Available online at
https://jurnal.uinsyahada.ac.id/index.php/Lavoisier/index
LAVOISIER: CHEMISTRY EDUCATION JOURNAL
Vol. 4 (2), 2025

Analysis Of Organoleptic Tests, Ph Tests, And Lactic Acid Levels In Saurkraut Fermentation From Cabbage (Brassica Oleracea) With The Addition Of Yellow Pears (Pyrus Nivalis) As An Antioxidant

Choirunnisa Ejaz Darvesh[1], Dinda Afrilianti[2], Fadilah Fauziah[3]

[1,2,3] Chemistry Education Study Program, Faculty of Tarbiyah and Teacher Training, State Islamic University of Sunan Gunung Djati Bandung, Jl. A.H. Nasution No. 105, Bandung 40614, Indonesia

*Correspondence: cedarvesh3464@gmail.com

Article History

Received 07 03rd 2025
Revised 10 29th 2025
Accepted 12 18th 2025
Available Online 12 31st 2025

Keywords:
Cabbage
Sauerkraut
Yellow pear
Fermentation
Organoleptic
Lactic acid
Antioxidant

Abstract

Cabbage (Brassica oleracea) is a vegetable that is rich in vitamins, fiber and minerals. Fermenting cabbage into sauerkraut is one solution to increase shelf life while producing functional food products. This research aims to analyze the characteristics of sauerkraut fermented from cabbage with the addition of yellow pears (Pyrus nivalis) as a source of natural antioxidants. The fermentation process is carried out naturally for five days with the addition of salt to support the growth of lactic acid bacteria (LAB). Evaluation of results is carried out through organoleptic tests (taste, aroma, texture), pH measurements to determine the acidity level, as well as analysis of lactic acid levels as an indicator of fermentation activity. The results showed that sauerkraut made from cabbage with the addition of yellow pear had good sensory characteristics, a pH value in the safe range for consumption, and lactic acid levels that were in accordance with fermented product standards. The addition of yellow pears is thought to contribute to the sensory quality and antioxidant compound content of the final product.

1. Introduction

Cabbage vegetables are widely grown in Indonesia and the amount of production is abundant. Cabbage vegetables that are not sold in traditional markets will be thrown away, therefore further handling of post-harvest cabbage is needed, one of which is by processing cabbage vegetables into sauerkraut

DOI : 10.24952/lavoisier.v4i2.16580

(pickled cabbage). Fermentation is one of the most ancient methods of preserving food and can maintain the nutritional value of food. Popular vegetable fermentation products today are kimchi (Korea), sauerkraut (Germany), pickles, pickles and salted vegetables. Sauerkraut (suerkhol) is a term from Germany known as "Sour cabbage", which is the result of lactic acid fermentation from cabbage slices with a length of about 20 cm and a width of 2 mm to 5 mm (Fevria, R. 2019).

Although it means sour cabbage, in its manufacture it only uses salt without the addition of a starter (inoculum) so it is often known as sauerkraut (Nakdiyani, R. 2019). In the fermentation process, salt plays a role in inhibiting the growth of decaying microbes and pathogens (Enwa F.O. 2014). Until recently, sauerkraut is still made based on instinct that can often lead to inferior or rotten sauerkraut. Fresh cabbage can be fermented into sauerkraut using salt with a certain concentration. The optimal salt concentration in fermented vegetables and fruits is between 2 - 3% where the appropriate salt concentration can stimulate the growth of BAL so that it can suppress unwanted bacterial growth (Anggraeni, L. 2021).

Yellow pear (Pyrus communis) is one of the fruits rich in bioactive compounds, especially natural antioxidants. The main antioxidant content in pears includes vitamin C, flavonoids such as quercetin and catechin, and phenolic acids such as chlorogenic acid (Butt & Sultan, 2011). These compounds play an important role in warding off free radicals that can cause cell damage, oxidative stress, as well as various degenerative diseases (Wu et al., 2004). In addition, antioxidants from pears also have a function in maintaining color, taste, and aroma stability during the fermentation process (Lee & Smith, 2003). In the context of fermented products such as sauerkraut, the presence of antioxidant compounds from yellow pears not only enriches the nutritional and functional value, but also has the potential to increase the shelf life of the product and maintain its sensory qualities. The addition of yellow pears to sauerkraut fermentation makes a potential bioactive contribution, so that it can increase the added value of the final product both in terms of health and taste.

This study aims to examine the characteristics of sauerkraut cabbage with the addition of yellow pears through organoleptic tests, pH measurements, and determination of lactic acid levels.

2. Materials and Methods

Tools and Materials

The main tools used include closed plastic fermentation containers, digital pH meters, burettes, statypes, clamps, erlenmeyers, measuring cups, volumetric pipettes, ball pipettes, measuring flasks, glass funnels, and other supporting tools. The main ingredients used in this study are white cabbage (Brassica

DOI : 10.24952/lavoisier.v4i2.16580

oleracea) and yellow pear (Pyrus nivalis). Pure table salt (NaCl), 0.1 N NaOH solution, phenolphthalein indicator, universal indicator and aquades are used in the fermentation process and laboratory analysis.

Research Procedure

Fresh cabbage vegetables that have been sorted from the damaged parts. Washing, then thinly sliced ± 2-3 mm (the bones, leaves and liver are not included) as much as 250 grams. Yellow pears are washed and cut lengthwise. Then mixed with 2% salt. The salting method used is dry salting, which uses salt in solid or crystalline form. The addition of salt is done by lubricating the cabbage and pear slices, then stirring until smooth. Put it in a clear plastic jar and press until solid. Tightly sealed so airtight and fermented for 5 days at room temperature. Furthermore, physical properties (organoleptic), chemical properties (pH, and lactic acid) are analyzed.

Data Analysis Organoleptic

The organoleptic test which includes color, aroma, taste, texture, and overall acceptance was carried out using a ranking test with 5 panelists.

pH

The pH value was measured with a Benchtop pH-meter (digital type) against sauerkraut storage water.

Lactic Acid

Calculated using: % Lactic Acid = $\frac{\text{ml NaOH} \times \text{N} \times 90}{\text{gram sample} \times 1000}$ 100%

Where: N = Normality of the NaOH solution used as a titer

3. Results and Discussions

Organoleptic Tests

The organoleptic test of sauerkraut uses a hedonic test that includes aroma, color, taste, texture and overall acceptance. Organoleptic tests were carried out on the 5th day of sauerkraut fermentation. The panelists used were 5 untrained panelists. The average comment that the panelists gave was that they liked the sour taste and texture of sauerkraut, and liked the color of sauerkraut, but somewhat disliked the pungent aroma of sauerkraut fermentation so the overall reception was somewhat liked.

DOI : 10.24952/lavoisier.v4i2.16580

a. Aroma

The aroma of sauerkraut produced is very strong, typical of fermented cabbage. This is due to volatile compounds formed during fermentation, especially sulfur compounds that naturally originate from cabbage. The addition of a very limited amount of pears (about 1/2 of a piece) is not enough to compensate for or mask the pungent aroma. Yellow pears do contain aromatic compounds such as esters and aldehydes that are fragrant and fresh, but the minimal amount causes the contribution of its aroma to the overall product to be very small.

b. Taste

In terms of taste, sauerkraut shows a very sour and savory taste. This shows that the fermentation process takes place optimally, characterized by the production of lactic acid by lactic acid bacteria (BAL). The dominant sour taste is also influenced by the lack of sugar content from pears, which should be able to become an additional substrate for bacteria and produce fermented products with a more balanced taste. Because the amount of pears used is small, the sweetness or flavor complexity expected from the addition of the fruit does not seem noticeable. So the sour taste is still dominant.

c. Color

Visually, the color of sauerkraut does not undergo a significant change, namely from the white color of cabbage to a little duller or yellowish due to the fermentation process.

d. Texture

The resulting sauerkraut texture is still quite crispy. In some parts, pears may taste softer.

pH Test

In this study, pH measurement was carried out using two methods, namely universal pH (indicator paper) and digital pH meter. The results of observations show that:

The universal pH shows a pH of about 4

Meanwhile, the pH meter shows a lower pH, which is 3.34

The pH measurement of fermented sauerkraut showed that there was a difference in yield between the two methods used, this difference can be explained by the level of accuracy and sensitivity of both methods. pH indicator paper is semi-quantitative and prone to color reading errors, so it only provides pH estimates within a specific range. In contrast, pH meters have electrode sensors that are able to measure the activity of H+ ions directly, so that the results are more precise and accurate (Ardiansyah et al., 2020).

DOI : 10.24952/lavoisier.v4i2.16580

The pH drop in sauerkraut occurs due to fermentation by lactic acid (BAL) bacteria, such as Lactobacillus plantarum and Lauconostoc mesenteroides, which convert sugar into lactic acid. The accumulation of these acids leads to a gradual decrease in pH during fermentation. A pH value of 3.34 measured with a pH meter shows that fermentation is going well and reaches safe conditions, a pH level below 4.0 can inhibit the growth of pathogenic microorganisms. According to Afifah et al. (2021), the ideal pH range for sauerkraut after fermentation ranges from 3.2 – 3.8 depending on the composition of the ingredients and fermentation conditions. These results are also in line with the international literature that states that ripe sauerkraut generally has a final pH between 3.3 – 3.6 (Paramithiotis et al., 2010).

Determination of Lactic Acid Bacteria Levels

Cabbage containing natural sugars and other nutritional components can be used as a substrate for the growth of lactic acid bacteria. The most important property of lactic acid bacteria is that it has the ability to ferment sugars into lactic acid. Lactic acid can inhibit the growth of unwanted microbes (disruptive microbes). Lactic acid fermentation can simulate parasites and fecal pathogenic microbes found in vegetables if human or animal feces are used as fertilizer (Koswara, 2013). Lactic acid growth will grow naturally depending on the pH value. Lactic acid bacteria are a group of bacterial species with the ability to form lactic acid from the results of carbohydrate metabolism and grow at low pH.

In this study, the lactic acid content produced from the sauerkraut fermentation process with the addition of yellow pears was 0.18%. This value is quite low when compared to the ideal lactic acid level in mature sauerkraut which is generally in the range of 0.6% to 1.5% depending on the duration of fermentation and the type of substrate used (Di Cagno et al., 2013).

Pears themselves, in addition to being a source of sugar, are also known as fruits that are rich in antioxidant compounds such as phenolics, flavonoids, and vitamin C. The addition of pears in fermentation not only aims to enhance taste, but also has the potential to increase the functional value of the product through the contribution of its antioxidant compounds. According to Nugraheni et al. (2020), local Indonesian pears have a total phenolic content of 102.55 mg GAE/100g, which shows quite high antioxidant activity. In this context, the presence of antioxidant compounds from pears can affect the dynamics of fermentation, both directly to microbes and to the stability of lactic acid compounds. Some studies have suggested that phenolic compounds have mild antimicrobial properties, which may indirectly limit the growth of large amounts of BALs, resulting in lower lactic acid production than fermentation without antioxidant-rich ingredients.

DOI : 10.24952/lavoisier.v4i2.16580

5. Conclusions

Based on the results of the research, several conclusions can be drawn, including:

a. The addition of yellow pears in the sauerkraut fermentation process from cabbage produces a product with organoleptic characteristics that are still dominated by the characteristics of cabbage fermentation, such as a pungent aroma and a strong sour taste. The addition of half a pear has not had a significant effect on the aroma, taste, color, or texture of sauerkraut.
b. The results of pH measurement using a pH meter showed a value of 3.34, while the universal pH showed a pH of about 4, which showed that the fermentation process had gone well and produced an acidic atmosphere that was safe from pathogenic microbial contamination.
c. The lactic acid content produced from the fermentation process is 0.18% which is relatively low compared to the ideal level in mature sauerkraut products. This is thought to be influenced by the limited amount of pears as a source of added sugars and the potential interaction of antioxidant compounds with lactic acid bacterial activity. Nonetheless, pears are known to contain antioxidant compounds such as flavonoids, phenolics, and vitamin C that have the potential to increase the functional value of the product. However, his contribution in this study has not been seen in real terms because the number of fruits used is relatively small.

References

Afifah, R., Suryani, R., & Taufik, M. (2021). The effect of fermentation time on pH and total acidity in the production of white cabbage sauerkraut. Journal of Food and Agricultural Products, 16(2), 85-50.

Anggraeni, L., N. Lubis & E.C. Junaedi. (2021). Review: The Effect of Salt Concentration on Fermented Vegetable Products. J. Case Science, Vol. 3 (6): 891-899.

Ardiansyah, F., Nurjanah, S., & Rohmana, A. (2020). Comparison of the accuracy of the pH measurement method using universal indicators and digital pH meters on acidic solutions. Journal of Applied Science and Technology, 2(1), 45-50.

Butt, M. S., & Sultan, M. T. (2011). Pyrus communis Linn. A review. African Journal of Food Science, 5(11), 686–691.

Di Cagno, R. et al. (2013). Fermented vegetables containing bioactive compounds: a new perspective for food design. Food Microbiology, 33(1), 1-7.

Enwa F.O. (2014). A mini review on the microbiochemical properties of sauerkraut. African Journal of Science and Research, Vol. 3(1): 15-16.

Fevria, R. & Hartanto, I. (2019). Isolation and Characterization of Lactic Acid Bacteria (Lactobacillus sp) from Sauerkraut with the Addition of Cayenne Pepper. Bioscience, Vol. 3(2): 169-175.

DOI : 10.24952/lavoisier.v4i2.16580

Lee, C. Y., & Smith, N. L. (2003). Phytochemical properties and antioxidant activity of pears. Acta Horticulturae, 596, 491–495.

Nakdiyani, R. & Batubara S.C. (2019). Low Grade Cabbage and Carrot Sauerkraut Quality with Different Salt Concentrations. J. Food Technology Cases., Vol. 1(2): 101-112.

Nugraheni, M., Hidayati, N., & Wulandari, T. (2020). Antioxidant content and antioxidant activity of local Indonesian pears. Jurbal Nutrition and Food, 15(2), 89-96.

Paramithiotis, S., Drosinos, E. H., & Tsakalidou, E. (2010). Fermentation of vegetables. In Fermented Foods and Beverages of the World (pp. 250-261). CRC Press.

Wu, X., Beecher, G. R., Holden, J. M., Haytowitz, D. B., Gebhardt, S. E., & Prior, R. L. (2004). Lipophilic and hydrophilic antioxidant capacities of common foods in the United States. Journal of Agricultural and Food Chemistry, 52(12), 4026–4037.

DOI : 10.24952/lavoisier.v4i2.16580