of carbohydrates, such as fructose, glucose, and sucrose (Burdon et al. 2016). The sugar-acid ratio is a comparison of the sugar and organic acid content in fruit. The sugar-salt ratio describes the typical taste of the fruit, which can change as ripening progress es. An increase in the sugar-acid ratio indicates a decrease in the acid content and an increase in the fruit sugar content due to conversion during the ripening process (Ronggao et al., 2015).

The total increase in dissolved solids occurs due to the breakdown of water-soluble polysaccharide components, such as cellulose and pectin, which are the main components of the cell wall, into water-soluble saccharides, such as glucose, sucrose, and fructose (Cardenas Perez et al. 2018)

iii. Water Content

Moisture content is the amount of water contained in the fruit, expressed as a percentage. Water content is also a very important characteristic of fruits, as it can affect their appearance, texture, and taste. The moisture content in the fruit determines its freshness and durability. A high moisture content results in the ease of bacteria, mold, and yeast to multiply, so that there will be changes in the fruit. Fruits with the right moisture content are not only more palatable but also more durable. Moisture content also plays an important role in fruit ripening. When fruits ripen, their moisture content can change, which can affect their texture and taste. Regular measurements can help producers and traders understand the stages of fruit ripening so that they can determine the right time for harvesting and marketing.

The importance of measuring the moisture content of fruits is closely related to food safety. High moisture content can create an environment conducive to the growth of bacteria and fungi, which can damage fruit and harm the health of consumers. Therefore, monitoring the moisture content is a preventive measure to prevent contamination and maintain product quality. High airl levels in agricultural products, especially horticultural products, will cause a shelf life that is not durable.

iv. Tannin Content

Tannins are known to be one of the active ingredients in salak fruit that gives salak fruit a pungent taste. Tannins are secondary metabolites found in plants and synthesized by plants. Tannins are usually hygroscopic, and their solutions in hot water form a colloidal solution instead of an actual solution. Solutions in polar organic solvents can be precipitated by the addition of mineral acids or salts. Tannins can be classified into two types based on their chemical structure hydrolyzed tannins (hydrolyzable tannins) and condensed tannins (condensed tannins).

Hydrolyzed tannins are ester compounds of simple sugars with one or more carboxylic acid polyphenols and are easily hydrolyzed by acids, bases, or enzymes. This compound can be broken down into gallic acid when dissolved in water (Hagerman, 2002). Condensed tannins produce hydrochloric acid. This type of tannin is mostly composed of polymer flavonoids and is a phenolic compound (Hagerman, 2002). Tannins are produced by green plants, both high- and low-level plants, with different levels and qualities.

The differences in cultivars affected the total content of tannins, flavonoids, and alkaloids, as well as the antioxidant activity in the five salak fruit cultivars. Analysis of the correlation between the effect of secondary metabolites on antioxidant activity in the five salak fruit cultivars showed that tannins had a moderate effect on antioxidant activity, whereas alkaloids and flavonoids had no effect. In addition, Park et al. (2017) stated that in the fruit ripening process, there is a change in dissolved tannins to insolu500e which is characterized by the loss of astringent properties or sepat in the fruit.

v. Dissolved Solids Rate

The change in the sweetness level of fruit can be explained by the total value of dissolved solids and its sugar-acid ratio. Total dissolved solids indicate the result of the overhaul of complex carbohydrates into simple dissolved gulagula components such as fructose, glucose, and sucrose (Burdon et al. 2016). The sugar-acid ratio compares the sugar and organic acid content in fruits. The sugar-salt ratio describes the typical taste of the fruit, which can change as the ripening process progresses. An increase in the sugar-acid ratio indicates a decrease in the acid content and an increase in the fruit sugar content due to conversion during the ripening process (Ronggao et al., 2015).

The total increase in dissolved solids occurs due to the overhaul of water-solu500e polysaccharide components, such as cellulose and pectin, which are the main components that make up cell walls, into water-solu500e saccharides such as glucose, sucrose, and fructose (CárdenasPérez et al. 2018; Wang et al. 2021). An increase in total dissolved solids during the ripening process also occurred in kiwifruit, as reported by Jordan et al. (2000). Azene et al. (2014) showed that the overhaul process in fruit ripening increases until it reaches the maximum point, followed by a decrease in the concentration of dissolved components because they are used as respiration substrates. The

temperature in the highlands is lower than that in the lowlands, so the sugar content of Sidimpuan salak is higher than that in the lowlands. Low temperatures also slow down the physiological activity that occurs in plants and the activity of microorganisms that help the process of absorbing nutrients for plants Respiration activities affect changes in the taste and texture of fruits; if there is an increase in the rate of respiration, the breakdown of carbohydrate polymers will occur faster. When the fruits ripen, the sugar content increases, but the acid content decreases. As a result, the sugar and acid contents undergo drastic changes. Rachmawati (2010).

vi. Ratio of Dissolved Solids and Total Dissolved Acids

The ratio of Dissolved Solids to Total Dissolved Acids is a comparison between the content of Dissolved Solids and the total acid content. The sweet and sour taste of the sidimpuan snake fruit is determined by the content of ATT. The comparative values of total acids and total dissolved solids of fruit show the level of ripeness of fruit, which is described from the value of the sugar-acid ratio. The increase in the sugar-acid ratio is correlated to the increase in sugar content and a decrease in the organic acid content of fruits. These changes show the fruit ripening process driven by ethylene hormone (Yebirzaf and Tolessa, 2018). The sugar acid ratio, type of sugar, and type of organic acid predominantly affect the distinctive taste and flavor strength of the fruit (Ronggao et al., 2015).

4. CONCLUSIONS AND SUGGESTIONS

The chemical characterization of the white salak sidimpuan fruit is known, and the vitamin C content of white sidimpuan snake fruit in Lubuk Raya and Batu Layan is not significantly different. However, based on the highest average, the vitamin C content in Lubuk Raya is higher (41.49 Mg/100 ml and is significantly different from the vitamin C content of white sidimpuan snake fruit in Palopat Maria (28.06 mg/100 ml). The total content of dissolved acids was significantly different in Lubuk Raya with a value of 1.68% in Lubuk Raya. The tannin content was significantly different in Lubuk Raya with a value of 0.38%. The moisture content of white sidimpuan snake fruit was significantly different with a value of 79.22. % on Palopat Maria.

The dissolved solid content of red sidimpuan snake fruit differed significantly, with a value of 19.86% in Batu Layan. observation of vitamin C content, total dissolved acid, moisture content, and tannin content of red sidimpuan snake fruit from the three locations showed no real difference between Lubuk Raya, Batu Layan, and Palopat Maria snake fruit.

5. REFERENCE

Adelina., R., Nasution., Y., & Jamaluddin. (2018). Perbandingan produksi dan kadar gula salak sidimpuan (*Salacca sumaterana* Becc.) di dataran rendah dan dataran tinggi. Jurnal Agroteknologi, 2(1), 1–6.

Adelina, R., 2021. Phenology of flowering and fruit set in snake fruit (Salacca sumatrana Becc.). Acta Agrobotanica. 74:1-12.

BPS., 2010. Kota Padangsidimpuan.

Burdon, J., Pidakala, P., Martin, P., Billing, D. and Boldingh, H. 2016. Fruit maturation and the solu500e solids harvest index for “Hayward” kiwifruit. Scientia Horticulturae, 213, 193–198.

Cárdenas-Pérez, S., Chanona-Pérez, J.J., Güemes-Vera, N., Cybulska, J., Szymanska-Chargot, M., Chylinska, M., Kozioł, A., Gawkowska, D., Pieczywek, P.M. and Zdunek, A., 2018, Structural, mechanical and enzymatic study of pectin and cellulose during mango ripening. Carbohydrate Polymers. 196, 313–321.

Hagerman, A.E. 2002. Condensed Tannin Structural Chemistry. Department of Chemistry and Biochemistry, Miami, University Oxford OH 45046.

I Wayan., W., I., 2017. Teknologi Tanaman Buah-Buahan . *Unuversitas Udayana Bali*.

Islam, M., Islam., Azim., A.. Y., Anwar., M., R., dan Uddin., M., M., 2014. Customer perceptions in buying decision towards Bangladeshi local apparel products. European Scientific Journal, 10(7), 482–497.

Julianti, E. 2012. Pengaruh Tingkat Kematangan dan Suhu Penyimpanan Terhadap Mutu Buah Terong Belanda (Cyphomandra betacea), Jurnal Hortikultura Indonesia, 2(1), 14.

Kader., A., A,. 2002. Quality and safety factors: Defnition and evaluation for fresh horticultural crops. *Postharvest technology of horticultural crops* : 279-285.

Lubis., M., I., & Halimatus Syahdia Hasibuan., (2023). Identifikasi Karakteristik Sifat Kimia Buah SalakSidimpuan *(Salacca Sumatrana Becc.).* Agrohita Jurnal Agroteknologi Fakultas Pertanian Universitas Muhammadiyah Tapanuli Selatan *Vol. 8 No. 2. (Hal. 304 – 310).*

Muchtadi., T., R., dan Sugiyono., 1992. Ilmu Pengetahuan Bahan Pangan. Departemen Pendidikan dan Kebudayaan. Direktorat Jendral Pendidikan Tinggi. Pusat Antar Universitas. Institut Pertanian Bogor. Bogor.

Manurung, Idin Robintua, dkk. (2018). Pengaruh Perbandingan Sari Buah Salak Padang Sidempuan. Dengan Buah Naga RED Dan Jumlah Asam Askorbat Terhadap Mutu Sirup Buah. Jurnal Rekayasa Pangan dan Pertanian. 6 (2).

Novita, M., Satriana., Martunis., Rohaya, S., and Hasmarita, E. 2012. Pengaruh pelapisan kitosan terhadap sifat fisik dan kimia tomat segar (Lycopersicum pyriforme) pada berbagai tingkat kematangan. Jurnal Teknologi dan Industri Pertanian Indonesia. 4(3):1-8.

Purnomo., H., 2001. *Budidaya SalakPondoh*. Aneka Ilmu. Semarang. 70 hal.

Pardede., E. (2014). Tinjauan Komposisi Kimia Buah dan Sayur : Peranan Sebagai Nutrisi dan Kaitannya dengan Teknologi Pengawetan dan Pengolahan. Journal VISI, Vol. 21(3): 10–16.

Rai., I., N., C.G.A. Semarajaya, W. Wiraatmaja. 2010. A Study on the Flowering Phenophysiology ofGula Pasir Snake Fruit to Prevent Failure of Fruit-set. J. Hort. 20(3):216-222.

Rachmawati, R. (2009). Pengaruh Suhu Dan Lama Penyimpanan Terhadap Kandungan Vitamin C Pada Cabe Rawit (Capsicum frustescens). Bali : Universitas Udayana

Ritonga, R., Adelina, R., Sartika, D. and Nasution, Y., 2024. Kajian Kualitas Buah Salak Sidimpuan Berdasarkan Jumlah Biji Pada Elevasi Yang Berbeda. *Jurnal Agrium*, *21*(3), pp.215-223.

Ronggao, G., Wei, Y., Zhihui, W., Mingan, L. and Guolu, L. 2015. Study on the SugarAcid Ratio and Relevant Metabolizing Enzyme Activities in Navel Orange Fruits

Sipahutar, A., Adelina, R., Lubis, E.S. and Pulungan, S., 2025. Perbungaan Dan Uji Sterilitas Serbuk Sari Salak Sidimpuan (Salacca sumatrana Becc.). *JURNAL AGRIUM Учредители: LPPM Universitas Malikussaleh*, *22*(1), pp.48-62.

Siregar, S., Adelina, R., Nasution, Y. and Pulungan, S., 2024. Struktur Morfologi Dan Anatomi Bunga Betina Salak Sidimpuan (Salacca sumatrana Becc.). *Jurnal Agrium*, *21*(3), pp.205-214.

Sudjijo. 2008. Karakterisasi dan evaluasi beberapa aksesi tanaman salak. J. Hort., 18(4), 373–379

Yebirzaf, Y. and Kassaye, T. 2018. Postharvest quality of tomato (Solanum lycopersicum) varieties grown under greenhouse and open field conditions, International Journal of Biotechnology and Molecular Biology Research, 9(1), 1–6.