HYDROGEN
JURNAL KEPENDIDIKAN KIMIA
https://e-journal.undikma.ac.id/index.php/hydrogen/index

February 2024. 12(1)
e-ISSN: 2656-3061
p-ISSN: 2338-6487
pp. 26-34

The Modification of Eco-Enzyme Liquid and The Effect on Tomato Preservation with Soaking Then Rinsing in Water Method

Meta Yuliana
Biology Study Program, Faculty of Science and Technology, UIN Raden Fatah, Jl. Pangeran Ratu, Kel. 5 Ulu, Kec. Seberang Ulu 1, Jakabaring, Kota Palembang, Indonesia
* Corresponding Author e-mail: metayuliana_uin@radenfatah.ac.id

Article History
Received: 18-01-2024
Revised: 21-01-2024
Published: 29-02-2024

Keywords: coconut, eco-enzyme, preservation, rice, tomatoes

Abstract
Tomatoes are the popular fruit but having short shelf life. This fruit require some treatment to maintain its quality during post-harvesting. Eco-enzyme is a fermented liquid, it's made by fermentation process of fresh waste vegetables or fruits. Previous study showed that spraying tomatoes with Eco-enzyme can maintain the shelf life of tomatoes. This study aims to observe the effect of various liquid in Eco-enzyme fermentation and its effect to tomatoes preservation by soaking method. The research was experiment research using quality scale of tomatoes. The Eco-enzyme was fermented using different liquid such as water, coconut water and rice rinsed water. Tomatoes were soaked with each Eco-enzyme treatment with 50% and 100% concentration of each liquid for 5 minutes then rinsed them and observed their quality for 8 days during storage process. The control treatments are non-soaked and non-rinsed tomatoes. The observation including the quality of tomatoes and the quality of Eco-enzyme. The result of this study found that modification of liquid in Eco-enzyme fermentation have different effect for tomatoes preservation. Soaking and rinsing method also have different effect for tomatoes. The best treatment for EE1 is EE1-rinse-concentration 50%, EE2 is EE2-rinse-concentration 100%, and EE3 is EE3-rinse-concentration 50%. The soaking followed rinsing was the best method for tomatoes preservation treatment using Eco-enzyme.

How to Cite: Yuliana, M. (2024). The Modification of Eco-Enzyme Liquid and The Effect on Tomato Preservation with Soaking Then Rinsing in Water Method. Hydrogen: Jurnal Kependidikan Kimia, 12(1), 26-34. doi:https://doi.org/10.33394/hjkk.v12i1.10593

https://doi.org/10.33394/hjkk.v12i1.10593

INTRODUCTION

Tomatoes are one of favorite fruits as raw food because they have good nutrition for body health. Sumasdiono *et al.* (2009) stated that in 180 gr of tomatoes contain some Vitamin (34,38 mg Vitamin C, 1121,40 IU Vitamin A, 14,22 mcg Vitamin K, 0,68 mg Vitamin E, 0,11 mg Vitamin B1, 0,14 mg Vitamin B6, 1,13 mg Vitamin B3, 0,09 mg Vitamin B2 and 0,44 mg Vitamin B5), fiber (1,98 gr) Protein (1,53 gr), Folat (27,00 mcg), Calium (399,6 gr), Molybdenum (9,00 mcg), Mangan (0,19 mg), Cromium (9,00 mcg), Copper (0,13 mg), Magnesium (19,80 gr), Iron (0,81 gr), Phospor (43,20 mg) and Tryptophan (0,01 gr).

The problem in tomatoes preservation has become the main problem. Tomatoes have short shelf life after post-harvesting due to high water content inside the fruit. Tomatoes have 94,92% water inside the fruit (Sumasdiono *et al*. 2009). Khathir *et al.* (2019) also reported that temperature affect the shelf life of tomatoes. Tomatoes have 4 to 5 days shelf life at room temperature, and they can be storage longer at low temperature. Yeast also has role in tomatoes shelf life. It can shorten the tomatoes shelf life. *Rhizoctonia solani*, *Phomopsis* sp, *Fusarium oxysporum* and *Phytopthora cactorum* were identified as pathogen in tomatoes causing fruit rot (Pratiwi *et al*. 2016; Ata *et al*. 2016).

The methods in extend tomatoes shelf life have been conducted. Refrigerator is one of method to maintain tomatoes quality but its demand high cost. The other method is fruit coating. Andriani *et al* (2018) said that tomatoes coating with jelly can maintain its shelf life. According to Angelia (2022), bee wax coating also can extend tomatoes shelf life at room temperature. In other hand, Farooq *et al*. (2023) found that *Aloe-vera* coating can also maintain tomatoes shelf life.

The other research found that some plant extracts can be used to extend tomatoes shelf life. Fruit coating using *Psidium guajava, Jatropha curcas* and seed of *Carica papaya* extracts have effect in extend tomatoes shelf life (Ahmad *et al.* 2020; Zulfatunna'im *et al*. 2022). Beside plant extract, another coating compound for tomatoes is Eco-enzyme. Eco-enzyme is fermented liquid made from fruit and vegetable fresh waste. Some research found that it can extend fruit shelf life such tomato (Mahmudah *et al*, 2021).

Mahmudah et al. (2021) stated that Spraying tomatoes with Eco-enzyme from pineapple peels can maintain tomatoes at room temperature. Spraying tomatoes with Eco-enzyme from cucumber peels, spinach and citrus peels also can extend its shelf life (Pravitasari *et al,*2022; Hamidah and Hafsah, 2022). The previous study by Nurlaela *et al*. (2022) also found that Eco-enzyme made by various sugar substrates have different effect for tomatoes shelf life. In this study, we study the variation of liquid in production of Eco-enzyme. The coconut water and rice rinsed water are the modified liquid for fermentation. Besides, in this study, the treatments of tomatoes were using soaking method for 5 minutes then followed by rinsing method. Apai (2010) found that soaking longan fruit followed by rinsing has the best result for longan fruit preservation compare with non-rinsing fruit. No work has been studied on effect of soaking with Eco-enzyme and rinsing with water on shelf life of tomatoes fruit. This research aim to study the effect modification of Eco-enzyme liquid during fermentation and the effect on tomatoes shelf life with soaking followed by rinsing method.

METHOD

The research done at August to December, 2023. Located at Palembang. The research was experiment. This research studied about the effect of Eco-enzyme using quality scale (modified from Hamidah and Hafsah (2023) and Utami et al.(2020)). Each treatment has 6 tomatoes. Each tomato will be assessed using quality scale and the average was counted. Observation of tomatoes quality was take 8 days, include aroma, texture and surface of tomatoes. The observation of Eco-enzyme including aroma, color, pH and volume of product.

Equipment and Material

The Eco-enzyme material comparison was 1:3:10 (sugar: fruit peels: liquid). 1st variable were 300 gr fruit peels, 100 gr palm sugar, and 1 liter of water. 2nd variable was 300 gr fruit peels, 100 gr palm sugar and 1 liter of coconut water. 3rd variable was 300 gr fruit peels, 100 gr palm sugar and 1 liter of washed rice water. The fruit peels were 185 gr mango peels, 85 gr citrus peels, and 30 gr banana peels. Tomatoes was bought from traditional market of Palembang. The equipment were jars, filters, bottles, paper box, pH meter, scale and measuring cups (Hamidah and Hafsah, 2023).

Eco-enzyme production

Fruit peels waste were cut into piece. The fruit peels waste, palm sugar and liquid were mixed into 1,5 liter jar. 3 jars were prepared for each variable. Eco-enzyme was fermented for 3 months. After 3 months, the Eco-enzyme was filtered for separation of the liquid and the waste (Hamidah and Hafsah, 2023).

Tomatoes preservation

6 tomatoes were prepared for each treatment. The chosen tomatoes have the similar color and size. Preservation was done by soaking tomatoes into Eco-enzyme for 5 minutes with each concentration of liquid was 50% and 100%. Then, the several tomatoes was rinsed but the other was not rinsed. This method was modification from Hamidah and Hafsah (2023).

The observation of Eco-enzyme and Tomatoes

The observation of Eco-enzyme including the aroma, color and product volume. Product volume was counted with formula (Utami *et al.,* 2020):

$$\% \text{ Volume} = \frac{\text{End Volume } \textit{Eco-enzyme}}{\text{Beginning Volume } \textit{Eco-enzyme}} \times 100\%$$

The observation of tomatoes use the quality scale 1 to 5, consist:

Table 1. Scale quality of the effect of Eco-enzyme for tomatoes preservation at room temperature (modification from Yuniastri *et al*., 2020)

Scale	Description		
	Aroma	**Texture**	**Surface**
1	Foul smelling	Total soft in fruit body	The surface has white yeast or black yeast; skin was peeled in all fruit body; juicy in all fruit body
2	Strong Sour smelling	Half soft in Fruit body	The surface has white yeast or black yeast; skin was peeled in half of fruit body; juicy fruit body
3	Sour smelling	A part soft in fruit body	The surface has white yeast or black yeast; skin was peeled in a part of fruit body; fruit body begin to be juicy
4	A bit sour smelling	Hard texture	The surface has injured and skin begin to peeled; fruit body begin to be juicy; no yeast in surface
5	Fresh smelling	Hard texture	No yeast; no juicy fruit body; no peeled skin.

RESULTS AND DISCUSSION

The Effect of Eco-enzyme in Tomatoes

The results of the study showed that each treatment of tomatoes soaked in Eco-enzyme for 5 minutes had a better effect on the shelf life of tomatoes than the control. EE1, EE2, EE3 showed a slower decline in the quality scale compared to the control (Table 1). This is in line with research by Nurlaela et al. (2022) who reported that the use of Eco-enzyme prolonged the shelf life of tomatoes compared to the control treatment.

The interesting thing about this research is that there was a decrease in the quality scale on the first day of storage of tomatoes which was thought to be due to damage from inside the tomato fruit. The tomatoes in this study were purchased from traditional markets. Each treatment consisted of 6 tomatoes, each fruit was assessed using a quality scale and then averaged to see the effect as a group. Treatments EE1-no rinse-100% and EE3-rinse-100% experienced a decrease in scale from 5 to 4 on the first day.

Scale 4 indicates that some tomatoes experience a change in aroma to sour and generally start to release small amounts of water. According to Yuniastri et al. (2020) mechanical damage to tomatoes often occurs during the post-harvest storage process. Tomatoes that experience mechanical damage generally still look fresh, have a typical tomato smell and are bright in

color but have a soft texture. The tomatoes selected in this study all have a hard texture, it is thought that the exocarp is hard only but soft on the endocarp so that the damage is not visible from the outside (Yuniastri et al., 2020).

Table 2. The average (n=6) of Tomatoes Quality using Quality Scale for Each Treatment

Treatment		Concentration	Day-							
			1	2	3	4	5	6	7	8
EE1	Not Rinsed	100%	4	4	4	4	3	3	3	3
		50%	5	5	5	4	4	4	4	4
	Rinsed	100%	5	5	5	5	5	5	4	4
		50%	5	5	5	5	5	5	5	5
EE2	Not Rinsed	100%	5	4	4	3	3	2	2	2
		50%	5	5	5	4	3	3	3	3
	Rinsed	100%	5	5	5	5	4	4	4	4
		50%	5	5	5	4	4	3	2	2
EE3	Not Rinsed	100%	5	4	4	3	3	3	3	3
		50%	5	4	4	4	2	2	2	2
	Rinsed	100%	4	3	3	3	3	3	3	3
		50%	5	4	4	4	4	4	3	3
Control			5	4	3	2	2	2	2	2

Note: EE1 : *Eco-enzyme* with water, EE2: *Eco-enzyme* with coconut water, EE3: *Eco-enzyme* with rinsed rice water. Yellow block: the first day of scale quality decreasing, blue block: the lowest scale number.

The Eco-enzyme in this research was not only able to extend the shelf life of tomatoes, but was also able to slow down mechanical damage. Table 1 shows that EE1, EE2, and EE3 are able to maintain a higher tomato fruit quality scale compared to the control. Although, tomatoes soaked with EE1 have a better quality scale than EE2 and EE3, it can be seen that there is no scale 2 in all groups of tomatoes in EE1. Meanwhile, EE2 has a better quality scale than EE3, namely scale 2 on day 6 for EE2 and on day 5 for EE3. Meanwhile, tomatoes in the control treatment had a quality scale of 2 on the 4th day.

The soaking method was a simple and cheap domestic method for fruit preservation at home. People commonly used this method for fruit preparation before storage and beneficial for enhancing fruit nutrition content (Siqueira *et al*., 2013). Mama et al. (2016) also stated that the hot water treatment soaking method for 20 minutes has been reported effectively maintain the tomatoes shelf life and reduce the fruit decay. Dandago *et al*. (2017) also found that 200 ppm NaOCl and 1 % $CaCl_2$ for 5 minutes have effect on tomatoes quality maintenance. This research showed that Eco-enzyme also has the ability to reduce fruit decay and maintain tomatoes quality during post-harvesting. The soaking method was one of alternative way for activating antioxidant enzyme and reducing the pathogen such as *B.cinerea* on tomatoes (Usall *et al*., 2016; Boonkorn, 2016). The soaking method can also reducing phenolic compound such as tannin (Yuliana *et al*., 2019).

Rinsing and no rinsing have different effects on each Eco-enzyme. Tomato fruit that was not rinsed after soaking EE1 had decreasing quality scale from 4 to 3 on the 5th day and keeping at scale 3 until 8th day at concentration of 100%, while at concentration of 50%, the decreasing quality scale from 5 to 4 on the 4th day and remaining at 4 scale until 8th day. The rinsed tomatoes had decreasing quality scale from 5 to 4 on the 7th day with 100% concentration and staying at scale 5 from 1st to 8th day at concentration of 50%. The tomatoes were soaked with EE1 at 50% concentration and followed by rinsing had best quality than the other in this treatment.

However, The treatment of soaking tomatoes with EE2 showed that the non-rinsed tomatoes had decreasing quality scale from 5 to 4 at 2nd day, then it continue the decreasing to scale 2 at 8th day for 100% concentration, while at 50% concentration the scale decreased from 5 to 4 at 4th day then scale 3 at 8th day. The rinsed tomatoes have decreasing scale from 5 to 4 at 5th day for 100% concentration and 4th day for 50% concentration. The tomatoes were soaked with EE2 at 100% concentration and followed by rinsing had the best quality than other in this treatment.

The treatment of EE3 showed that the non-rinsed tomatoes had decreasing scale from 5 to 4 at 2nd day for 100% concentration and 50% concentration. Besides, they have scale 3 for 100% concentration and scale 2 for 50% concentration at 8th day. Therefore, the rinsed tomatoes showed the decreasing quality scale to 4 at 1st day following to 3 until 8th day for 100% concentration. The rinsed tomatoes at 50% concentration started decreasing scale at 2nd day from 5 to 4 and followed to 3 at 7th day and 8th day. Soaking tomatoes with EE3 at 50% concentration and rinsing it was the best treatment than the other in this treatment.

Zewdie *et al*., (2022) found that soaking fruit into liquid compound-based plant has effect on increasing Titratable acidity of tomatoes body than non-soaking fruit. He assumed that during storage process, fruit utilized the acid in it's body as respiration substrate and starting decay process due to lower acid content body, however the soaking method could prevent it by lowering the rate respiration, ethylene production, and other metabolic activity.

In other hand, this finding found that the soaking method with liquid compound-based plant containing acid such as Eco-enzyme should be followed by another method such as rinsing. The data in this research showed that non-rinsed tomatoes has lower quality than rinsed tomatoes. This result similar to finding by Apai (2010). He reported that soaking longan fruit with HCL has different at non-rinsed and rinsed fruit. He stated that acid of HCL diffused into fruit flesh during soaking process and induced flesh discoloration and infection at storage time, then the rinsing after soaking could reduce its effect on fruit by eliminating the acid on the fruit surface. The Eco-enzymes (EE1, EE2, EE3) in this research have 4-5 pH (Table 3). We assumed the non-rinsed and rinsed tomatoes in this study have similar condition with previous research.

The results of this research also showed that solvent modification in making Eco-enzyme has a different effect on each tomato. Differences in concentration and rinsing also matter. The coconut water and rice washing water used in this study have different contents and effects on tomatoes. Fermented coconut water contains several enzymes such as catalase, peroxidase and dehydrogenase, as well as amino acids and benzene ethanol compounds which have an antibacterial and antioxidant role (Ramamurthy, 2022). This compound is thought to play a role in maintaining the durability of tomatoes in this study.

The Several studies also say that coconut water is able to preserve food ingredients from meat. Widaningrum et al. (2015) stated that banana peel vinegar and coconut water were able to preserve chicken meat the same as commercial acetic acid when stored for 12 days. Suara et al. (2014) also reported that fermented coconut water ice was able to preserve Cakalang fish. Safitri (2021) states that fermented coconut water can be used as a tofu preservative. Similar things were found in this study, fermented coconut water as a mixture of Eco-enzyme gave the best results as a tomato preservative with a concentration of 100% and the rinsing treatment compared to the control treatment.

Rice washing water contains 89%-90% carbohydrates, protein, cellulose, hemicellulose, sugar and vitamin B (Maharani, 2023). Carbohydrates in rice washing water have the potential in the fermentation process of lactic acid bacteria in making Eco-enzyme. Lactobacillus sp. is a group of lactic acid bacteria found in rice washing water. This group of bacteria produces acetic acid

and organic acids during the fermentation process and it is known that these compounds are able to kill pathogens such as *Aspergillus* sp. and has the potential to be used as a natural preservative (Bukhari et al., 2020). Rice washing water can also be used to reduce formaldehyde levels in wet noodle foods by soaking the noodles using rice washing water. The results of research by Ramdan (2018) show a reduction in levels formalin was 91.8% in noodles soaked for 90 minutes. In this study, rice washing water could be used in making Eco-enzyme and was able to maintain the best quality of tomatoes on a quality scale of 4 on the 6th day of the rinse treatment with a soaking concentration of 50% compared to the control treatment.

Quality of Eco-enzyme

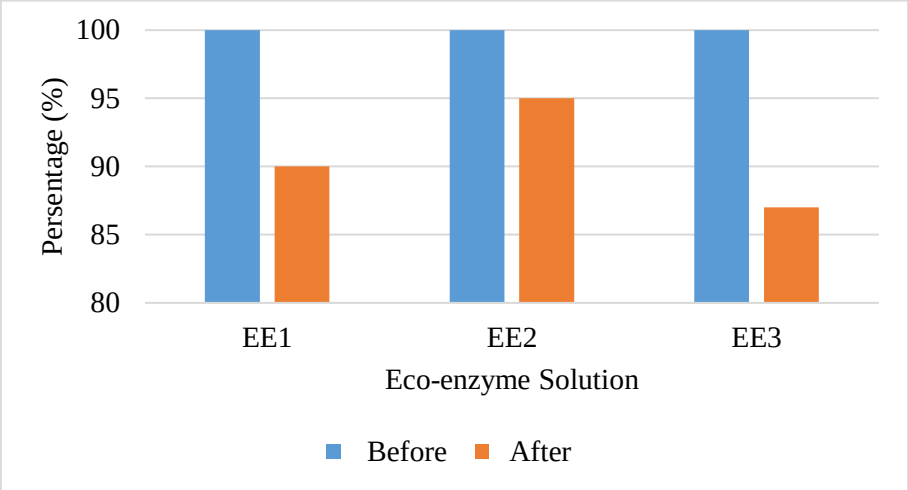

Figure 1. Presentage of Final Product of Eco-enzyme at each treatment
Note: EE1 : *Eco-enzyme* with water, EE2: *Eco-enzyme* with coconut water, EE3: *Eco-enzyme* with rinsed rice water.

Treatment EE3 has a lower final product percentage than EE1 and EE2, namely 87%. Treatment EE2 has the highest final product percentage, namely 95%, while EE1 has a final product percentage of 90% (Chart 1). EE3 uses rice washing water which has a carbohydrate content of 89-90% (Maharani, 2023), it is suspected that this content is used by microbes in the fermentation process and has an effect on the minimum percentage of the final product. EE2 uses coconut water, which in this study did not completely dissolve in the Eco-enzyme liquid. Based on the results of this research, the pulp in EE2 has a smoother and harder texture than EE1 and EE3, it is suspected that coconut water is not absorbed into the fruit skin so that the final product is more abundant than EE1 and EE3. EE1 uses plain water and has a final product percentage of 90%.

Table 3. Quality of Eco-enzyme at each treatment

Treatment	Aroma	Color	pH		
			1st week	2nd week	3rd week
EE1	Fresh aroma and dominated by citrus aroma	Light brown (++)	4,7	4,7	5,0
EE2	Fresh aroma and dominated by citrus aroma	Dark light brown (+++)	4,7	4,7	5,0
EE3	Fresh aroma and dominated by citrus aroma	Light brown (++)	4,6	4,7	4,9

Note: EE1 : *Eco-enzyme* with water, EE2: *Eco-enzyme* with coconut water, EE3: *Eco-enzyme* with rinsed rice water.

The research results show that the three Eco-enzymes have a fresh, sour and citrus aroma is more dominant than the skin of other fruits (banana and mango). EE2 colors are more intense than EE1 and EE3 colors. The pH of the Eco-enzyme solution is around 4 and increases at the end of the week, namely pH 5. Yuliana (2021) said that in the fermentation process, the longer the fermentation process takes, the pH of the solution will approach normal pH, this is due to decreased microbial activity.

A B C

Figure 2. Liquid of EE1 (A), EE2 (B), and EE3 (C)

CONCLUSION

Modification of the Eco-enzyme solution with coconut water and rice rinsed water had an effect on tomato fruit durability compared to the control. Rinsing and concentration have different effects on each treatment. EE1 has a higher quality scale than EE2 and EE3. The best treatment for EE1 is EE1-rinse-concentration 50%, for EE2 treatment is EE2-rinse-concentration 100%, and EE3 treatment is EE3-rinse-concentration 50%. The rinsed tomatoes have better quality than non-rinsed tomatoes. Rinsing tomatoes after soaking in Eco-enzyme for 5 minutes provides better preservation. We also found that tomatoes mechanical damage during post-harvest give contribution on tomatoes shelf life. Tomatoes with mechanical damage on fruit have rotting process faster. However, Eco-enzyme can prevent the decay fruit process causing by mechanical damage slower and extend shelf life of tomatoes. The antimicrobial effect and compound content from liquid modification on Eco-enzyme need to study further for better understanding of its effect and mechanism on fruit preservation.

BIBLIOGRAPHY

Ahmad, M., Mohammed , A, M., Sale, S. (2020). Enhancing the shelf life of tomato fruits using plant material during storage. *J. Hortic. Postharvest Res*, *3*(2), 347–354. https://doi.org/10.22077/jhpr.2020.2946.1109.

Andriani,S. E., Hintono, A. (2018). Perubahan Fisik Tomat Selama Penyimpanan Pada Suhu Ruang Akibat Pelapisan Dengan Agar-Agar Physical Changes of Tomatoes During Storage At Room Temperature Due To Coating With Agar. In *Jurnal Teknologi Pangan* (Vol. 2, Issue 2). www.ejournal-s1.undip.ac.id/index.php/tekpangan.

Angelia, I.O. (2022). Mempertahankan Mutu Kandungan Vitamin C dan Umur Simpan Pada Tomat (*Solanum Lycopersicum*) Dengan Pelapisan Lilin Lebah. *JVST 1(2), 58-61*

Apai, W. (2010). Effects of Fruit Dipping in Hydrochloric Acid Then Rinsing in Water on Fruit Decay and Browning of Longan Fruit. *Crop protection, 29:* 1184-1189.

Ata, H., Papuangan, N., Bahtiar. (2016). identifikasi cendawan patogen pada tanaman tomat (*Solanum lycopersicum* L). *jurnal bioedukasi, 4(2).*

Boonkorn, P. (2016). Impact of Hot Water Soaking on Antioxidant Enzyme Activities and Some Qualities of Storage Tomato fruits. *International Food Research Journal,* 23(3); 934-938.

Bukhari, S. A., Salman, M., Numan, M., Javed, M. R., Zubair, M., Mustafa, G. (2020). Characterization of antifungal metabolites produced by Lactobacillus plantarum and Lactobacillus coryniformis isolated from rice rinsed water. *Molecular Biology Reports, 47*(3): 1871–1881. https://doi.org/10.1007/s11033-020-05281-1

Dandago, M.A., Gungula, D., Nahunnaro, H. (2017). Effect of Postharvest Dips on Quality and Storability of Tomato Fruits (*Lycopersicon esculentum* Mill) in Kura, Kano State, Nigeria. *Annals. Food Science and Technology*, 18(1): 78-84.

Farooq, A., Niaz, B., Saeed, F., Afzaal, M., Armghan Khalid, M., Raza, M. A., al Jbawi, E. (2023). Exploring the potential of aloe vera gel-based coating for shelf life extension and quality preservation of tomato. *International Journal of Food Properties*, *26*(2): 2909–2923. https://doi.org/10.1080/10942912.2023.2263661

Hamidah, L.,Hafsah, H. (2023). Aplikasi ekoenzim bayam dan kulit jeruk pada pengawetan buah tomat. *pros sem nas masy biodiv indon*, *8*(2), 2023. https://doi.org/10.13057/psnmbi/m080208.

Khathir, R., Sukarno Putra, B., Agustina, R. (2019). The Prediction of Tomato shelf life Based on Its Total Soluble Solid by Using Arrhenius and Q 10 Model. In *Rona Teknik Pertanian, 12(1).*

Maharani, P. A. (2023). Pemanfaatan Kandungan Gizi Pada Air Beras Untuk Pertumbuhan Cabai. In *Journal of Nutrition Science*, 12(1).

Mama, S., Yemer, J., Woelore, W. (2016). Effect oh Hot Water Treatments on Shelf Life of Tomato (*Lycopersicon esculentum* Mill). *Journal of Natural Science Research*, 17(6): 69-77.

Nurlaela, Astuti, A., Maharani, E.T,W. (2022). Pengaruh Penambahan Eco-Enzyme Limbah Kubis Terhadap Pengawetan Buah Tomat Dengan Perbandingan Variasi Substrat. *Hydrogen: Jurnal Kependidikan Kimia*. *10*(2). http://ojs.undikma.ac.id/index.php/hydrogen/

Pratiwi, W.N., Juliantari, E., Napsiyah, L.K. (2016). Identifikasi Jamur Penyebab Penyakit Pascapanen pada Beberapa Komoditas Bahan Pangan. In *Jurnal Riau Biologia, 14(1).*

Pravitasari, N. V., Astuti, A. P., Tri, E., & Maharani, W. (2022). Analisis Kadar dan Mutu Ecoenzim Kulit Nanas Dalam Pengawetan Buah Anggur dan Buah Tomat. In *Jurnal Teknologi Pangan, 6(2).* www.ejournal-s1.undip.ac.id/index.php/tekpangan.

Ramamurthy, V. (2022). Production & Characterisation of Fermented Coconut Water and a Report on Its Health Benefits. *Food Science & Nutrition Technology*, *7*(1), 1–5. https://doi.org/10.23880/fsnt-16000278

Ramdan, M. U. (2018). Efektivitas Penggunaan Air Leri Terhadap Keberadaan Formalin Yang Terdapat Pada Produk Makanan Mie Basah. *Prosiding Seminar Nasional dan Diseminasi Penelitian Kesehatan STIKes Bakti Tunas Husada Tasikmalaya*.

Safitri, V. (2021). Pemanfaatan Air Kelapa Hasil Fermentasi Sebagai Bahan Alternatif Pengawet Alami Pada Tahu. *Jurnal pendidikan teknologi pertanian* , 7(1).

Siqueira, B.D.S., Soares Junior, M.S., Fernandes, K.F., Caliari, M., Damiani, C. (2013). Effect of Soaking on The Nutritional Quality of pequi (*Caryocar brasiliense* Camb) peel flour. *Food Science and Technology, 33(3),* 500-506.

Suara, Y., Naiu, A. S., Mile, L. (2014). Analisis Organoleptik pada Ikan Cakalang Segar yang Diawetkan dengan Es Air Kelapa Fermentasi. In *Jurnal Ilmiah Perikanan dan Kelautan, 2(3).*

Sumardiono, S., Basri, M., Pasonang Sihombing, R. (2009). Analisis Sifat-Sifat Psiko-Kimia Buah Tomat (Lycopersicon Esculentum) Jenis Tomat Apel, Guna Peningkatan Nilai Fungsi Buah Tomat Sebagai Komoditi Pangan Lokal. *Semantic scholar*.

Usall, J., Ippolito, A., Sisquella, M., Neri, F. (2016). Physical Treatment to Control Postharvest Diseases of Fresh Fruits and Vegetables. *Postharvest Biology and Technology*, 122: 30-40.

Utami, M.I.P, Puji Astuti, A., & Tri Wahyuni Maharani, E. (2020). *Manfaat Ekoenzim Dari Limbah Organik Rumah Tangga Sebagai Pengawet Buah Tomat Cherry*. *Seminar Nasional Edusainstek FMIPA UNIMUS 2020*

Widaningrum, J., Miskiyah, Juniawati. (2015). Efikasi Cuka Kulit Pisang Dan Air Kelapa Sebagai Penghambat Listeria monocytogenes Pada Daging Ayam. *Jurnal penelitian pascapanen pertanian , 12(2).*

Yuliana, M. (2021). The Effect of Local Microorganism (Mol) as Liquid Organic Fertilizer to the Growth of Ipomea reptans Poir. In *Jurnal Biota, 7(1).* http://jurnal.radenfatah.ac.id/index.php/biota

Yuliana, M., Meryandini, A., Sunarti, T.C. (2019). Selection of Lactic Acid Bacteria and Its Application as Starter for Sorghum Grain Fermentation. *Sumberdaya Hayati Journal,* 5(1): 35-42.

Yuniastri, R., Atkhiyah, V. M., & al Faqih, K. (2020). Karakteristik Kerusakan Fisik Dan Kimia Buah Tomat . *Journal of Food Technology and Agroindustry*, *2*.

Zewdie, B., Shonte, T.T., Woldetsadik, K.(2022). Shelf life and Quality of Tomato (*Lycopersicon esculentum* Mill.) Fruits as Affected by Neem Leaf Extract Dipping and Beeswax Coating. *International Journal of Food Properties*, 25 (1): 570-592.

Zulfatunna'im, L.D., Bintari, S.H., Mubarok, I, Dewi, P. (2022). Potensi Ekstrak Akuades Biji Pepaya Sebagai Penghambat Pertumbuhan Khamir Penyebab Busuk Buah Tomat Dan Stroberi. *Life science , 11(1).*