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Differences in Fermentation Time Varying Cassava Tapai Substrate, Purple Sweet Potatoes and Banana Kepok Based on Physical Properties, Organoleptic Characteristics and pH

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Abstract

Tapai is a fermented product that is very popular with the public and has better nutritional value. Using various substrates in producing tapai can be a new alternative in diversifying food processing, one of which is purple sweet potato and Kepok banana, which are a problem in production and occupy the top ranking of agricultural products in Indonesia. Purple sweet potatoes and Kepok bananas have the same essential ingredients as cassava, namely starch. This research was conducted to determine the effect of fermentation time and substrate variations on the physical properties, organoleptic characteristics and acidity levels of cassava tapai, purple sweet potato and Kepok banana. This research was conducted using a completely randomized design experimental research method with a factorial pattern consisting of two factors. The first factor is the substrate factor, and the second is the fermentation time length. The analysis showed that the fermentation time and substrate variations influenced the physical properties, organoleptic characteristics and acidity level of the tapai. Overall, tapai-fermented food was preferred by panelists on the third day of fermentation.

Introduction

Tapai is a local traditional fermented food widely consumed by Indonesians with a distinctive taste and better nutritional value. Until now, cassava tapai has been commonly produced. Because tapai has a reasonably high starch content, it is usually made with a substrate containing starch, such as cassava. Cassava (*Manihot utilissima* Pohl) includes plants with relatively high carbohydrate and energy content. The nutrients contained in food, especially carbohydrates and water content in cassava, are 60.00 grams and 37.90 grams per 100 grams of ingredients (Sahratullah et al., 2017).

Apart from cassava, starch-based substrates can also be another alternative for tapai production. One of them is purple sweet potatoes and kepok bananas; considering the problem of banana production and purple sweet potatoes occupying the top ranking of agricultural products. Indonesia can produce around 8,741,147 tons of bananas per year. Meanwhile, sweet potatoes were produced at approx 1,806,389 tons in 2018. With the abundant production of bananas and sweet potatoes, making tapai using this substrate could be a new alternative in diversifying the processing of these foods. Both banana and sweet

potato substrates also have almost similar cassava contents, so they are suitable for production as a material for making tapai.

Kepok banana (*Musa paradisiaca* L) has the advantage of resistant starch and high fibre content. Kepok bananas have a starch content of 22 – 25%. Kepok bananas contain around 0.3% fructooligosaccharide compounds, which are a source of prebiotics (Faizul et al., 2012). Purple sweet potatoes also have the same high calorie and carbohydrate content as cassava. The content of purple sweet potatoes includes high levels of natural food fibre, such as low glycemic index levels, oligosaccharides and prebiotics. Purple sweet potato also contains Zn, Cu, K, and Mg, with an average of 20%. Purple sweet potatoes are rich in crude fibre, protein, minerals, fats and vitamins. The nutritional content of purple sweet potato also meets the needs of microbial growth during fermentation.

Some factors such as starch, manufacturing process and yeast influence tapai making. The quantity of this yeast can be affected since the over quantity of yeast makes tapai textures soft. Tapai yeast is a mixed population consisting of species of genera Acetobacter and Saccharomyces (Hasanah et al., 2013). In yeast tapai, there are also several types of fungi, such as *Rhizopus* sp., *Chlamydomucor oryzae*, and *Mucor* sp. There are also other factors, such as temperature, pH, and oxygen. Besides that, the fermentation temperature also affects the microbes involved in the fermentation process since the optimum temperature for tapai fermentation is between 35°C - 40°C. The acidity level also has a significant influence on the development of bacteria. An excellent acidic pH condition for bacterial growth is between 3.5-5.5 (Kanino, 2019). The fermentation period also has a significant impact on the tapai fermentation process. The tapai fermentation period will affect the quality of the tapai in terms of whether it is suitable for consumption. Fermentation occurs due to microbial activity, which converts starch into sugar; some of the sugar will be converted into alcohol and components flavor. All of those factors will impact the quality of the tapai product; however, apart from taste, the tapai quality can also be determined based on the aroma, texture, and physical characteristics of the tapai.

Substitutes for raw tapai materials other than cassava, such as purple sweet potatoes and Kepok bananas, can be used because fermentative microbes can use their resistant starch and fiber content to make tapai. However, when using kapok bananas and purple sweet potatoes as raw materials for making tapai, it is necessary to give attention to the fermentation time, which is a factor that influences the fermentation results of the tapai based on the aroma, texture, taste, and other organoleptic characteristics of the tapai. Therefore, in this research, the tapai will be made using kapok banana and purple sweet potato as raw materials compared to cassava, with different fermentation times. This research aims to determine the differences in the physical characteristics of the tapai produced, namely the pH value and organoleptic properties of the differences in fermentation time for the three raw materials used.

Methods

This research is part of an experiment using a Completely Randomized Design (CRD) with a factorial pattern consisting of two factors. The two factors used in this research are the substrate variation factors, namely cassava (*Manihot utilissima* Pohl), banana kepok (*Musa paradisiaca* L), and purple sweet potato (*Ipomoea batatas* L). The second factor is the length of fermentation time, which takes five days. The combination of these two factors produces five treatment combinations. Each treatment was repeated three times until 15 experimental units were reached.

Table 1. Research Design

Variation Substrate	Fermentation Time				
	1 Day (L1)	2 Day (L2)	3 Day (L3)	4 Day 4 (L4)	5 Day (L5)
Cassava (K1)	K1L1	K1L2	K1L3	K1L4	K1L5
Puple Sweet Potato (K2)	K2L1	K2L2	K2L3	K2L4	K2L5
Banana Kepok (K3)	K3L1	K3L2	K3L3	K3L4	K3L5

Material

The main ingredient used is cassava (*Manihot utilissima* Pohl), Banana Kepok (*Musa paradisiaca* L.) and purple sweet potato (*Ipomoea batatas* L.), other supporting materials such as commercial tapai yeast (NKL), banana leaves, water.

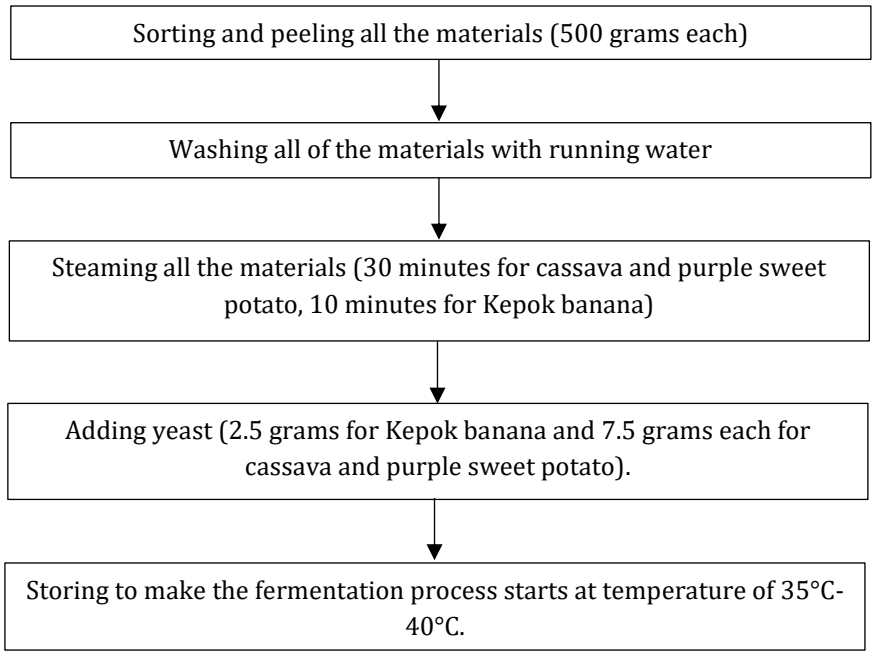
Tool

The equipment needed for this research is a KOBE SF-400 Brand Digital Kitchen Scale, GSF-4540 Electric Multipurpose Scale, basin, large pan, spoon, fork, stove, knife, cloth, basket, cutting board, plastic, plastic container, plastic utensils, and pH paper Merck MQuant pH Indicator Strips (Non-Bleeding) pH 0 - 14 (1.09535.0001).

Procedures

The procedures of making Cassava Tapai, Purple Sweet Potato, and Kepok Banana consist of:

1. 500 grams of cassava, purple sweet potato and Kepok banana were sorted, the skin was peeled and the substrate material was washed with running water until clean.
2. Then steamed, cassava (30 minutes), purple sweet potato (30 minutes), Kepok banana (10 minutes), maintained the level of doneness so that it is not completely cooked, then cooled.
3. After cooling, add 2.5 grams of yeast for 500 grams of Kepok bananas and purple sweet potatoes, while 7.5 grams for 500 grams of cassava.
4. Then, each ingredient is divided into 5, each 100 grams, which are stored for fermentation variations from day 1 to 5 day.
5. The fermentation process is carried out at a temperature of 35°C-40°C.



Figureure 1. The tapai from cassava, purple sweet potato, and kepok banana making process diagram

Organoleptic Test

Organoleptic tests were carried out to analyze the level of satisfaction and determine the suitability of people's tastes for the tapai produced. This test involved around ten panelists. Respondents will fill in the questionnaire, which includes assessing tapai products in terms of aroma, color, texture and taste. Organoleptic tests were carried out using a numerical scale with assessment criteria: 1 = dislike very much, 2 = dislike, 3 = somewhat like, 4 = like, and 5 = like very much.

Acidity Level Test

A pH test uses Merck MQuant pH paper pH Indicator Strips (Non-Bleeding) pH 0 - 14 (1.09535.0001). This test is carried out to determine a material's alkalinity or acidity level. If the pH indicator is less than 7, it is acidic; conversely, if the pH is more than 7, it is essential or alkaline, and if the pH is equal to 7, it is neutral. The way to test pH is to dissolve the tapai in water, then test the pH of the liquid with pH paper and see the results.

Results and Discussion

The results were obtained based on the physical properties, organoleptic characteristics, and acidity levels of cassava, purple sweet potato and kepok banana tapai for five days fermentation time, based on the tapai fermentation optimal time (Nasution et al., 2021). Based on Table 2, it can be seen that the comparison of the physical properties of each tapai substrate on the first day of observation has a pale white colour, while on the fifth day, the colour changes to a slightly yellow colour. This colour change is in line with research by Rahmah (2010), which showed a change in the colour of cassava to yellowish. When measuring the colour of the purple sweet potato substrate tapai on the first day, it showed a light purple colour. After several days of fermentation, until the fifth day, the purple sweet potato tapai changed to purple. According to Mardyansyah et al. (2020), the colour change in purple sweet potatoes is influenced

by the mixture of white yeast used in fermentation, with sweet potato substrate. Next, the substrate that was observed was Kepok banana. On the first day of observation, the banana was yellow, while on the fifth day, it was dark yellow. The changes in the Kepok banana tapai did not follow Utami (2017), that the resulting tapai produced brighter colours. The resulting difference is because the researchers used ripe bananas.

Table 2. Comparison Physical Properties of Tapai Cassava, Purple Sweet Potato, Banana Substrate

Tapai Material	The Shape of Tapai	
	Day 1	Day 5
Cassava (*Manihot uttilissima pohl*)		
Purple Sweet Potato *(Ipomea batatas*)		
Kepok Banana (*Musa paradisiaca L*)		

Organoleptic Properties

The organoleptic characteristics of tapai made from cassava, purple sweet potato, and kepok banana obtained results according to Figure 2, which include the characteristics of color, texture, taste, and aroma based on the test results to the panelists. In Figure 2a it can be seen that color is one of the indicators for assessing food products, which determines consumer decisions before consuming food. Figure 2a described that tapai made from cassava has a color that is exceptionally preferred on the fifth day of fermentation. In contrast, the purple sweet potato had the color that the panelists really liked on the second day, and the kapok banana had the color that the panelists most liked on the third day of fermentation. This shows that tapai made from cassava only has a color that is quite favorable on the last day of fermentation. In contrast, purple sweet potato and banana kepok get a very favorable color before the fermentation time ends. Apart from that, the attractive color of purple sweet potato tapai is due to the high anthocyanin content which will actually be more stable in acidic conditions due to fermentation (Aulia et al., 2023).

In Figure 2b it can be seen that the panelists very liked the texture of cassava and purple sweet potato tapai, with the highest score of 5 on the 2nd day of fermentation, while for the tapai from Kepok bananas, the panelists gave the most preferred texture a score of 5 on the third day of fermentation. It shows that the tapai made from purple sweet potato has a preferred texture, like the usual tapai on the second day of fermentation, and the most preferred texture of banana kepok, like most tapai from cassava on the third day of fermentation. The tapai texture characteristic that the panelists most preferred showed a soft texture due to the fermentation process. On the first day of fermentation, the tapai texture of the three types of substrates tended to be less liked by the panelists because there was no fermentation process, but as the days went by the substrate texture would soften. This was due to breaking down carbohydrates from the substrate into simple sugars, then leading to the fermentation process to become alcohol. This process releases the water content so that the water content in the tapai increases, causing a change in texture to become soft (Prasetyajari & Sujarwanta, 2015).

Figure 2c explains the results of the flavor properties assessed by the panelists regarding tapai made from cassava, purple sweet potato, and kepok banana. The results showed that on the fifth day of fermentation, tapai made from cassava had the most preferred taste (value 5). In contrast, tapai made from kepok banana only had a preferred value (value 4) on the first and second days of fermentation only. On the other hand, tapai made from purple sweet potatoes had a decreasing value from liking it on the first and second days of fermentation to quite liking it (score 3) on the fourth and fifth days of fermentation. It showed that of the three tapas fermentation substrates, the panelists liked the taste of tapas made from cassava the most, especially if the fermentation process was optimal on the fifth day. According to Dwijoseputro (2005) the change in taste in tapai was caused by a fermentation process carried out by microbes in tapai yeast consisting of members of species from the genus *Aspergillus, Saccharomyces, Candida, Hansenula* and *Acetobacter* bacteria which work synergistically with each other. *Aspergillus* breaks down starch into glucose using the enzyme glucoamylase, while *Saccharomyces, Candida,* and *Hansenula* use the glucose into alcohol and other organic substances. *Acetobacter* is responsible for breaking down alcohol into acid. Therefore, the resulting tapai taste tended to be sweet due to the presence of glucose. On the next fermentation day, there was a slight alcoholic taste due to the alcoholic fermentation process.

Figure 2d explains the aroma characteristics assessed by the panelists. The aroma of a food product has an important role because the results of the aroma assessment can influence whether or not the product is accepted. Usually food products will be accepted if they have an aroma that is not strong or tasteless (Zuhriani, 2015). In Figure 2d, it can be seen that the panelists most liked the tapai aroma of cassava, purple sweet potato, and banana kepok on the fifth day of fermentation. On the last day of the fermentation process, a distinctive and sharp tape aroma was obtained, which the panelists really liked. The aroma of this tape comes from the yeast fermentation process which breaks down starch into alcohol (Santosa & Prakosa, 2010).

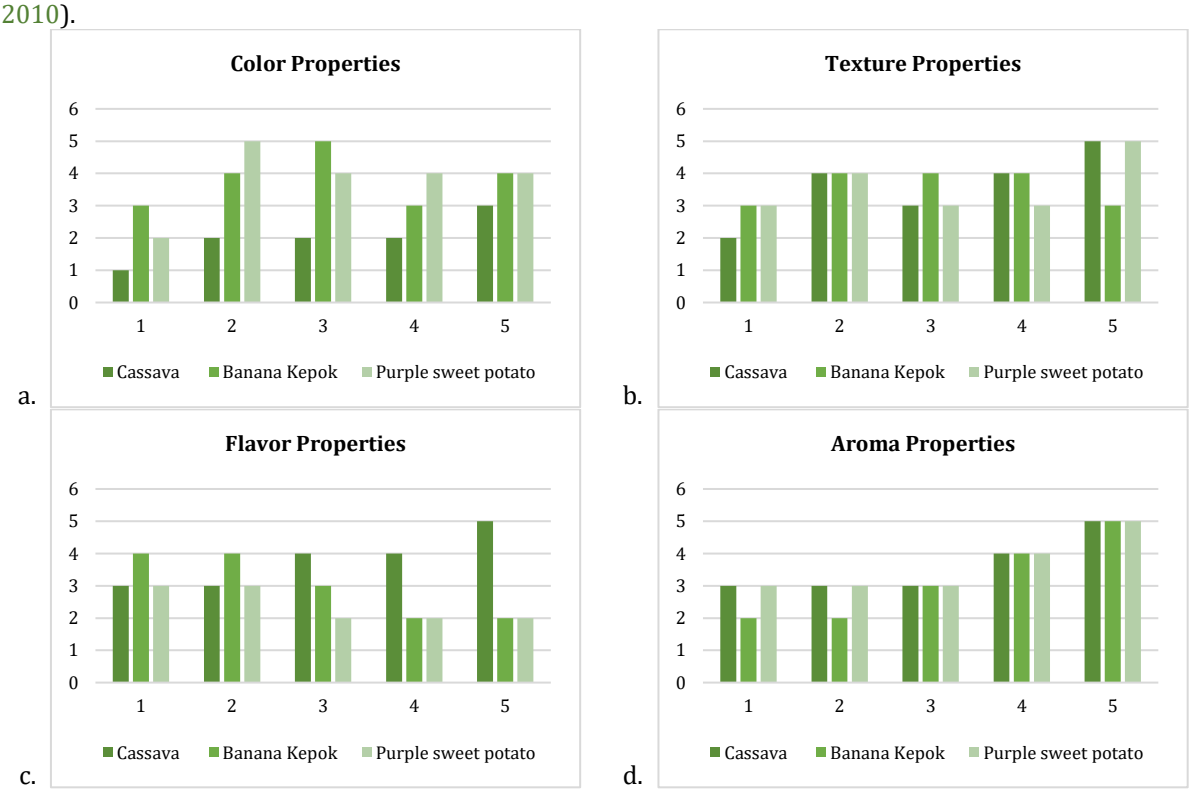


Figure 2. a) Color Properties, b) Texture Properties, c) Flavor Properties, and d) Aroma Properties of Tapai from Cassava, Banana Kepok, and Purple Sweet Potato in Five Days Fermentation by Panelists

Table 3. Tapai Color Indicator Scale

Substrate	Color Descriptions				
	Day 1	Day 2	Day 3	Day 4	Day 5
Cassava	White pale	White yellowish	Little bit yellow	Yellow	Dark yellow
Banana kepok	Yellow pale	Light yellow	Yellow	Old yellow	Pale yellow
Purple sweet potato	Purple pale	Violet	Puple reddish	Purple	Dark purple

Tabel 3 showed the color characteristics produced from cassava, banana kepok, and purple sweet potato tape. Tapai from cassava showed a change in color from pale white on the first day of fermentation to dark yellow on the fifth day of fermentation. Tapai from purple sweet potato changed from pale purple to dark purple after the fermentation process. At the same time, tapai banana kapok also showed a change in color from pale yellow to dark yellow, but on the fifth day of fermentation, it returned back to pale yellow.

Table 4. Tapai Texture, Taste and Aroma Indicator Scale

Indicator	Descriptions				
	Day 1	Day 2	Day 3	Day 4	Day 5
Texture	Very Hard	Hard	A Little Soft	Soft	Very Soft
Flavor	Very sour	Sour	Sweet	Sweet a bit	Very sweet
Aroma	Not alcoholic	Less alcoholic	Less alcoholic	alcoholic	Very alcoholic

Based on Figure 2 and Table 3, it can be seen that the texture of cassava tapai on day 1 is still hard, while on day 5 after fermentation it changes to soft. On purple sweet potato tapai, the texture on day 1 was soft, while on day five the texture of purple sweet potato was very soft. On the first day, Kepok banana tapai was soft, and on the fifth day, the texture of the Kepok banana tapai was soft. Based on these results, it has been known that over time, the three substrates experience a change in texture, becoming softer due to the breakdown of starch into simple carbohydrates, which also produce water so that the texture becomes soft. Apart from that, the taste changes over time to become sweeter due to the hydrolysis of starch into glucose and maltose by the enzymes amylase and maltase (Devi et al., 2023). The presence of more and more microorganisms also causes this. It affects the degradation of cassava starch into sugar (Nirmalasari & Liani, 2018). The aroma of alcohol is also produced due to the fermentation process. Even on the fifth day, the tapai produces a very alcoholic aroma, which is caused by the presence of *Saccharomyces, Candida*, and *Hansenula* yeasts, which can hydrolyze glucose into alcohol and other organic compounds (Hasanah et al., 2012). The reaction of glucose and organic acids produced will also give a distinctive aroma because alcohol and organic acids will react to form esters (Santosa & Prakosa, 2010). Fauziah (2022) revealed that the pungent aroma of tapai is caused by various flavour-forming compounds present in significant intensity. During fermentation, these compounds are formed through glucose hydrolysis and alcohol oxidation on tapai, which has volatile properties. Meanwhile, Saniyah (2018) revealed that the aroma that forms on the tapai or smells like alcohol is caused by the fermentation process, where microorganisms break down starch into glucose and alcohol. The difference in taste in each treatment is caused by the amount of yeast used in making the tapai and the fermentation process by microorganisms. The aroma of the tapai is formed by volatile components (volatile compounds) originating from the product, and can be detected using the nose's sense of smell (Febriyanti & Sunarti, 2022). If the fermentation process was not stopped on the fifth day, the taste of the resulting tapai tended to be sour due to the presence of organic acids produced together with the alcohol.

Acidity level testing was carried out during five days of fermentation to determine the pH value produced by the three substrates used as raw materials for tapai in the fermentation process. The results were that the pH was at five on the first day, but on the fifth day, the pH decreased to 4. Furthermore, the purple sweet potato tapai on the first day showed a pH of 5, whereas on the fifth day, the pH was 3. The pH can influence changes in the duration of fermentation in cassava tapai and purple sweet potato during the fermentation period from the first day to the fifth day. The pH decreases along with the increase in fermentation time due to microbial activity, which can convert cassava and purple sweet potato starch into alcohol compounds. Alcohol is also an acidic compound that can experience a rapid decrease in pH. If fermentation continues, organic acids can form due to the microbes in the yeast tapai. Tapai yeast consists of various microbial species with different tapai fermentation abilities. For example, Aspergillus can convert starch into glucose, *Saccharomyces, Candida, and Hansenula* convert glucose into alcohol, and *Acetobacter* converts alcohol into acid (Dwijoseputro, 2005). Enhancement the quantity of alcohol is directly proportional to the increasing duration of fermentation because the longer the fermentation period, the more glucose is converted into alcohol; therefore, the concentration of alcohol produced increases. Alvarenga et al. (2011) showed that within 1-7 days, the ethanol content in the tapai continued to increase, whereas after 7 days, the ethanol content in the tapai decreased.

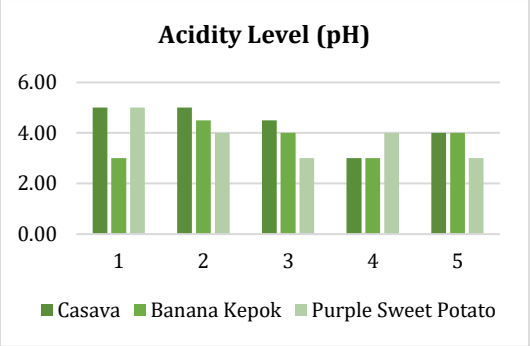


Figure 3. pH Test Results for the Three Substrates

Conclusions

The length of fermentation time and variations in substrate influence the physical properties, organoleptic characteristics, and acidity level of cassava tapai, purple sweet potato, and kepok banana. On the third day, the panelists preferred the tapai fermented food on taste and aroma. The increase in alcohol level is directly proportional to the increased duration of fermentation. This also affects the resulting pH. Variations in the appropriate dosage of yeast tapai still need to be studied. 2. It is necessary to study the length of steaming time to control each substrate's maturity level.

References

Alvarenga, R.M., Carrara, A.G., Silva, C., Oliviera, E.S. (2011). Potential Application of Saccharomyces cerevisae Strains for the Fermentation of Banana Pulp. *African Journal of Biotechnology*, 10(18):3608-3615.

Aulia, LP., Perdaningtyas, SF., Muflihah T., Hasna, T. (2023). Effect of Purple Sweet Potato (Ipomoea batatas) extract and Fermentation Time in Water Kefir Chemical Properties. *Jurnal Teknologi Pertanian*, 24(2): 29-40.

Bestari, N. (2021). Purple sweet potato Turns out it's more bitter than regular sweet potatoes, apparently this is the reason. https://bobo.grid.id/read/083027370/ubi-ungu-terasa-lebih-pahit-dibanding-ubi-biasa-ternyata-ini-sebabnya (Accessed 27 May 2023)

Devi, M., Wibowotomo, B., Ummu, N., Hidayati, L., Martiningtyas, A., & Ariffin, H. F. (2023). Effect of Fermentation Time on Nutrient Content and Organoleptic Quality of Corn (Zea mays L.) Tapai as Superfood. *ACEIVE 2022: Proceedings of the 4th Annual Conference of Engineering and Implementation on Vocational Education,* Vol. 1, No. A2P2, p. 51.

Dwidjoseputro. (2005). *Dasar-dasar Mikrobiologi*. Jakarta: Djambatan

Faizul Umam, M., Utami, R., Widowati, E., Technology, J., Faculty, H.P., University, P., & March, S. (2012). Kajian Karakteristik Minuman Sinbiotik Pisang Kepok (Musa paradisaica forma typical) dengan Menggunakan Starter Lactobacillus acidophillus IFO 13951 dan Bifidocaterium longum ATCC q5707. *Jurnal Teknosains Pangan*, 1(1): 2-11.

Fauziah, K.N., Kurnia, K., Nita, A., Abrori, A. (2022). Pengaruh Pemberian Dosis Ragi Tape (Kapang Amilolitik) terhadap Pembuatan Tape Pisang Kepok. *Jurnal Pangan dan Gizi*, 10(1): 11-17.

Febriyanti, U and Sunarti, Riri N. (2022). Organoleptic Test on Tapai Purple Sweet Potato and Yellow Sweet Potato with Different Dosages of Ragi Tapai. *Proceedings of the National Seminar on Applied Science and Technology*, 5, 590-598.

Hasanah, H., Jannah, A., & Fasya, A. G. (2012). Pengaruh lama fermentasi terhadap kadar alkohol tape singkong (Manihot utilissima Pohl). *Alchemy*, 2(1), 68-79.

Kanino, D. (2019). Pengaruh konsentrasi ragi pada pembuatan tape ketan (The effect of yeast concentration on making tape ketan). *Jurnal Penelitian Dan Pengembangan Agrokompleks*, 64-74.

Kurniati, A. R., Tazhkira, A. T., Ma'sumah, D. M. S., Sari, I. P., Agnesia, D. A., & Prayitno, S. A. (2018). Mutu Organoleptik Tape Ubi Jalar Kuning (*Ipomoea batatas* L) Akibat Perbedaan Konsentrasi Ragi (*Saccharomyces cerevisiae*). *Food Science and Technology Journal (Foodscitech)*, 1(2), 35-43. https://doi.org/10.25139/fst.v1i2.1373

Mardiansyah K, Usup A, Asie ER. (2020). The effects of biochar and chicken manure application on red ginger (*Zingiber officinale* Rosc.) growth and yield of semi paludiculture in tropical peatlands. *J Trop Peat*, 10(2):9–16. https://doi.org/10.52850/jtpupr.v10i2.2070

Nasution, E., Setiawati, VR., Nairfana, I. (2021). Pengaruh Lama Fermentasi terhadap Mutu Organoleptik, Tingkat Keasaman (pH) dan Tingkat Kemanisan Tape Sorghum (Sorghum bicolor L. Moench). *Food and Agroindustry Journal*, 2(2): 53-61.

Nirmalasari, R and Liani, I.E. (2018). Pengaruh Dosis Pemberian Ragi terhadap Hasil Fermentasi Tape Singkong Manihot utilissima. *Jurnal Ilmu Alam dan Lingkungan*, 9(18): 8-18.

Prasetyajati E.B & Sujarwanta, A. (2015). Pengaruh variasi lama fermentasi terhadap kandungan protein pada tape talas (Colocasia esculenta) sebagai Sumber Belajar Biologi SMA Kelas XII pada Materi Bioteknologi Pengolahan Bahan Pangan. *Bioedukasi Jurnal Pendidikan Biologi*, 6(1): 45-53. http://dx.doi.org/10.24127/bioedukasi.v6i1.157

Rahmah, H. N. L. (2010). Pengaruh Waktu Fermentasi terhadap Kadar Etanol dari Tape Singkong (Manihot esculenta crantz). *Doctoral dissertation*, UIN Sunan Kalijaga Yogyakarta.

Rahmayudi. (2019). Manufacturing Technology Tapai Banana Kepok. http://cybex.pertanian.go.id/mobile/artikel/85288/Teknologi-PembuatanTape-Pisang-Kepok/ (Accessed 27 May 2023).

Sahratullah, S., Dyah Jekti, D. S., & Zulkifli, L. (2017). Pengaruh Konsentrasi Ragi dan Lama Fermentasi Terhadap Kadar Air, Glukosa Dan Organoleptik Pada Tape Sukun. Jurnal Pijar Mipa, 12(2), 95–101. https://doi.org/10.29303/jpm.v12i2.348

Saniyah. (2018). Mutu Organoleptik Tape Ubi Jalar Kuning (Ipomoea batatas L) Akibat Perbedaan Konsentrasi Ragi (Saccharomyces cerevisiae). *Food Science and Technology Journal (Foodscitech)*, 1(2), 35-43. https://doi.org/10.25139/fst.v1i2.1373

Santosa, A., & Prakosa, C. (2010). Karakteristik tape buah sukun hasil fermentasi penggunaan konsentrasi ragi yang berbeda. *J. Unwidha*, 22(73), 48-55.

Utami, C. R. (2017). Pengaruh Waktu Fermentasi Terhadap Karakteristik Kimia dan Organoleptik Tape Pisang Kepok. *Jurnal Teknologi Pangan*, 8(2), 99-106.

Zuhriani, F., & Rahayu, T. (2015). Kualitas Organoleptik Brownies Kukus Dari Tepung Beras Hitam. *Doctoral dissertation* Universitas Muhammadiyah Surakarta.