



Effect of fermentation time on dietary fiber content, total sugar content, and organoleptic quality of Jali Tape (*Coix Lacryma-Jobi L*)

*Pengaruh waktu fermentasi terhadap kadar serat pangan, kadar gula total, dan mutu organoleptik Tape Jali (*Coix lacryma-jobi L*)*

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Abstract

The prevalence of diabetes mellitus (age >15 years) is 1,8% and is increasing every year in Indonesia. Jali seeds (*Coix lacryma-jobi L*) are known to contain good dietary fiber for people with DM. One of the processed foods from jali seeds is tape. Therefore, tape jali can be used as an alternative snack food for patients with DM. The aim of this study was to determine the effect of fermentation time on the food fiber content, total sugar content, and organoleptic quality of jali tapes. This study was conducted using a Completely Randomized Design (CRD) method. The organoleptic test was carried out in May 2023 by 30 semi-trained panelists from the Nutrition students of the Faculty of Medicine and Health, Muhammadiyah University, Jakarta. Tests for food fiber content and total sugar content were carried out at the PT Saraswanti Indo Genetech laboratory with one control factor, three treatments (48, 72, and 96 h fermentation), and five replications. Organoleptic tests included hedonic quality and liking (hedonic) tests using the questionnaire method, food fiber content tests using the enzymatic-gravimetric method, and total sugar content tests using the Luff Schoorl method. The Kruskal-Wallis and Mann-Whitney tests were used for data analysis. The results showed that there were differences in each sample for the quality of aroma, sour taste, sweetness, and texture ($p < 0,05$), and the sample that was most liked by the panelists was TJ2. Laboratory test results showed that the sample with the highest fiber content and lowest total sugar content was TJ2, at 5,72% and 19,1%, respectively. In conclusion, fermentation time has an effect on the dietary fiber content, total sugar content, and organoleptic quality of jali tape.

Keywords: Diabetes Mellitus, fermentation, Jali, Tape

Abstrak

Prevalensi diabetes melitus (usia >15 tahun) mencapai 1,8% dan meningkat setiap tahunnya di Indonesia. Biji jali (*Coix lacryma-jobi L*) diketahui mengandung serat pangan yang baik bagi penderita DM. Salah satu makanan olahan dari biji jali adalah tape, sebagai alternatif makanan kudapan bagi penderita DM. Tujuan penelitian untuk mengetahui pengaruh lama waktu fermentasi terhadap kadar serat pangan, kadar gula total, dan mutu organoleptik tape jali. Penelitian eksperimental menggunakan metode Rancangan Acak Lengkap (RAL) dengan 1 faktor kontrol, 3 kali perlakuan (fermentasi 48 jam, 72 jam, dan 96 jam), dan 5 kali ulangan. Uji organoleptik dilakukan pada Mei 2023 oleh 30 orang panelis semi terlatih yaitu mahasiswa Gizi Fakultas Kedokteran dan Kesehatan Universitas Muhammadiyah Jakarta. Uji meliputi mutu hedonik dan uji kesukaan (hedonik) menggunakan metode kuesioner, uji kadar

serat pangan dan menggunakan metode Enzimatik-Gravimetri, dan uji kadar gula total dilakukan di laboratorium PT Saraswanti Indo Genetech menggunakan metode *Luff Schoorl*. Analisis data menggunakan *Kruskal wallis* dan uji lanjut *Mann-whitney*. Hasil menunjukkan bahwa terdapat perbedaan pada setiap sampel terhadap mutu aroma, rasa asam, rasa manis, dan tekstur dengan *p-value* <0.05 serta sampel yang paling disukai oleh panelis adalah TJ2. Hasil uji laboratorium menunjukkan bahwa sampel dengan kadar serat tertinggi dan kadar gula total terendah adalah TJ2 masing-masing sebesar 5,72% dan 19,1%. Kesimpulan, terdapat pengaruh waktu fermentasi terhadap kadar serat pangan, kadar gula total, dan mutu organoleptik tape jali.

Kata Kunci: Diabetes Melitus, Fermentasi, Jali, Tape

Introduction

Diabetes Mellitus (DM) is a health problem in the world that needs attention (Harna et al., 2022). Type 2 DM is a chronic metabolic disorder characterized by increased blood glucose levels (Rohani, 2019). Patients with diabetes mellitus have Fasting Blood Sugar (GDP) levels greater than 126 mg/dL or Current Blood Sugar levels (GDS) greater than 200 mg/dL (PERKENI, 2021).

The World Health Organization (WHO) reported that diabetes mellitus sufferers worldwide in 2000 reached 171 million people, and this number will double by 2030 to 366 million people (Lestari et al., 2021). Basic Health Research Data (RISKESDAS) in 2018 showed that the prevalence of diabetes mellitus in Indonesia aged >15 years reached 1,8% and continues to increase every year (Kemenkes RI, 2018).

A good diet is important to maintain the health of patients with diabetes mellitus. This is intended to help insulin to work more optimally in converting glucose into glycogen (Harna et al., 2022). Eat food with balanced nutrition, especially foods high in fiber. The recommended fiber consumption for patients with type 2 DM is 20 – 35 g/day (PERKENI, 2021). Fibers can slow the increase in blood sugar levels, reduce insulin use, and increase the workload of the pancreas to produce insulin. Fibers can slow the increase in blood sugar levels, reduce insulin use, and increase the workload of the pancreas to produce insulin (Laily et al., 2022).

Diabetes mellitus occurs due to insulin secretion, metabolic abnormalities that interfere with insulin secretion, mitochondrial abnormalities, and other conditions that interfere with blood sugar tolerance (Denggog, 2023). Limiting the intake of foods high in sugar

is also necessary for patients with DM. The recommendation for sugar consumption per day recommended by WHO is <10% of the total energy intake or 4 tablespoons per person per day. Indonesia has various types of plants. Plants that can replace sugar consumption include jali seeds, stevia plants, and sugar cane.

The jali plant (*Coix lacryma-jobi* L) is a class of cereals that has not been properly utilized by Indonesian people (Nurmala et al., 2019). Jali contains dietary fiber; therefore, it can be used as a functional food (Qurnaini et al., 2021). Jali seeds (100 g) contain 324 kcal of energy, 11 g of protein, 4 g of fat, 61 g of carbohydrates, 1,65% dietary fiber, 1,186% crude fiber, 21,44% amylose, and 77,38% amylopectin (Juhaeti et al., 2021).

Jali can potentially be used as a snack food, such as tape, porridge, and compote mixture, because it has a chewy and non-sticky texture (Histifarina et al., 2020). One effort to diversify food is to carry out the tape jali fermentation process. Fermentation is performed to increase the nutritional value of food and make it easier for the body to digest (Apriyanto, 2021). The hydrolysis process in tape fermentation produces oligosaccharides, reducing sugars, dextrans, and resistant starch, which cannot be digested; thus, it has the potential to be a good prebiotic for diabetes mellitus sufferers (Apriyanto, 2021).

Based on the results of research conducted by Nasution et al. (2021), it is known that there is a real influence between the length of fermentation time and the pH, level of sweetness, and aroma of sorghum with fermentation times of 48, 72, and 96 h. Similar research conducted by Ardiansyah et al. (2022) showed that the concentration of yeast and the length of fermentation time had a significant influence on the aroma, taste, and texture of

purple sweet potato tape with fermentation times of 48, 72, and 96 h.

The tape used in this study used jali seed as a substrate and tape yeast was added at a concentration of 1%. The length of the fermentation time refers to the research conducted by Nasution et al. (2021) and Ardiansyah et al. (2022), namely 48 h, 72 h, and 96 h.

Based on this study, we aimed to determine the effect of fermentation time on food fiber content, total sugar content, and organoleptic quality of tape jali (*Coix lacryma-jobi L*) for patients with diabetes mellitus.

Methods

This type of research is quantitative, with an experimental research design using a Completely Randomized Design (CRD). Compared with other experimental designs, a Completely Randomized Design is the simplest experimental design (Rahmawati & Erina, 2020). This design had one control factor with three treatments carried out in five repetitions. This design is based on the influence of a long fermentation time on tape jali. The research design was as follows (Nasution et al., 2021):

1. Control : Jali Seeds
2. Treatment 1: Fermentation of tape jali for 48 hours
3. Treatment 2: Fermentation of tape jali for 72 hours
4. Treatment 3: 96 hour fermentation of tape jali

The CRD formula for calculating the number of replications in a sample is as follows:

$$t(n-1) \geq 15$$

$$4(n-1) \geq 15$$

$$4n-4 \geq 15$$

$$4n \geq 15+4$$

$$4n \geq 19$$

$$n \geq 4,75 (5)$$

Information:

T : Lost of treatment

n : Lost of repetition

Table 1. Jali Tape research desain

Repetition	Sample TJ1	Sample TJ2	Sample TJ3
1	TJ1U1	TJ2U1	TJ3U1
2	TJ1U2	TJ2U2	TJ3U2
3	TJ1U3	TJ2U3	TJ3U3

4	TJ1U4	TJ2U4	TJ3U4
5	TJ1U5	TJ2U5	TJ3U5

Information:

TJ1 : Sample 48 Jam

TJ2 : Sample 72 Jam

TJ3 : Sample 96 Jam

Research Location and Time

Organoleptic tests were carried out in May 2023, whereas tests for food fiber content and total sugar content were carried out at the PT Saraswanti Indo Genetech laboratory in July 2023 (number SIG. MARK. R. VI.2023.000860).

Large Sample

The organoleptic test was carried out by 30 semi-trained panelists, namely nutrition students from the Faculty of Medicine and Health, Muhammadiyah University, Jakarta, who met requirements such as being in good health in terms of taste, smell, and sight, as well as not being color blind and not hungry or full.

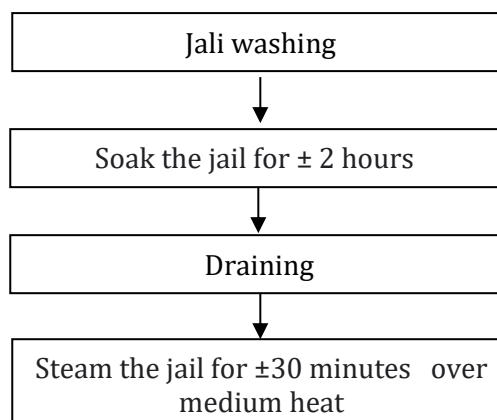
Materials and Tools

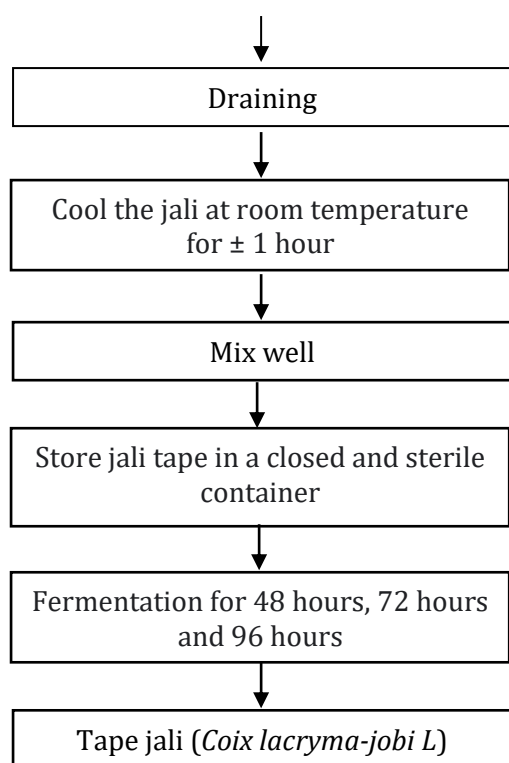
The ingredients used in making jali tape (*Coix lacryma-jobi L*) were 100 g of jali seeds and a tape yeast concentration of 1% or 1 g.

The tools used to make jali tape (*Coix lacryma-jobi L*) are food scales, small bowls, wide-baking pans, closed containers, spoons, measuring jugs, stoves, steamers, and cempals. In the organoleptic test, the tools used were hedonic quality test forms and hedonic tests, stationery, label paper, trays, disposable containers, and spoons. Fermentation for 48, 72, and 96 h

Preparation and Processing Process

The preparation and processing of the jali tape are illustrated in Figure 1.





Picture 1. Flowchart of the Jali Tape preparation and processing process

Sampling Method

In the organoleptic test, data were collected using a questionnaire related to organoleptic quality and the panelists' hedonic (likeability) tests. After performing the organoleptic quality test, the next test was performed on the jali tape product (*Coix lacryma-jobi L*) based on the attributes of color, aroma, sour taste, sweet taste, and texture, with a rating scale of 1 to 5. The color of jali tape (*Coix lacryma-jobi L*) has a rating scale, namely, one color is very yellow, two colors are yellow, three colors are slightly yellow, four colors are off-white, and five colors are white. The aroma of jali tape (*Coix lacryma-jobi L*) has a rating scale, namely 1 very strong aroma, 2 strong aroma, 3 rather strong aroma, 4 weak aroma, and 5 very weak aroma. The sour taste of tape jali (*Coix lacryma-jobi L*) has a rating scale, namely 1 very strong sour taste, two strong sour tastes, three slightly strong sour tastes, four weak sour tastes, and five very weak

sour tastes. The sweet taste of tape jali (*Coix lacryma-jobi L*) has a rating scale, namely 1 taste is not very sweet, 2 taste is not sweet, 3 taste is slightly sweet, 4 taste is sweet, and 5 taste is very sweet. The texture of jali tape (*Coix lacryma-jobi L*) has a rating scale, namely 1 texture is very not soft, 2 texture is not soft, 3 texture is slightly soft, 4 texture is soft, and 5 texture is very soft. Meanwhile, the hedonic (liking) test for the jali tape product (*Coix lacryma-jobi L*) based on the attributes of color, aroma, sour taste, sweet taste, and texture has a rating scale of 1 to 5, namely 1 really dislikes, 2 does not like, 3 is normal, 4 like, and 5 really like.

Testing for food fiber content was performed using the Enzymatic-Gravimetric method, which refers to AOAC 1995, and testing for total sugar content was performed according to SNI 01-2892-1992 using the Luff School method.

The data were analyzed by carrying out a normality test first with the Shapiro-Wilk test because there were less than 50 respondents. The results of the normality test were ($p < 0.05$), so the data were not normally distributed, so the Kruskal Wallis test and the Mann-Whitney follow-up test were carried out to determine the differences in each treatment if the Kruskal-Wallis test results were significant ($p < 0.05$). This research received ethical approval from KEPK FKK UMJ (No. 40/PE/KE/FKK-UMJ/IV/2023). The limitation of this study is that the control and total sugar levels were tested for food fiber content, and the three samples were only tested with one replication because of limited financial resources.

Result and Discussion

An organoleptic test is carried out by panelists or consumers to assess the liking (hedonic) and hedonic quality of a food product. The organoleptic test parameters used in this study were color, aroma, sour taste, sweet taste, texture, and overall preference.

Table 2. Results of hedonic quality test and jali tape hedonic test

Criteria	J	TJ1	TJ2	TJ3	<i>p-value</i>
Color					
Hedonik Quality Test	3,70	3,60	3,50	3,40	0,455
Hedonik Test	3,13	3,20	3,47	3,50	0,095
Flavor					

Hedonik Quality Test	4,50	2,80	2,37	2,10	0,000*
Hedonik Test	2,67	3,03	3,30	3,77	0,000*
Sour Taste					
Hedonik Quality Test	4,93	3,67	3,57	3,20	0,000*
Hedonik Test	2,73	3,53	3,07	2,73	0,000*
Sweetness					
Hedonik Quality Test	1,37	3,20	2,67	2,63	0,000*
Hedonik Test	2,53	3,67	3,37	2,83	0,000*
Texture					
Hedonik Quality Test	2,03	3,13	3,53	4,17	0,000*
Hedonik Test	2,37	2,83	3,27	3,67	0,000*
Overall Favorite					
Hedonik Test	2,50	2,90	3,30	3,87	0,000*

*Significantly different from the p -value $<0,05$ based on the Kruskal Wallis test

Table 3. Mann-whitney advanced test results on jali tape likes

Difference	Flavor	Sour Taste	Sweetness	Texture	Overall Favorite
J dan TJ1	0,069	0,000*	0,000*	0,045*	0,061
J dan TJ2	0,003*	0,102	0,000*	0,000*	0,000*
J dan TJ3	0,000*	0,823	0,144	0,000*	0,000*
TJ1 dan TJ2	0,216	0,017*	0,182	0,056	0,068
TJ1 dan TJ3	0,003*	0,001*	0,001*	0,001*	0,000*
TJ2 dan TJ3	0,052	0,099	0,015*	0,055	0,003*

*Significant difference with p -value $<0,05$ based on Mann Whitney's further test

Based on Table 3, it can be seen that the results of the hedonic quality test on the color of jali tape (*Coix lacryma-jobi* L) show that sample code J (control) has the highest average value, namely 3,70 (slightly yellow color) and sample code TJ3 (96 h fermentation) has the lowest average value, namely 3,40 (slightly yellow color), while the hedonic test (liking) in sample code TJ3 (96 h fermentation) has the highest color preference level, namely 3,50 (normal) and the lowest preference in sample code J (control) with an average value of 3,13 (usual). Hidayah et al. (2021) stated that the color of the tape depends on the raw materials used. White jali seeds were used as raw material in this study. In the process of making jali tape, the jali seeds were first soaked and steamed. This causes the volume of the jali seeds to increase because they absorb water, so the color of the jali seeds becomes slightly yellow. The color of the jali tape also did not show a significant difference in each sample, because the yeast concentration used was the same (1 %).

The tape aroma that appears during the fermentation process is the result of the hydrolysis of simple sugars (glucose), oxidation of alcohol, and volatile compounds. A study by Nasution et al. (2021) stated that increasing the fermentation time increases the aroma of the tape sharper because the alcohol content and

acidity level increase. According to Anisa (2017), the tape contains ethyl acetate, which gives it a strong distinctive aroma. This is in line with this research, where sample code TJ3 (96 h fermentation) has a stronger aroma compared to sample code TJ2 (72 h fermentation), and sample code TJ2 has a stronger aroma compared to sample code TJ1 (48 h fermentation). Sample code J (control) had an average value of 4,93 with a weak sour taste category because the control did not ferment or add tape yeast. However, in this study, it was found that the stronger the aroma of jali tape (*Coix lacryma-jobi* L), the higher the panelists' level of liking because this is a characteristic of tape with a strong alcoholic aroma.

The results of the hedonic quality test on the sour taste of tape jali (*Coix lacryma-jobi* L) show that sample code J (control) has the highest average value, namely 4,93 (weak sour taste) and sample code TJ3 (96 hour fermentation) has the highest value. the lowest is 3,20 (slightly strong sour taste), while the hedonic test (liking) in sample code TJ1 (48 h fermentation) had the highest level of liking for sour taste, namely 3,53 (usual), and the lowest level of liking in sample code J (control) and TJ3 (96 h fermentation), with an average value of 2,73 (dislike). The sour taste of tape is the result of breaking down starch into alcohol, acid, and

CO₂ (Anisa 2017). Research by Fauziah et al. (2020) stated that the longer the fermentation time, the more sour the taste of the tape because the alcohol content is higher. This is in line with this research, where sample code TJ3 (96 h fermentation) has a slightly stronger level of sour taste compared to the other two samples, namely TJ1 and TJ2, and is the sample with the lowest level of liking along with sample code J (control), while the TJ1 sample (48 h fermentation) was the sample with the highest level of liking; thus, in this study, it was found that the more sour the taste of the tape, the more the panelists' liking level decreased. The sour taste is also influenced by the pH value of tape jali (*Coix lacryma-jobi* L) because the pH decreases as the fermentation time increases. A low pH value indicates high acidity of the tape.

The results of the hedonic quality test on the sweet taste of tape jali (*Coix lacryma-jobi* L) showed that sample code TJ1 (48 h fermentation) had the highest average value, namely 3,20 (slightly sweet taste), and sample code J (control) had the lowest average value. the lowest average is 1,37 (very not sweet taste), while the hedonic test (liking) in sample code TJ1 (48 hour fermentation) has the highest level of liking for sweet taste, namely 3,67 (normal) and the lowest level of liking for code sample J (control) with an average value of 2,53 (dislike). According to Nasution et al. (2021), the length of fermentation time will affect the level of sweetness of the tape because the ability of the bacteria in the yeast to break down simple sugars into organic acids will increase, decreasing the sweet taste of the tape. In line with this research, the sample code J (control) had a sweet taste quality in the very not sweet category because this sample did not contain the addition of yeast and no fermentation process was carried out. The taste of tape jali (*Coix lacryma-jobi* L) with a fermentation time of 96 h and fermentation for 72 h is no longer sweet, so only sample code TJ1 (fermentation 48 h) still has a slightly sweet taste. This is why the panelists prefer sample code TJ1 (48 h fermentation) to the other samples.

The results of the hedonic quality test on the texture of jali tape (*Coix lacryma-jobi* L) show that

sample code TJ3 (96 hour fermentation) has the highest value, namely 4,17 (soft texture) and sample code J (control) has the lowest average value, namely 2,03 (not soft texture), while the hedonic test (liking) on sample code TJ3 (96 hour fermentation) had the highest level of texture liking, namely 3,67 (ordinary) and the lowest level of liking on sample code J (control) with a value the average is 2,37 (dislike). According to Velayati et al. (2021), the amount of organic acids, alcohol, and CO₂ increases as the fermentation time increases, and these compounds are liquid and gaseous so that the texture of the tape becomes softer. In line with this research, the texture of the sample with a fermentation time of 96 h was soft compared to the fermentation times of 48 h and 72 h, which had a slightly soft texture. This caused sample code TJ3 (96 h fermentation) to have the highest level of texture preference compared to the other samples. The sample with the lowest level of liking was sample code J (control) because the texture was not soft and sample code TJ1 (48 h fermentation). The resulting texture can also be influenced by the length of time that the jali seeds are soaked and steamed. The longer the soaking and steaming times for the jali seeds, the softer the texture of the jali tape.

The results of the hedonic (liking) test on the overall liking level of jali tape (*Coix lacryma-jobi* L) show that the sample code TJ3 (96 h fermentation) has the highest average value, namely 3,87 (ordinary) because it has the highest liking value for the parameters color, aroma, and texture compared to other samples. Sample code J (control) had the lowest average value, namely 2.50 (dislike). The results of the organoleptic quality test on jali tape (*Coix lacryma-jobi* L) showed that the panelists liked the jali tape, which was slightly yellow in color, had a strong aroma, a slightly strong sour taste, a sweet tape taste, and a soft texture.

Based on the fermentation results of tape jali (*Coix lacryma-jobi* L) for 48 hours (TJ1), 72 hours (TJ2), and 96 hours (TJ3), it is known the results of the analysis of food fiber content and total sugar content with the weight of each sample being 100 grams can be seen in Table 4.

Table 4. Results of analysis of food fiber content and total sugar content of Jali Tape

Sample code	Parameter (%)					
	Dietary Fiber			Total sugar		
	Simplo	Duplo	Average	Simplo	Duplo	Average
J	11,25	11,50	11,38	14,49	14,31	14,4
TJ1	4,14	4,02	4,08	22,78	23,49	23,14
TJ2	5,62	5,82	5,72	19,79	18,41	19,1

TJ3	5,35	5,27	5,31	21,79	22,67	22,23
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Based on Table 4, the results of the analysis of dietary fiber content in tape jali (*Coix lacryma-jobi* L) are sample code J (control) 11,38% for sample code TJ1 (48 h fermentation) 4,08% for sample code TJ2 (fermentation 72 hours) 5,72%, and 5,31% for sample code TJ3 (96 h fermentation); therefore, it is known that tape jali (*Coix lacryma-jobi* L) does not meet the recommended nutritional adequacy figures. Tape jali (*Coix lacryma-jobi* L) can be used as an alternative snack food because it contains dietary fiber, which is beneficial for DM sufferers. However, this jali tape should not be consumed too often and should not be used as an appetizer because yeast that contains carbon dioxide gas can cause the stomach to feel bloated or full, so it is feared that it could interfere with the main meal intake.

The results of the analysis of total sugar content in tape jali (*Coix lacryma-jobi* L) were sample code J (control) 14,4%, sample code TJ1 (48 hour fermentation) 23,14%, sample code TJ2 (72 hour fermentation) 19, 1%, and sample code TJ3 (96 hour fermentation) 22,23% so it is known that tape jali (*Coix lacryma-jobi* L) has a low total sugar content and is good for consumption for diabetes mellitus sufferers. However, when consuming tape jali, it is best to consume it in sufficient amounts because the recommended sugar consumption for Indonesians in a day is 4 tablespoons or 50 grams, starting from the main meal to snacks or snacks.

The weakness of the raw material used is that jali seeds are still difficult to find in the market. The limitation of this research is that the test for dietary fiber content and total sugar content in the control and the three samples was only tested with one replication owing to limited financial resources.

Conclusion

There were differences in the quality of aroma, sour taste, sweet taste, and texture, but no differences were observed in the color quality of the jali tape (*Coix lacryma-jobi* L) in each sample. The results of the hedonic test (liking) of the four samples showed that the one most liked by the panelists based on the overall liking level was sample code TJ2 (72

hour fermentation). The highest food fiber content was in sample code TJ2 (72 h fermentation), and the lowest total sugar content analysis results were in sample code TJ2 (72 h fermentation).

Both healthy people and patients with diabetes mellitus are advised to consume jali tape as a snack or distraction to prevent or control blood sugar levels to reduce PTM problems, but still consume it in reasonable amounts because it contains yeast, which can cause the stomach to feel bloated.

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References

- Anisa, F. (2017). Mutu kimia dan organoleptik tape hasil fermentasi umbi talas kimpul (*xanthosoma sagittifolium*) dengan berbagai konsentrasi ragi. *Jurnal Aplikasi Teknologi Pangan*, 6(1), 43-47. <https://doi.org/10.17728/jatp.207>
- Apriyanto, M. (2021). *Pangan berbasis fermentasi*.
- Ardiansyah, A., Kalsum, U., & Nasirudin, M. (2022). Pengaruh lama fermentasi dan konsentrasi ragi terhadap mutu tape ubi jalar ungu (*ipomoea batatas* l.) varietas ayamurasaki. *Exact Papers in Compilation (EPiC)*, 4(1), 525-528. <https://doi.org/10.32764/EPiC.V4I1.699>
- Denggos, Y. (2023). Penyakit diabetes mellitus umur 40-60 tahun di Desa Bara Batu Kecamatan Pangkep. *HealthCaring: Jurnal Ilmiah Kesehatan*, 99(99), 55-61. <https://doi.org/10.47709/healthcaring.v2i1.2177>
- Fauziah, K, K., & A, N. (2020). Pengaruh pemberian dosis ragi tape (kapang amilolitik) terhadap pembuatan tape

- pisang kepok. *Jurnal Pangan Dan Gizi*, 10(1), 11–17. <https://doi.org/10.26714/jpg.10.1.2020.11-17>
- Harna, H., Efriyanurika, L., Novianti, A., Sa'pang, M., & Irawan, A. M. A. (2022). Status gizi, asupan zat gizi makro dan kaitannya dengan kadar hba1c pada pasien diabetes melitus tipe 2. *Poltekita: Jurnal Ilmu Kesehatan*, 15(4), 365–372. <https://doi.org/10.33860/jik.v15i4.806>
- Hidayah, N., & Basirun, B. (2021). Pengaruh jenis kemasan terhadap sifat organoleptik tape singkong. *Nutriology: Jurnal Pangan, Gizi, Kesehatan*, 2(1), 101–105. <https://doi.org/10.30812/nutriology.v2i1.1244>
- Histifarina, D., Rahadian, D., Ratna, P. N., & Liferdi. (2020). Hanjeli utilization as a functional food to support food sovereignty. *IOP Conference Series: Earth and Environmental Science*, 443(1). <https://doi.org/10.1088/1755-1315/443/1/012105>
- Juhaeti, T., Setyowati, N., & Gunawan, I. (2021). Pemanfaatan dan prospek sereal minor jali (*coix lacryma-jobi* l.) dalam pembuatan kuliner untuk pengembangan usaha industri rumah tangga. *VIVABIO: Jurnal Pengabdian Multidisiplin*, 3(2), 6. <https://doi.org/10.35799/vivabio.3.2.2021.34113>
- Kemenkes RI. (2018). RISKESDAS. *Kementerian Kesehatan RI*, 53(9), 1689–1699.
- Laily, W. N., Wati, D. A., Suci Ayu, R. N., & Pratiwi, A. R. (2022). Hubungan tingkat konsumsi bahan makanan sumber isoflavon dan serat dengan kadar hba1c pasien diabetes mellitus tipe ii di rumah sakit Dr. H. Bob Bazar Lampung Selatan. *Jurnal Kedokteran Dan Kesehatan: Publikasi Ilmiah Fakultas Kedokteran Universitas Sriwijaya*, 9(2), 153–160. <https://doi.org/10.32539/jkk.v9i2.17014>
- Lestari, Zulkarnain, & Sijid, S. A. (2021). Diabetes melitus: review etiologi, patofisiologi, gejala, penyebab, cara pemeriksaan, cara pengobatan dan cara pencegahan. *UIN Alauddin Makassar, November*, 237–241. <https://doi.org/10.24252/psb.v7i1.24229>
- Nasution, E., Setiawati, V. R., & 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. <https://jurnal.uts.ac.id/index.php/JTP/article/view/1165>
- Nurmala, T., Yuniarti, A., Firdawati, W., & Qosim, W. A. (2019). Pengaruh pupuk biosilika terhadap pertumbuhan, hasil, dan kekerasan biji tanaman hanjeli (*coix lacryma-jobi* l.) varietas batu dan pulut. *Jurnal Kultivasi*, 18(2), 919–923. <https://doi.org/10.24198/kultivasi.v18i2.22556>
- PERKENI. (2021). Pedoman pengelolaan dan pencegahan diabetes melitus tipe 2 dewasa di Indonesia 2021. *Global Initiative for Asthma*, 46. www.ginasthma.org.
- Qurnaini, N. R., Nasrullah, N., & Fauziyah, A. (2021). Pengaruh substitusi biji jali (*coix lacryma-jobi* l.) terhadap kadar lemak, serat, fenol, dan sifat organoleptik tempe. *Jurnal Pangan Dan Gizi*, 11(01), 30–41. <https://doi.org/10.26714/jpg.11.1.2021.30-41>
- Rahmawati, A. S., & Erina, R. (2020). Rancangan acak lengkap (ral) dengan uji anova dua jalur. *OPTIKA: Jurnal Pendidikan Fisika*, 4(1), 54–62. <https://doi.org/10.37478/optika.v4i1.333>
- Rohani, B. (2019). Oral manifestations in patients with diabetes mellitus. *World Journal of Diabetes*, 10(9), 485–489. <https://doi.org/10.4239/wjd.v10.i9.485>
- Velayati, J. M. (2021). Tetapi (tape talas pandan hijau): inovasi dan peningkatan kualitas pada tape talas dengan daun pandan. *Proceeding of Integrative Science Education Seminar*, 1(2015), 449–457. <https://prosiding.iainponorogo.ac.id/index.php/pisces/article/view/411>