

STUDY OF THE EFFECT OF MORINGA LEAF COMBINATION (*Moringa oleifera*) AND PANDAN LEAVES (*Pandanus amaryllifolius* Roxb) ON THE CHEMICAL AND ORGANOLEPTIC QUALITY OF KOMBUCHA TISANE

Cannia Angelica Sitepu^{1*}, Retnani Rahmiati², Yuyun Yuniati³

Faculty of Food and Fisheries Technology / Universitas Dr. Soetomo, Surabaya^{1,2,3}

E-mail: canniaangelica05@gmail.com¹, retnani.rahmiati@unitomo.ac.id²

Received : 01 December 2025

Published : 31 January 2026

Revised : 15 December 2025

Link Publish : <https://radjapublika.com/index.php/MORFAI/article/view/5077>

Accepted : 10 January 2026

Abstract

Moringa leaf kombucha is a functional beverage rich in nutrients and antioxidants and has various health benefits, including anti-inflammatory, antimicrobial, and anticancer properties. Kombucha from fragrant pandan leaves contains many chemical compounds including flavonoids, alkaloids, phenolics, polyphenols, and saponins and has the potential as antibacterial and antioxidant. Kombucha from moringa leaves has a strong and pungent taste and aroma, while kombucha from fragrant pandan leaves has a sour and sweet taste and aroma. This study aims to determine the effect of the combination of moringa leaves (*Moringa oleifera*) and pandan leaves (*Pandanus amaryllifolius* Roxb) on the chemical and organoleptic quality of kombucha drinks. This study used a laboratory experimental method. The experimental design used was a completely randomized design (CRD) with 1 factor, namely the different combinations of moringa leaves and pandan leaves, which consisted of 5 treatments, namely K1P1 (100:0), K2P2 (0:100), K3P3 (75:25), K4P4 (25:75), K5P5 (50:50), each repeated 3 times. The quality parameters observed included chemical (pH, total acid, and alcohol level) and organoleptic tests (color, aroma, and taste) which were assessed by 30 panelists. Data from the chemical quality research were analyzed using analysis of variance (ANOVA) and organoleptic data were tested using the nonparametric *Kruskal-Wallis method*. The results showed that the combination of moringa leaves and pandan leaves had a significant effect on chemical and organoleptic quality. Based on the effectiveness test, the best treatment was obtained in the K4P4 combination. (25:75) with chemical characteristics of pH 3.63, total acid 0.73%, and alcohol content 1.54%. Organoleptically, this treatment was preferred by panelists with a median score of 4 (like) for the color, taste, and aroma parameters.

Keywords: *moringa leaves, pandan leaves, fermentation, kombucha.*

INTRODUCTION

Kombucha is a fermented beverage resulting from a symbiotic relationship between bacteria and fungi that is functional and has various health benefits, including antioxidants, antibacterials, improving intestinal microflora, increasing immunity, and lowering blood pressure (Hananta *et al.*, 2025). Kombucha also plays a role in detoxification and improving liver function due to its glucuronic acid content which can neutralize toxic compounds in the body (Aditiwati, 2003). The raw material for kombucha can come from leaves rich in antioxidants (Verdayanti, 2009), not limited to black tea, but also herbal leaves in the form of functional teas or tisanes that are not derived from *Camellia sinensis* (Bennet *et al.*, 2016). Various studies have reported the use of herbal leaves as kombucha ingredients, including moringa leaves (Hikmah & Budiandari, 2018), a combination of ashitaba, cherry, and moringa leaves (Rosida *et al.*, 2021), pandan leaves (Irmayanti *et al.*, 2025), and fruit ingredients such as dragon fruit peel (Naufal *et al.*, 2022). Moringa leaves (*Moringa oleifera*) are known as a nutrient-rich herbal plant and have the potential to be more functional after being fermented into kombucha, with higher antioxidant activity than regular brewing (Velicanski, 2007). Moringa leaf kombucha contains vitamins A and C which act as antioxidants in protecting the body from free radicals (Krisnadi, 2015). *Pandanus amaryllifolius* Roxb leaves also have potential as a kombucha ingredient because they contain flavonoids, alkaloids, phenolics, polyphenols, and saponins that have antibacterial, antioxidant, anticancer, and anti-inflammatory properties (Suryani, 2017; Irmayanti *et al.*, 2025). The fermentation process of pandan leaf kombucha produces additional bioactive compounds that enhance the beverage's functional characteristics

(Pawestriningtyas, 2024). Organoleptically, moringa leaf kombucha has a bright color and a relatively mild taste, although some panelists disliked its aroma (Hikmah & Budiandari, 2018). Pandan leaf kombucha showed an increase in total acid and a decrease in pH after fermentation, which was caused by the formation of organic acids such as acetic acid (Irmayanti *et al.*, 2025; Guspratiwi *et al.*, 2025). This decrease in pH plays an important role in increasing the microbiological safety and health benefits of kombucha through the inhibition of pathogenic microorganisms and supporting digestive health (Cheepchirasuk *et al.*, 2025). Based on this, this study was conducted to examine the effect of different concentration treatments on kombucha combined with moringa leaves and pandan leaves, with the hope of producing a functional beverage that has good organoleptic characteristics and optimal health benefits.

LITERATURE REVIEW

Kombucha

Kombucha has been known for thousands of years and is thought to have originated in China around 2,000 years ago (Amarasinghe *et al.*, 2018). Since 221 BC, Chinese people have consumed kombucha as a health drink and called it *the tea of immortality* because it was believed to prolong life (Naland, 2008). Kombucha is the result of the fermentation of sweet tea by a symbiotic combination of acetic acid bacteria and yeast, such as *Acetobacter*, *Saccharomyces*, *Schizosaccharomyces*, *Pichia*, and *Torula*. During fermentation, these microorganisms convert sucrose into organic acids, amino acids, antibiotics, and various micronutrients (Mayser *et al.*, 2023). Kombucha is considered a functional food, meaning it provides additional physiological benefits beyond basic nutrition due to its content of bioactive compounds in micro to milligram amounts (Riezzo *et al.*, 2005). These bioactive compounds include carotenoids, polyphenols, and flavonoids (Jayabalan *et al.*, 2014). According to the FDA, kombucha is considered safe for consumption because it has passed pathogen testing and clinical trials (Ayu, 2020). Various biological benefits of kombucha include antioxidant, antimicrobial, antidiabetic, anticancer, and anti-inflammatory activities (Kaewkod, 2019; Ayu, 2020; Khaerah, 2019; Jayabalan, 2014; Gaggia, 2019; Yanti, 2020; Aloulou, 2012; Zubaidah, 2019; Villarreal-Soto, 2019; Watawana, 2015; Priyono, 2021).

Kombucha Quality Standards

Kombucha quality standards are necessary to ensure product safety and consistency. The main parameters used include ethanol content, titration acidity, and pH (Sepulveda, 2023). The ethanol content for non-alcoholic kombucha is in the range of 0.2–2.0%, the maximum titration acidity is 2.8%, and the maximum pH is 3.8, but must be below 4.6 to ensure food safety.

a. Alcohol Content

Ethanol is formed during fermentation by the yeast *Saccharomyces cerevisiae*, which converts sugar into alcohol anaerobically (Pratiwi, 2012). The alcohol content of kombucha varies depending on fermentation conditions, with a range that still meets non-alcoholic standards according to several previous studies (Herwin, 2013; Simanjuntak, 2016; Jakubczyk, 2020; Kapp, 2019; Sepulveda, 2023; Priyono, 2021).

b. Titration Acidity

Acidity titration is a volumetric analysis method for determining the amount of organic acids in kombucha. This process involves using a standard solution until the equivalence point is reached, indicated by a color change in the indicator (Keenan *et al.*, 2000). The success of the titration is influenced by the accuracy of the titrant concentration, the determination of the endpoint, and the accuracy of the volume measurement (Sastrohamidjojo, 2005).

c. Potential of Hydrogen

The decrease in kombucha pH occurs due to the conversion of sucrose into organic acids such as acetic acid and gluconic acid during fermentation by bacteria and yeast (Screeramulu, 2000). The longer the fermentation, the higher the concentration of acid formed, so the kombucha pH decreases (Afifah, 2010; Simanjuntak, 2016; Goh, 2012).

Kombucha Making Process

The process of making kombucha includes brewing herbal leaves with hot water up to $\pm 100^{\circ}\text{C}$ adding sugar, cooling to room temperature for 5-8 minutes, inoculating kombucha starter and SCOBY, and fermenting for ± 10 days (Rosida *et al.*, 2021).

Moringa Leaves

Moringa oleifera leaves are a tropical plant from the *Moringaceae* family that is rich in nutrients and antioxidants (Chase *et al.*, 1996). Moringa leaves contain vitamins A, C, E, minerals, protein, essential amino acids, and phenolic compounds that have the potential as functional foods (AVRDC, 2006; Berkovich *et al.*, 2013; Sreelatha, 2009; Simbolon, 2008; Anwar *et al.*, 2007; Berawi *et al.*, 2019). Moringa leaves are widely used as herbal tea and as a base ingredient for kombucha to increase the beverage's functional value.

Pandan leaves

Pandanus amaryllifolius Roxb is a monocotyledonous plant from the *Pandanaceae* family that is used as a dye, flavoring, and traditional medicine (Margaretta *et al.*, 2011). The distinctive aroma of pandan comes from the compound 2-acetyl-1-pyrroline (Faras, 2014). The flavonoids, alkaloids, saponins, tannins, and polyphenols contribute to its antibacterial and antioxidant activity (Andriani, 2008; Suryani, 2017; Nurul, 2023).

Organoleptic Test

Organoleptic testing is a method for assessing the quality of food products based on human sensory perception of taste, aroma, and color. Assessments are conducted using a hedonic scale of 1–5 by panelists to determine consumer acceptance of kombucha products (Mehran, 2015). This test aims to assess preferences, quality control, product development, and shelf life determination (Nurjaya, 2023). Panelists are classified into expert, trained, and untrained panelists based on their sensitivity levels (Betty, 2008).

Effectiveness Test

Effectiveness testing is used to assess the success of a treatment in achieving research objectives. Effectiveness indicates the level of achievement of results compared to predetermined plans and is expressed through an index calculation based on the treatment value, the highest value, and the lowest value (Sigit, 2020).

RESEARCH METHODS

The research was conducted from October to December 2025. Chemical quality tests were conducted at the laboratory of Turnojoyo University, Madura, while organoleptic tests were conducted at the Tristar Institute, Surabaya. The main ingredients used were dried moringa leaves and dried pandan leaves, obtained through online stores. Supporting ingredients included sugar, a scoby with a diameter of ± 8 cm, and a kombucha starter. The tools used included scales, glass jars, spatulas, funnels, sieves, measuring cups, measuring spoons, and laboratory equipment such as electrode glasses, pH meters, magnetic stirrers, volumetric flasks, pipettes, burettes, pycnometers, and distillation flasks. The research method used was a quantitative laboratory experimental method. This experimental study aimed to validate the effect of the combination of moringa and pandan leaves on the chemical and organoleptic quality of kombucha. The experimental design used was a one-factor Completely Randomized Design (CRD) with five treatments, namely K1P1 (100% moringa leaves), K2P2 (100% pandan leaves), K3P3 (75% moringa: 25% pandan), K4P4 (25% moringa: 75% pandan), and K5P5 (50%: 50%). Based on the replication calculation formula from (Hanafiah, 2001) namely $(t-1)(r-1) \geq 15$, the ideal number of replications is 5 times, but in this study it was carried out 3 times so that 15 experimental units were obtained. The material mixing formulation consisted of 1000 ml of water for each treatment, 0–20 g of moringa leaves, 0–20 g of pandan leaves, 100 g of sugar, 100 ml of kombucha starter, and 8 cm of scoby according to the treatment combination (Rosida *et al.*, 2021).

The procedure for making kombucha refers to the report (Rosida *et al.*, 2021). It begins by boiling water to $\pm 100^\circ \text{C}$ then adding moringa and pandan leaves according to concentration, 100 g of sugar, and filtering the tea solution before inoculating it with 100 ml of kombucha starter and 8 g of scoby. The solution is then fermented for 3 days at room temperature in a glass jar, after which it is filtered and stored in a plastic bottle for organoleptic and chemical quality testing. The variables observed include total alcohol content using the specific gravity method (SNI 3774-2013), titration acidity level using titrimetric (SNI 06-2422-1991), pH using a pH meter (SNI 01-2891-1992), and organoleptic tests based on taste, color, aroma, and texture using 30 panelists on a scale of 1–5 (Mehran, 2015). The data obtained were analyzed parametrically using analysis of variance (ANSIRA) with the help of SPSS version 26. If there was a significant difference ($p < 0.05$) or very significant ($p < 0.01$), it was continued with further testing or post hoc using Duncan.

RESULTS AND DISCUSSION

1. Chemical Test

Alcohol Content

The results of the analysis of variance (ANOVA) showed that mixing kombucha tisane with moringa leaves and pandan leaves had a significant effect on alcohol content, with a significance value of 0.000 (<0.05). The average alcohol content for each treatment can be seen in Table 1.

Table 1. Average alcohol content of kombucha

Treatment Code	Average %
K1P1	1.37 a \pm 0.028
K2P2	1.32 a \pm 0.021
K3P3	1.35 a \pm 0.000
K4P4	1.54 b \pm 0.053
K5P5	1.57 b \pm 0.047

Note: The same letter notation behind the average number indicates no significant difference between treatments with BNJ test ($\alpha \geq 5\%$).

There was a significant difference between the kombucha tisane treatments with the addition of moringa leaves and pandan leaves, which could be caused by differences in the concentration of the raw materials. The significant difference in alcohol content between the treatments could be caused by the antibacterial compounds contained in moringa leaves. These results are in line with a report (Selmi *et al.*, 2025) stating that natural active compounds in moringa leaves, such as flavonoids, tannins, alkaloids, and saponins, can inhibit the action of antimicrobials such as enzymes, damage cell membranes, and disrupt bacterial DNA metabolism. These compounds can inhibit the growth and activity of fermenting microorganisms that play a role in alcohol formation through the conversion of sugar to ethanol. In addition, (Rahman *et al.*, 2021) and (Leone *et al.*, 2016) stated that moringa leaf extract effectively suppresses the growth of bacteria and yeast, thus affecting fermentation results, including alcohol formation. Therefore, the significant difference in alcohol content is likely caused by the influence of moringa leaf concentration, which acts as an inhibitor of the activity of fermenting microorganisms. Table 1 shows that the alcohol content of kombucha tisane made from a mixture of moringa and pandan leaves ranges from 1.37 to 1.57%. Based on this alcohol content, the research results meet the requirements for kombucha beverages, as explained by Sepulveda (2023) that the alcohol content in kombucha beverages is between 0.2 and 2.0%. This value is still within category A, which is a low-alcohol beverage (Minister of Trade Regulation No. 20/2014).

Titration Acid Level

The results of the analysis of variance (ANOVA) showed that the mixture of moringa leaf and pandan leaf kombucha tisane significantly affected the titratable acid content, with a significance value of 0.000 (<0.05). The average titratable acid content for each treatment can be seen in Table 2.

Table 2. Average results of kombucha titration acid content

Treatment Code	Average %
K1P1	0.64 b \pm 0.017
K2P2	0.55 c \pm 0.022
K3P3	0.60 b \pm 0.012
K4P4	0.73 a \pm 0.012
K5P5	0.50 c \pm 0.012

Note: The same letter notation behind the average number indicates no significant difference between treatments with BNJ test ($\alpha \geq 5\%$).

There was a significant difference between the kombucha tisane treatments with the addition of moringa leaves and pandan leaves. This significant difference may be due to the compounds contained in pandan leaves, which can support the optimal growth of acetic acid bacteria. This is in line with Irmayanti's (2025) report that fragrant pandan leaf kombucha contains flavonoids and phenolics that can influence the fermentation process. During fermentation, the activity of microorganisms produces various organic acids that play a role in increasing the acidity of the product, one of which is acetic acid.

Furthermore, although pandan leaves are known to possess antimicrobial activity, at certain concentrations and proportions, these compounds do not inhibit the growth of microorganisms, but instead contribute to creating more stable fermentation conditions (Simanjuntak 2016). Thus, the increase in titratable acid levels in moringa and pandan leaf kombucha tisane is influenced by the more dominant proportion of pandan leaves, which play a role in supporting the formation of organic acids during the fermentation process. Table 2 shows that the acetic acid content of kombucha tisane made from a mixture of moringa leaves and pandan leaves ranges from 0.50 to 0.73%. Based on this acetic acid content, the research results meet the requirements for kombucha beverages, as explained by Sepulveda (2023) that the titratable acid content in kombucha beverages is between 0.2 and 2.0%.

Potential of Hydrogen

The results of the analysis of variance (ANOVA) showed that mixing kombucha tisane with moringa leaves and pandan leaves significantly affected pH levels, with a significance value of 0.000 (<0.05). The average pH of kombucha for each treatment can be seen in Table 3.

Table 3. Average results of kombucha pH levels

Treatment Code	Average %
K1P1	4.17 ^a ± 0.022
K2P2	3.68 ^b ± 0.008
K3P3	3.78 ^b ± 0.008
K4P4	3.63 ^c ± 0.022
K5P5	3.80 ^c ± 0.009

Note: The same letter notation behind the average number indicates no significant difference between treatments with BNJ test ($\alpha \geq 5\%$).

There was a significant difference between the kombucha tisane treatment with the addition of moringa leaves and pandan leaves. This decrease in pH value corresponds to the results of the increase in acetic acid during the fermentation process. This significant difference may be caused by the content of compounds in pandan leaves, such as compounds that can support the activity of microorganisms, especially acetic acid bacteria that contribute to the decrease in kombucha pH. This is in line with the report (Jayabalan *et al.*, 2007), which states that during kombucha fermentation, organic acid levels increase along with changes in flavonoid and phenolic content that directly contribute to the decrease in kombucha pH. Table 3 shows that the pH level of kombucha mixed with moringa leaves and pandan leaves ranges from 3.63-4.17%. Based on this pH content, the results of the study meet the requirements for kombucha drinks, as explained by Sepulveda (2023) that the alcohol content in kombucha drinks is between 0.2-2.0%.

2. Organoleptic Test

Color

The results of organoleptic tests using the Kruskal-Wallis method showed that mixing moringa leaf and pandan leaf kombucha tisane significantly affected color, with a significance value of 0.000 (<0.05). The median color values of kombucha tisane for each treatment are presented in Table 4.

Table 4. Results of organoleptic color test

Treatment	Color Median
K1P1 (100% : 0%)	3b
K2P2 (0% : 100%)	4a
K3P3 (75% : 25%)	4a
K4P4 (25% : 75%)	4a
K5P5 (50% : 50%)	4a

Note: The same letter notation behind the average number indicates no significant difference between treatments using the Mann-Whitney test

Table 4 shows a significant difference in the color of the kombucha tisane from each treatment, which was still preferred by the panelists. Attractive colors can influence panelists or consumers when tasting the product being tested, and the appearance of kombucha is also a factor in panelists' assessments (Rosyada, 2022). The deeper color of moringa leaf kombucha and the brighter color of pandan leaf kombucha can help balance the color of the kombucha tisane, making it more acceptable to the panelists. This is in line with a report by Putri et al. (2024) who stated that pandan leaf kombucha produces a clear color and is not too dark. In addition, Andi et al. (2024) stated that pigments are important compounds that give color to various parts of plants and have a significant role in the level of panelist preference. One of the plants that contain pigments with high potential is pandan leaves and moringa leaves. Thus, the pigments contained in pandan leaves and moringa leaves have the same color, namely green, so that panelists still liked each kombucha tisane treatment.

Flavor

The results of organoleptic tests using the Kruskal-Wallis method showed that mixing moringa leaf and pandan leaf kombucha tisane significantly affected taste, with a significance value of 0.000 (<0.05) (Appendix 7). The median taste value of kombucha tisane for each treatment is presented in Table 5.

Table 5. Organoleptic test results of race a

Treatment	Median Taste
K1P1 (100% : 0%)	3 ^b
K2P2 (0% : 100%)	4 ^a
K3P3 (75% : 25%)	4 ^a
K4P4 (25% : 75%)	4 ^a
K5P5 (50% : 50%)	4 ^a

Note: The same letter notation behind the average number indicates no significant difference between treatments using the Mann-Whitney test

Table 5 shows a significant difference in the taste of kombucha tisane from each treatment that was still liked and acceptable by the panelists. The K1P1 treatment of 100% moringa leaves showed a significant difference with a median of 3. This is due to the content of moringa leaves which have compounds that make the taste of moringa leaf kombucha have a bitter taste. In line with the report (Trigo *et al.*, 2023) stated that moringa leaves contain catechin, a phenol compound that has a bitter taste and causes a green color that is sometimes disliked by consumers. It can be concluded that the more moringa leaves used, the stronger the bitter taste will be produced, so the addition of fragrant pandan leaves can help kombucha be liked by panelists.

Aroma

The results of organoleptic tests using the Kruskal-Wallis method showed that mixing kombucha tisane with moringa leaves and pandan leaves significantly affected aroma, with a significance value of 0.000 (<0.05) (Appendix 7). The median aroma value of kombucha tisane for each treatment is presented in Table 6.

Table 6. Organoleptic aroma test results

Treatment	Median Texture
K1P1 (100% : 0%)	3 ^b
K2P2 (0% : 100%)	4 ^a
K3P3 (75% : 25%)	4 ^a
K4P4 (25% : 75%)	4 ^a
K5P5 (50% : 50%)	4 ^a

Note: The same letter notation behind the average number indicates no significant difference between treatments using the Mann-Whitney test

Table 6 shows a significant difference in the aroma of kombucha tisane from each treatment that was still liked and accepted by the panelists. The 100% moringa leaf treatment showed a significant difference, this is because the content of fragrant pandan leaves is usually used as a flavoring in cooking or drinks, so the dominant aroma of pandan leaves will help the kombucha tisane to be liked by the panelists. This is in line with reports (Nawawi 2015) and (Maisarah *et al.*, (2020) which state that the content of the main volatile compound called 2-acetyl-1-pyrroline (2AP) is a compound that makes the aroma of pandan strong and distinctive. In addition, the report of Irmayanti (2025) stated that the resulting fragrant pandan leaf kombucha has a distinctive aroma and sweet taste. Thus, the mixture of more dominant pandan leaves will produce a stronger aroma and can be liked by the panelists.

3. Determination of Best Treatment (Effectiveness Test)

Effectiveness testing was conducted to determine the best and most preferred treatment. The results of the effectiveness test for all chemical and organoleptic parameters (Appendix 8) showed that the best treatment was characterized by the highest yield (NH) value. The average NH value for all effectiveness test parameters is presented in Table 1.

Table 7. Effectiveness Test of Yield Value (NH) of Treatment

Parameter	Weight	K1P1	K2P2	K3P3	K4P4	K5P5
pH level	9	0.00	0.16	0.09	0.12	0.14
Acetic acid content	9	0.08	0.00	0.04	0.16	0.18
Alcohol content	9	0.03	0.00	0.02	0.14	0.05
Color	8	0.00	0.09	0.04	0.07	0.09
Flavor	7	0.00	0.04	0.00	0.07	0.03
Aroma	9	0.00	0.08	0.04	0.09	0.04
Total	51	0.11	0.37	0.24	0.66*	0.52

Description* = best treatment

Based on the determination of the effectiveness test on all research parameters, it can be seen in Table 4.8 that the mixing of kombucha tisane of moringa leaves and pandan leaves in the chemical test with K4P4 treatment showed the best treatment by producing a pH value = 0.14%, acetic acid content = 0.18%, alcohol content = 0.05%, color = 0.09%, taste = 0.03%, aroma = 0.04%.

CONCLUSION

Based on the results of research and data analysis of the combination of *Moringa oleifera* leaves (*Moringa oleifera*) and pandan leaves (*Pandanus amaryllifolius* Roxb) kombucha tisane, it can be concluded that there is a significant effect on the chemical and organoleptic quality of each kombucha tisane treatment. The alcohol content ranges from 1.32-1.57% and is still below the regulatory standards for low-alcohol beverages. The acetic acid content ranges from 0.50-0.73% and increases in the K4P4 treatment. The pH value ranges from 3.63-4.17% and decreases in the K4P4 treatment, it can be concluded that the increase in acetic acid levels and the decrease in pH indicate that the kombucha tisane fermentation process is going well. Organoleptic tests (color, taste, and aroma) using the Kruskal-wallis test, it can be concluded that the addition of pandan leaves is proven to be able to increase panelists' preferences because it improves the strong sensory characteristics of Moringa leaves.

Based on the effectiveness test using the De Garmo method, the best formulation was obtained in the K4P4 treatment with a combination of 25% Moringa leaves and 75% pandan leaves with the highest total yield value (NH) of 0.66 and had a pH value = 3.63%, total acetic acid = 0.73% and alcohol = 1.54%.

REFERENCES

- Aditiwati. 2003. Kultur campuran dan faktor lingkungan mikroorganisme yang berperan dalam fermentasi Tea-Cider. *ITB Sains*, 5(2):147-162.
- Aloulou, A, K. Hamden, D. Elloumi, M.B Ali, K. Hargafi, B.Jaouadi, F. Ayadi, A, Elfeki, E. Ammar. 2012. Hypoglycemic and antilipidemic properties of kombucha tea in alloxan-induced diabetic rats". *BMC Complementary and Alternative Medicine*, 12:63.
- Andi, N, Alimin, W. O. R. 2013. Analisis Kandungan Zat Besi (Fe) Pada Buah Kelor dan Daun Kelor (*Moringa Oleifera*) yang Tumbuh di Desa Matajang Kec. Dua Boccoe Kab. Bone. *Al-Kimia*, I (1), 10–17.
- Anwar, F, S. Latif, M. Ashraf, A.H. Gilani. 2007. *Moringa oleifera*: A food plant with multiple medicinal uses. *Phytotherapy Research*, 21: 17-25.
- AVRDC. 2006. *World vegetable center*. afrika: AIRCA. N0.03:564.
- Ayu. 2020. Karakteristik kimia dan fisik teh hijau kombucha pada waktu pemanasan yang berbeda. *Journal of Pharmacy and Science*, 15-20.
- Bahrudin, A. S. 2014. *Metode penelitian kuantitatif aplikasi dalam pendidikan*. Yogyakarta: deepublish.(1)174.
- Bennet, -R, S. Vijayalakshmi, R. Dinesh, R. Yuvaraj. 2016. Formulation and sensory evaluation of tisanes. *International Journal of Pharma and Bio Sciences*.7(4),115-120. <https://doi.org/10.22376/ijpbs.2016.7.4.b115-120>.
- Berkovich, L, E. Gideon, R. Iilan, R. Adam, V. Akiva, L L. Shahrar. 2013. *Moringa oleifera Aqueous Leaf Extract Down-Regulates Nuclear Factor-KappaB and Increases*. 13(1):2-12.
- Betty, 2008. Bahan Ajar Penilaian Indera. Sumedang: Jurusan Teknologi Pangan Fakultas Teknologi Industri Pertanian Universitas Padjadjaran.110
- Chase, R Kesseli dan K.S. Bawa. 1996. Microsatellite markers for population and conservation genetics of tropical trees. *Am J Bot*, 83:51-57
- Cheepchirasuk, N, K. Thida, S. Sureeporn, I. Varachaya, T. Yingmanee. 2025. Functional metabolites and inhibitory efficacy of kombucha beverage on pathogenic bacteria, free radicals and inflammation. *Scientific reports* <https://doi.org/10.1038/s41598-025-03545.1-19>.
- Faras, 2014. Effect of leaf extract of *pandanus amaryllifolius* roxb on growth of escherichia coli and micrococcus (Staphylococcus). *International Food Research Journal* . 21(1): 421-423.
- Goh. 2012. Fermentation of black tea broth (Kombucha): effects of sucrose concentration and fermentation time on the yield of microbial cellulose. *International Food Research Journal*, 109-117.
- Guspratiwi, R, Agustina, T. Tiyas, H. Demas. 2025. Pengaruh lama fermentasi terhadap profil sensori, ph, dan aktivitas antioksidan kombucha teh daun kelor (moringa oleifera). *J. Sains dan Teknologi Pangan (JSTP)*.10(2)8331-8339.
- Hananta, L,S,V Kurniawan, Z.Lonah, E.Arieselia, J.Surjono,Setiawan, A. Adhitya, Dewi Puspa, J.Prayoga, R.Vallerie, D.Rita. 2025. Antioxidant, Antimicrobial ,Anti-Inflammatory, and Gut Microbiota Modulation Effects of Kombucha :a Literature Review. *UrbanHealth Research*, 3(2):1-9. doi: 10.25170/juhr.v3i2.6445
- Herwin. 2013. Analisis kadar alkohol produk kombucha daun permot (passiflora foetida l.). *As-Syifaa*, 112-118.
- Hikmah, A dan R.U. Budiandari. 2025. Karakterisasi dan evaluasi sensori kombucha daun kelor (*Moringa Oleifera* L.) optimal. Universitas Muhammadiyah Sidoarjo: 1–8.
- Irmayanti, N.A Yanti, Sahidin. 2025. Profil senyawa kimia dan aktivitas antibakteri kombucha daun pandan wangi (*Pandanus amaryllifolius* Roxb) . *BioWallacea:Jurnal Penelitian Biologi (Journal of Biological Research)*, 12(1): 9-21.
- Jakubczyk, K, J.Kałuńska, J.Kochman, & Janda, K. 2020. Chemical profile and antioxidant activity of the kombucha beverage derived from white, green, black and red tea. *Antioxidants*, 9: 447.
- Jayabalan, C.K Tchekessi, Célestin, M.J Houssou, Bérénice, Koudoro Yaya, Yete Pélagie, S. Kouglblenou, G. Gandehe, Justin, Sachi Pivot, S.B Banon, Jultesse, D.C.Agbangnan. Pascal, Y. Bokossa. Innocent, M. 2014. A review on Kombucha tea-microbiology, composition,fermentation, beneficial effects, toxicity, and tea fungus. *Comprehensive Reviews in Food*. (13) 4.538-550.

STUDY OF THE EFFECT OF MORINGA LEAF COMBINATION (*Moringa oleifera*) AND PANDAN LEAVES (*Pandanus amaryllifolius* Roxb) ON THE CHEMICAL AND ORGANOLEPTIC QUALITY OF KOMBUCHA TISANE
Cannia Angelica Sitepu et al

- Jayabalan, R., Marimuthu, S., & Swaminathan, K. 2007. Changes in content of organic acids and tea polyphenols during kombucha tea fermentation. *Food Chemistry*, 102(1), 392–398.
- Kaewkod, T, Sakunne, Yingmanee. 2019. Microorganisms efficacy of kombucha obtained from green, olong, and black teas on inhibition of pathogenic bacteria, antioxidation, and toxicity on colorectal cancer cell line. *Microorganisms*,(12)7:700.
- Kapp, M,Julie & Walton 2019. a Systematic review of the empirical evidence of human health benefit. *Annals of Epidemiology*, (3)2 66-70.
- Khaerah, A, dan F. Akbar. 2019. Aktivitas antioksidan teh kombucha dari beberapa varian teh yang berbeda. *Seminar Nasional LP2M UNM*, 472-476.
- Krisnadi. 2015. Kelor Super Nutrisi. Blora: Pusat informasi dan pengembangan. 60.
- Maisarah, A. M., Asmah, R., & Fauziah, O. 2020. Proximate analysis, antioxidant and antiproliferative activities of different parts of *Pandanus amaryllifolius*. *Journal of Meinong*, 2(1), 12-18.
- Margaretta, S,Handayani,S,D,Indraswati,N,Hindarso, H. 2011. Ekstraksi senyawa phenolic *Pandanus amaryllifolius* Roxb sebagai antioksidan. *Widya Teknik*. (10)1, 21-30.
- Mehran. 2015. *Tata laksana uji organoleptik nasi*. Banda Aceh: Balai Pengkajian Teknologi Pertanian Aceh:1-5.
- Naland, H. 2008. Kombucha: *The ajaib pencegah aneka penyakit*. Jakarta: Agromedia Pustaka: 22-25.
- Naufal, A, N. Harini, D. Putri. 2022. Karakteristik kimia dan sensori minuman instan kombucha dari kulit buah naga merah (*hylocereus polyrhizus*) berdasarkan konsentrasi gula dan lama fermentasi. *Jurnal Teknologi Pangan dan Ilmu Halal*, 5(2): 137-153.
- Nawawi, A., & Rahmat, A. 2015. Standardization of *Pandanus amaryllifolius* Roxb. leaves from three different locations in Malaysia. *Journal of Applied Pharmaceutical Science*, 5(5), 032-038.
- Nurjaya. 2023. *Buku ajar ilmu teknologi pangan*.Jurusan Gizi Poltekes Kemenkes Palu.33-35
- Pawestriningtyas, H. K.2024. Pengaruh lama fermentasi terhadap karakteristik kimia dan aktivitas. 108.
- Pratiwi, A. 2012. Pengaruh waktu fermentasi terhadap sifat fisik dan kimia pada pembuatan minuman kombucha dari rumput laut sargassum sp. *Maspari Journal*, 131-136.
- Priyono, D. R. 2021. Studi kritis minuman teh kombucha: manfaat bagi kesehatan,kadar alkohol dan sertifikasi halal. *IJMA : International Journal Mathla'ul Anwar of Halal Issues* , 2-10.
- Putri, M. K., Sari, E. J. M., & Fajri, M. A. (2024). Karakteristik Fisikokimia dan Organoleptik Kombucha Daun Pandan Wangi (*Pandanus amaryllifolius* Roxb). *Jurnal Teknologi Pangan dan Gizi*, 12(1), 45-55.
- Rahman, M. M., Sheikh, M. M. I., Sharmin, S. A., Islam, M. S., Rahman, M. A., Rahman, M. M., & Alam, M. F. 2021. Antibacterial activity of leaf juice and extracts of *Moringa oleifera* Lam. against some human pathogenic bacteria. *CMU Journal of Natural Sciences*,
- Riezzo, G, M. Chiloiro, F. Russo. 2005. Functional foods: salient features and clinical applications. *Current Drug Targets – Immune, Endocrine and Metabolic Disorders*, 5(3): 331-337
- Rosida, D. F, D.L. Sofiyah, A.Y.T Putra . 2021. Aktivitas antioksidan minuman serbuk kombucha dari daun ashitaba (*Angelica keiskei*), kersen (*Muntingia calabura*) dan kelor (*Moringa oleifera*). *Jurnal Teknologi Pangan*, 15(1): 81-97.
- Rosyada, A. 2022. Pengaruh Substitusi Tepung Daun Kelor terhadap Daya Terima dan Nilai Gizi Cookies. *Jurnal teknologi pangan*, 1(2): 1-10.
- Sastrohamidjojo, H. 2005. *Kimia Analitik Kuantitatif*. Yogyakarta: Liberty.Vol 1.
- Screeramulu. 2000. Kombucha fermentation and it's antimicrobial activity . *journal of Agricultural food Chemistry*, 65-73.
- Sepulveda, K. (ed.). 2023. *Kombucha Brewers International Code of Practice*. Washington DC: Kombucha Brewers International.
- Suryani. 2017. . Aktivitas Antioksidan Ekstrak Etanol Daun Pandan (*Pandanus amaryllifolius*) dan Fraksi-Fraksinya. *Agritech*, 271-179.
- Velicanski. 2007. Antimicrobial and Antioxidant Activity of Lemon Balm Kombucha. 27.
- Zubaidah. 2019. Anti-diabetes activity of kombucha prepared from different snake fruit cultivars. *Nutrition and Food Science*, 49(3): 333-343.