

A synergistic of pectinase, cellulase, and glucoamylase on anthocyanin content and extraction yield of roselle petals (*Hibiscus sabdariffa* L.)

Mardiah^{1*}, Noli Novidahlia¹, Ma'rifat Khoirunnisa¹, Hanafi², and Aminullah^{1*}

¹ Department of Food Technology and Nutrition, Faculty of Halal Food Science, Djuanda University, Bogor, West Java, Indonesia

² Polytechnic of Bogor Chemical Institute, Bogor, West Java, Indonesia

* Corresponding email: mardiahrohman@yahoo.com; aminullah@unida.ac.id

Submitted: 16 August 2019, Accepted: 22 March 2021, DOI: <http://dx.doi.org/10.23960/jthp.v26i2.65-71>

ABSTRACT

The Roselle petals contain anthocyanin pigment which function as an antioxidant and a natural food colorant. The objective of this research was to study the effect of three enzymes: pectinase, cellulase, and glucoamylase, on the quality of the extract of the Roselle petals. The fresh and dried Roselle petals were extracted using distilled water in a ratio of 1:4, and divided into five parts, in which each part was added by pectinase (P) of 1000ppm; pectinase and cellulase (PC) of 500:500ppm; pectinase and glucoamylase (PG) of 500:500ppm; and pectinase, cellulase and glucoamylase (PCG) of 333:333:333ppm, and without enzyme (TE) as a control. Furthermore, 1% of citric acid was added to all treatments. Determination of the chosen treatment used was based on residue extract, anthocyanin analysis, and the pH value. The results showed that fresh Rosella extract with PC has a yield value of 7.60% and it was not significantly different from the extract with PCG which yielded 7.37%. Dried Rosella extract with PCG had the highest yield of 22.10% compared to the control (without enzyme) of 12.96%. However, the PCG addition generated a sticky product. Both fresh and dried Roselle extracts with PC contained the highest anthocyanin content of $156.64 \pm 1.30 \text{ mgL}^{-1}$ and $35.09 \pm 0.04 \text{ mgL}^{-1}$, respectively. The pH values of fresh and dried Roselle extracts were 2.65 and 2.24, respectively. This research showed that treatment of fresh and dried Roselle petals with addition of P, PC or PCG increased the extraction yield value. Additionally, these enzymes could also increase the anthocyanin content of the extracts.

Keywords: anthocyanin content; enzyme treatment; extraction yield; pH value; roselle petal

Introduction

Roselle (*Hibiscus sadbariffa* Linn) is a member of the Malvaceae family. The Rosella plant thrives well in subtropical and tropical climates and contains a high content of anthocyanin which is a natural red pigment and an antioxidant. Furthermore, Roselle petals contain cyanidin-3-O-glucoside, delphinidin-3-O-glucoside, cyanidin-3-O-sambubioside, and delphinidin-3-O-sambubioside (Kouakou et al., 2015). Roselle is very effective in lowering blood pressure and sugar levels (diabetes) (Mardiah et al., 2014; Riaz & Chopra, 2018; Yusni & Meutia, 2020), protecting the liver from damage (Halim et al., 2019), enhancing antioxidant enzyme activity in the liver, anti-inflammation, analgesics (Mardiah et al., 2015; Izquierdo-Vega et al., 2020) as well as lowering uric acid (Yuanta, 2019). Roselle petals can be processed into a variety of products such as tea, jam, jelly, juice, natural colorant, and extract powder which can be applied in foods, supplements, and drugs. According to Mardiah et al. (2014), Roselle extract was dried using spray dryers yields lower extraction result. This is due to the residues (pectins) which are normally attached to the walls of the spray dryer that leads to a decline in extraction yield.

Numerous researches have proven that pectinase increases the extract yield of rosella petals (Kumar, 2015; Mardiah et al., 2018). During the extraction of the grape's red pigments, pectin can also shorten the time for macerating, settling, and the filter processes, a lot faster than just using ethanol (Lotfi et al., 2015). According to Hanafi (2009), the combination of both pectinase and cellulase simultaneously, can increase the yield. The enzyme combination has a synergistic effect in increasing the yield of banana juice extraction (Handique et al., 2019) and oil extraction from the pulp of *Euterpe oleracea* fruit (de Ferreira et

al., 2018). The aim of the research was to study the synergistic effect of the addition of pectinase, cellulase, and glucoamylase enzymes on the extraction yield of Roselle petals and the quality and content of anthocyanins in the extract.

Materials and methods

Materials

The objects of the study were fresh Roselle petals obtained from West Palimanan, Cirebon, Indonesia. Dried Roselle was obtained from drying fresh Rosella under the sun for three days. Pectinase, cellulase, and glucoamylase (Jiangsu Boli Bioproducts Co., Ltd, China), distilled water, citric acid (PT Budi Acid Jaya Tbk., Indonesia), maltodextrin (Shandong Xiwang GroupCo., Ltd, China), and other chemicals were used for this analysis. This research consists of two stages namely; extraction and analysis.

The primary equipment for the research was extraction kits consisted of water bath, stirrer, and thermometer. Other equipments were spray drier, pH meter (WTW, Xylem Inc., Germany), and UV-VIS spectrophotometry (WTW, Xylem Inc., Germany).

Experimentan Design

The research used a one-factor descriptive statistical analysis method in two replications. Data were analyzed using SPSS® software version 21 (IBM Co., NY, USA). The treatments were the addition of enzymes in the extraction process of fresh and dried Roselle petals. The enzymes added were pectinase (P) of 1000 ppm, pectinase and cellulase (PC) of 500:500 ppm, pectinase and glucoamylase (PG) of 500:500 ppm, pectinase, cellulase and glucoamylase (PCG) of 333:333:333 ppm, and without enzyme (TE) as a control

Anthocyanin extraction

Anthocyanin extraction referred to Mardiah et al. (2014). The anthocyanin extraction was conducted using distilled water in a 1 : 4 combination ratio of 100 g of the Roselle petal (fresh or dried) and 400 ml of the distilled water. The enzymes were added according to the treatments, followed by addition of 1% (w/w) citric acid to all the treatments. The extraction was conducted at 50°C for 60 minutes. The extract was filtered and dried using a spray dryer with 10% maltodextrin (w/w) as filler, and inlet and outlet temperatures of 150°C and 80°C respectively.

Extract Analysis

The extracted products were analyzed for pH values using a pH meter (WTW, Xylem Inc., Germany) and total anthocyanin content using UV-VIS spectrophotometry (WTW, Xylem Inc., Germany). Anthocyanin content was determined by two replications and quantified in cyaniding 3-glucoside by the following formula:

$$A = [(A_{520} - A_{700})_{\text{pH 1.0}} - (A_{520} - A_{700})_{\text{pH 4.5}}] \quad (1)$$

$$\text{Anthocyanin concentration (mg/L)} = (A \times MV \times DF \times 1000) / (\epsilon \times L) \quad (2)$$

A₅₂₀ is the absorbance of wavelength of 520 nm, A₇₀₀ is the absorbance of wavelength of 700 nm, A is optional density, MV and ϵ is the molecular weight (449.2) and molar absorbance of cyaniding 3 glucoside, respectively, DF is the dilution factor, L is the cuvette thickness (cm), and ϵ is molar absorbance. Measurement of the yield was calculated based on the weight of the Roselle extract after drying and divided by the amount of initial Roselle weight. The amount of sample used was 1 ml of rosella extract.

Results and discussion

Extraction yield

The extraction yield of fresh and dried Roselle petals using several enzymes can be seen in Table 1. Table 1 shows the extraction yield of the fresh roselle petals with the addition of P, PG, PC, and PCG, which were 7.60%, 6.56%, 5.84%, and 7.37%, respectively. Descriptive analysis showed that the extraction yield of Roselle flower petals with the addition of P were slightly different from the extraction yield from PCG treatment. However, these yields were very different from the extraction yields from the others. Extraction of dried Roselle petals with the addition of PCG resulted in the highest yield of 22.10%, while the yields of extraction with the addition of P, PG and PC were 18.54%, 17.3%, and 14.79%, respectively. On the other hand, the extraction yield of dried Roselle flower petals with the addition of PCG was the highest compared the extraction yield from other treatments. Additionally, Table 1 also shows that the addition of pectinase can increase the yield compared to the yield of the control (without enzymes) in the both fresh and dried Rosella treatments. These results were in agreement with Mardiah et al. (2018) which stated that the pectinase enzyme could degrade pectin compounds into simpler forms to increase yield. Pectinase could break pectin bonds in cells and increase procyanidin extract. Other studies (Kumar, 2015; Sudeep et al., 2020; Nguyen and Nguyen, 2018) also explained that pectinase could increase extraction yield, total dissolved solids, and acidity, as well as reduce turbidity and viscosity. Nguyen and Nguyen (2018) stated that pectinase could degrade pectin causing a decrease in the water holding capacity of pectin, which releases more juice in the mixture, and consequently, produces more juice.

Table 1. Extraction yield of fresh and dried Roselle petals

Enzyme	Extraction yield (%)	
	Fresh Roselle petals	Dried Roselle petals
P	7.60±0.35	18.54±0.45
PC	5.84±0.34	14.79±0.42
PG	6.56±0.18	17.30±0.42
PCG	7.37±0.57	22.10±0.36
TE	5.80±0.13	12.96±0.48

P = Pectinase; P:C = Pectinase : Cellulase; P:G= Pectinase : Glucoamylase; P:C:G = Pectinase : Cellulase: Glucoamylase; T.E = control (without enzyme).

The combination of PC, PG, and PCG enzymes can increase the yield of both dried and fresh Rosella. The combination of carbohydrase enzymes such as pectinase, pectinesterase, hemicellulase, and cellulase can increase enzyme activity, because the enzymes work synergistically. According to Oumer (2017), the structure of plant cell walls consisted of cellulose, hemicellulose and pectic compounds. Cellulose compounds play a role in giving strength to cell walls, while hemicellulose and pectic compounds function as cementing agents for cellulose tissue. Pectic compounds contribute to complex physiological processes such as cell growth and cell differentiation, including determining the integrity and rigidity of plant tissues. Pectinase can effectively degrade the cell wall structure through the hydrolysis of pectic substances, while cellulase works to reduce the molecular size of cellulose particles and the viscosity of the substrate.

Hanafi (2009) explained that the mechanism of the combination of pectinase and cellulase increased the yield due to their synergistic effect. Cellulase degrades cellulose cell walls while pectinase degrades pectin molecules bound to cellulose compounds. Handique et al. (2019) and de Ferreira et al. (2018) stated that extraction using more than one enzyme produced higher yields.

Anthocyanin content

The anthocyanin content from fresh and dried Roselle petals can be seen in Table 2. Table 2 shows that the fresh Rosella extract contains more anthocyanins than the dried rosella extract. This was due to the high temperature applied to the drying process of dried Rosella flower petals reduced anthocyanin content

(Mardiah et al., 2015). Further analysis showed that the anthocyanin content of all enzyme treatments tend to be higher than that of the non-enzyme (TE) treatment. The lowest anthocyanin content was produced from fresh Roselle flower petals with pectinase (P) treatment. According to Vukoja et al. (2019), pectinase reduced the stability of anthocyanins due to its glucosidase activity which hydrolyzed the glycoside bonds of β -1-2 cyanidin-3-sophoroside and cyanidin-3-glucosyl-rutinoside to cyanidin-3-glycoside and cyanidin-3-rutinoside. Furthermore, extraction with the addition of pectinase and cellulase (PC) resulted in the highest anthocyanin content in both fresh and dried Roselle extracts. According to Lotfi et al. (2015) pectinase and cellulase had a synergistic effect in breaking down the cell wall and so that the anthocyanin pigments in the cell wall were easily extracted. The same thing was also expressed by Ranveer et al. (2020), that the addition of cellulase and pectinase enzymes increased the concentration of anthocyanins in the skin of kokum fruit (*Garcinia indica* Choisy). Jia et al. (2019) also informed that the combined use of cellulose, hemicellulose, and pectinase enzymes increased anthocyanin content, shortened processing time, increased efficiency, and lowered processing temperatures in the manufacture of cherry wine compared to using single enzymes. This happens because hemicellulase enzymes break down cellulases and hemicellulases, dissolving plant cell walls and releasing more intracellular solutions. In contrast, lower anthocyanin content was obtained when glucoamylase was added (PG and PCG) to the treatment. This happens because glucoamylase degrade anthocyanin pigments and make them unstable by hydrolyzing the bonds between aglycones and glycones. The hydrolysis causes the aromatic ring of anthocyanins to turn into colorless cation compounds.

Table 2. Anthocyanin content of fresh and dried Roselle petals

Enzyme	Anthocyanin content (mg.L ⁻¹)	
	Fresh Roselle petals	Dried Roselle petals
P	101.29±0.53	26.40±0.46
PC	184.02±0.15	35.09±0.04
PG	156.64±1.30	33.20±0.80
PCG	141.05±0.56	23.51±0.53
TE	131.89±0.76	23.25±0.08

P = Pectinase; P:C = Pectinase : Cellulase; P:G= Pectinase : Glucoamylase; P:C:G = Pectinase : Cellulase: Glucoamylase; T.E = control (without enzyme).

Glucoamylase can increase the sugar content in the extract. The presence of sugar induces an increase in the color intensity of anthocyanins under acidic conditions. However, the higher sugar content in the extraction led to lower anthocyanin stability. The presence of sugar can accelerate the degradation of anthocyanins and their ability to condense with anthocyanins and produce brown compounds. Glucoamylase could hydrolyze α -1,6 glycosidic bonds so that the dextrin product would be converted into glucose units, the dextrin product caused a high level of sweetness and sugar yield (Tiwari et al., 2015). Additionally, the extraction treatment with addition of PCG resulted in a sticky extract caused by high glucose levels. Kumar (2015) also reported that glucoamylase reacts with carbohydrates to produce a sticky extract.

pH value

The pH value of fresh and dried Roselle petals can be seen in Table 2. Table 3 shows that the pH values of all treatments in the range of 2.3-2.7, which means the pH value of Roselle flower petal extract is stable. The addition of enzymes to fresh or dried Roselle petals did not affect the pH value. In addition, further analysis showed that all combinations of enzyme additions had no effect on the pH value of fresh Roselle petal extract. However, the combination of enzyme additions effected the pH of the dried Roselle flower petal extract. This pH condition also indicated the optimum working conditions for the enzyme, where pectinase had an optimum pH of 5.8 (Sudeep et al., 2020). Li et al. (2020) reported that the best pH to produce the most anthocyanins in Mulberry juice extract using pectinase was in the pH range of 3-6. At a

higher pH, pectinase had a lower ability to decompose cell walls, resulted in lower anthocyanins being extracted.

Table 3. pH value of fresh and dried Roselle petals

Enzyme	pH	
	Fresh Roselle petals	Dried Roselle petals
P	2.56±0.10	2.79±0.04
PC	2.74±0.33	2.46±0.09
PG	2.38±0.09	2.21±0.13
PCG	2.65±0.07	2.24±0.28
TE	2.65±0.10	2.03±0.04

P = Pectinase; P:C = Pectinase : Cellulase; P:G= Pectinase : Glucoamylase; P:C:G = Pectinase : Cellulase: Glucoamylase; T.E = control (without enzyme).

Anthocyanin stability was influenced by several factors, one of which was the pH value. The low pH value of 2-4 affected the stability of anthocyanins because under these conditions anthocyanins were reddish in color and were in the form of cyanidin-3 glucoside and cyanid-3 on the outside. A decrease in pH would shift the equilibrium condition to the red flavilium cation. Conversely, an increase in pH would form carbinol and colorless balconies (Nurtiana, 2019). Khoo et al. (2017) reported that β glucosidase enzymes caused anthocyanin color changes to become anthocyanidins and sugars that spontaneously formed colorless aglycones (anthocyanidins). The pH measurement showed that the cyanidin content was more stable at pH below 3 (Lotfi et al., 2015), and Jia et al. (2019) stated that at pH 3, the anthocyanin extract reached its maximum value. There was an effect of pH on the color change of anthocyanins, where a pH of less than 3 could control the color change that correlates with the anthocyanin content in red sweet fermented drinks (Khoo et al., 2017). The addition of acids such as citric acid and lactic acid prevents the breakdown of anthocyanins. In this reseach, 1% citric acid was added to all Roselle flower petal extraction treatments to maintain the pH below 3, so that the color of Roselle extract powder was in excellent stability. Lotfi et al. (2015) reported the color of anthocyanin extracts produced using solvents with the addition of enzymes (pectinase, cellulose, proteases) resulted in better chroma values and more stable lightness than those produced from acidified ethanol solvents.

Conclusion

The data in this work confirmed that the addition of PCG enzymes increased the extraction yield on both fresh and dried Roselle petals, followed by the addition of P, PG and PC, however, PCG produced a sticky extract. The highest anthocyanin level was obtained from the extract with the addition of PC on both fresh and dried Roselle petals. The addition of enzymes on fresh or dried Roselle petals did not affect the range of pH value (2.3-2.7).

Acknowledgements

This research was supported by Grant of Penelitian Unggulan Perguruan Tinggi (PUPT) under contract No.1598/K4/KM/2017 from Ministry of Research, Technology, and Higher Education, Republic of Indonesia.

References

- de Ferreira, E. S., Rogez, H. L. G., & Herman, C. A. N. P. (2018). Effect of the combination of enzymatic preparations on the aqueous extraction yield of the oil from the pulp of Euterpe oleracea fruit. *Brazilian Journal of Chemical Engineering*, 35(4), 1193–1201. <https://doi.org/10.1590/0104-6632.20180354s20170305>
- Halim, D., Sihning, E. J., & Tehupuring. (2019). The effect of roselle (*Hibiscus sabdariffa* Linn) flower extract to the SGPT activity in male wistar rats (*Rattus norvegicus*) induced by high dose paracetamol. *IOP*

- Conference Series: Earth and Environmental Science*, 217(1). <https://doi.org/10.1088/1755-1315/217/1/012018>
- Hanafi. (2009). *Sifat aktivitas enzim sellulase dan pectinase dalam mendegradasi dinding sel tanaman untuk tujuan ekstraksi pigmen*. Akademi Kimia Analis.
- Handique, J., Bora, S. J., & Sit, N. (2019). Optimization of banana juice extraction using combination of enzymes. *Journal of Food Science and Technology*, 56(8), 3732–3743. <https://doi.org/10.1007/s13197-019-03845-z>
- Izquierdo-Vega, J. A., Arteaga-Badillo, D. A., Sánchez-Gutiérrez, M., Morales-González, J. A., Vargas-Mendoza, N., Gómez-Aldapa, C. A., Castro-Rosas, J., Delgado-Olivares, L., Madrigal-Bujaidar, E., & Madrigal-Santillán, E. (2020). Organic acids from Roselle (*Hibiscus sabdariffa* L.)—A brief review of its pharmacological effects. *Biomedicines*, 8(5), 1–16. <https://doi.org/10.3390/BIOMEDICINES8050100>
- Jia, C., Han, F., Miao, X., Zhang, Q., Yan, A., & Wu, P. (2019). Study on optimization of extraction process of anthocyanin from cherry wine lees. 9(1), 18–27. <https://doi.org/10.15406/jnhfe.2019.09.00321>
- Khoo, H. E., Azlan, A., Tang, S. T., & Lim, S. M. (2017). Anthocyanidins and anthocyanins: Colored pigments as food, pharmaceutical ingredients, and the potential health benefits. *Food and Nutrition Research*, 61, 1–21. <https://doi.org/10.1080/16546628.2017.1361779>
- Kouakou, T. H., Konkon, N. G., Ayolié, K., Obouayeba, A. P., Abeda, Z. H., & Koné, M. (2015). Anthocyanin production in calyx and callus of Roselle (*Hibiscus sabdariffa* L.) and its impact on antioxidant activity. *Journal of Pharmacognosy and Phytochemistry JPP*, 4(43), 9–15. <http://www.phytojournal.com/archives/2015/vol4issue3/PartA/4-3-24.1.pdf>
- Kumar, S. (2015). Role of enzymes in fruit juice processing and its quality enhancement. *Advances in Applied Science Research*, 6(6), 114–124.
- Li, Y., Tao, F., Wang, Y., Cui, K., Cao, J., Cui, C., Nan, L., Li, Y., Yang, J., & Wang, Z. (2020). Process optimization for enzymatic assisted extraction of anthocyanins from the mulberry wine residue. *IOP Conference Series: Earth and Environmental Science*, 559, 012011. <https://doi.org/10.1088/1755-1315/559/1/012011>
- Lotfi, L., Kalbasi-Ashtari, A., Hamedi, M., & Ghorbani, F. (2015). Effects of enzymatic extraction on anthocyanins yield of saffron tepals (*Crocus sativus*) along with its color properties and structural stability. *Journal of Food and Drug Analysis*, 23(2), 210–218. <https://doi.org/10.1016/j.jfda.2014.10.011>
- Mardiah, Hasanah, R. N., Novidahlia, N., & Hasan, A. E. Z. (2018). Optimasi kondisi ekstraksi menggunakan enzim dengan response surface methodology (RSM) terhadap ekstrak kelopak bunga rosela (*Hibiscus sabdariffa* L.). *Jurnal Pertanian*, 9(2), 93–100.
- Mardiah, Zakaria, F. R., Prangdimurti, E., & Damanik, R. (2014). The effect of roselle extract (*Hibiscus sabdariffa* Linn.) on blood glucose level and total antioxidant level on diabetic rat induced by streptozotocin. *IOSR Journal of Pharmacy*, 4(10), 08–16. <https://doi.org/10.9790/3013-0401008016>
- Mardiah, Zakaria, F. R., Prangdimurti, E., & Damanik, R. (2015). Anti-inflammatory of purple Roselle extract in diabetic rats induced by streptozotocin. *Procedia Food Science*, 3, 182–189. <https://doi.org/10.1016/j.profoo.2015.01.020>
- Nguyen, C. L., & Nguyen, H. V. N. (2018). The Quality of Mulberry Juice as Affected by Enzyme Treatments. *Beverages*, 4(41), 1–12. <https://doi.org/10.3390/beverages4020041>
- Nurtiana, W. (2019). Anthocyanin as natural colorant: a review. *Food ScienTech Journal*, 1(1), 1–7. <https://doi.org/10.33512/fsj.v1i1.6180>
- Oumer, O. J. (2017). Pectinase: substrate, production and their biotechnological applications. *International Journal of Environment, Agriculture and Biotechnology*, 2(3), 1007–1014. <https://doi.org/10.22161/ijeab/2.3.1>
- Ranveer, R. C., Nanadane, A. S., Ganorkar, P. M., & Sahoo, A. K. (2020). Enzyme-assisted extraction of anthocyanin from kokum (*Garcinia indica* Choisy) rinds. *European Journal of Nutrition & Food Safety*, 12(10), 125–133. <https://doi.org/10.9734/ejnf/2020/v12i1030309>
- Riaz, G., & Chopra, R. (2018). A review on phytochemistry and therapeutic uses of *Hibiscus sabdariffa* L. *Biomedicine and Pharmacotherapy*, 102, 575–586. <https://doi.org/10.1016/j.biopha.2018.03.023>
- Sudeep, K. C., Upadhyaya, J., Joshi, D. R., Lekhak, B., Chaudhary, D. K., Pant, B. R., Bajgai, T. R., Dhital, R., Khanal, S., Koirala, N., & Raghavan, V. (2020). Production, characterization, and industrial application of pectinase enzyme isolated from fungal strains. *Fermentation*, 6(59), 1–10.

<https://doi.org/10.3390/FERMENTATION6020059>

- Tiwari, S. P., Srivastava, R., Singh, C. S., Shukla, K., Singh, R. K., Singh, P., Singh, R., Singh, N. L., & Sharma, R. (2015). Amylases: an overview with special reference to alpha amylase. *Journal of Global Biosciences*, 4(1), 1886–1901.
- Vukoja, J., Pichler, A., & Kopjar, M. (2019). Stability of anthocyanins, phenolics and color of tart cherry jams. *Foods*, 8(7), 1–9. <https://doi.org/10.3390/foods8070255>
- Yuanta, Y. (2019). Pengaruh pemberian seduhan rosella terhadap penurunan kadar asam urat wanita menopause. *ARTERI: Jurnal Ilmu Kesehatan*, 1(1), 69–75. <https://doi.org/10.37148/arteri.v1i1.23>
- Yusni, Y., & Meutia, F. (2020). Action mechanism of rosella (*Hibiscus sabdariffa* L.) used to treat metabolic syndrome in elderly women. *Evidence-Based Complementary and Alternative Medicine*, 2020, 1–6. <https://doi.org/10.1155/2020/5351318>

Proses Review artikel ilmiah dengan judul “A Synergistic of pectinase, cellulase, and glucoamylase on anthocyanin content and extraction yield of roselle petals (*Hibiscus sabdariffa* L.)”

1. Tangkapan layar proses submisi pada sistem OJS Jurnal Teknologi dan Industri Hasil Pertanian – bagian 1



The screenshot shows the submission page for article #3409 in the OJS system. The page header includes the journal title "Jurnal TEKNOLOGI & INDUSTRI HASIL PERTANIAN" and ISSN information: 2302-4399 (Online) and 1410-3044 (Print). The navigation menu includes Home, About, User Home, Search, Current, Archives, and Announcements. The main content area displays the article title "A synergistic of pectinase, cellulase, and glucoamylase on anthocyanin content and extraction yield of roselle petals (*Hibiscus sabdariffa* L.)" and the authors: Mardiah Mardiah, Noli Novidahlia, Ma'rifat Khoirunnisa, Hanafi Hanafi, Aminullah Aminullah. The submission date is August 16, 2019, at 02:15 PM. The page also shows a sidebar with various links like PLAGIARISMA.NET, FOCUS AND SCOPE, and a user login section indicating the user is logged in as aminullah.

Submission	
Authors	Mardiah Mardiah, Noli Novidahlia, Ma'rifat Khoirunnisa, Hanafi Hanafi, Aminullah Aminullah
Title	A synergistic of pectinase, cellulase, and glucoamylase on anthocyanin content and extraction yield of roselle petals (<i>Hibiscus sabdariffa</i> L.)
Original file	3409-8300-1-SM.DOC 2019-08-16
Supp. files	None
Submitter	Aminullah Aminullah
Date submitted	August 16, 2019 - 02:15 PM
Section	Articles
Editor	Ribut Sugiharto, M.Sc.
Abstract Views	460

2. Tangkapan layar proses submisi pada sistem OJS Jurnal Teknologi dan Industri Hasil Pertanian – bagian 2

Status

Status Published Vol 26, No 2 (2021): Jurnal Teknologi & Industri Hasil Pertanian
 Initiated 2021-06-24
 Last modified 2021-09-30

Submission Metadata

Authors

Name	Mardiah Mardiah
Affiliation	—
Country	—
Bio Statement	—
Name	Noli Novidahlia
Affiliation	—
Country	—
Bio Statement	—
Name	Ma'rifat Khoirunnisa
Affiliation	—
Country	—
Bio Statement	—
Name	Hanafi Hanafi
Affiliation	—
Country	—
Bio Statement	—

JOURNAL CONTENT

Search

Search Scope All

Browse

- By Issue
- By Author
- By Title
- Other Journals

RECOMMENDED TOOLS

Cover Letter & Checklist

Article Template

3. Tangkapan layar proses submisi pada sistem OJS Jurnal Teknologi dan Industri Hasil Pertanian – bagian 3

Name Aminullah Aminullah
 Affiliation —
 Country —
 Bio Statement —
 Principal contact for editorial correspondence.

Title and Abstract

Title A synergistic of pectinase, cellulase, and glucoamylase on anthocyanin content and extraction yield of roselle petals (Hibiscus sabdariffa L.)

Abstract

The Roselle petals contain anthocyanin pigment which functions as an antioxidant and a natural food colorant. The objective of this research was to study the effect of three enzymes: pectinase, cellulase, and glucoamylase, on the quality of the extract of the Roselle petals. The fresh and dried Roselle petals were extracted using distilled water in a ratio of 1:4 and divided into five parts, in which each part was added by pectinase (P) of 1000ppm; pectinase and cellulase (PC) of 500:500ppm; pectinase and glucoamylase (PG) of 500:500ppm; and pectinase, cellulase and glucoamylase (PCG) of 333:333:333ppm, and without enzyme (TE) as a control. Furthermore, 1% of citric acid was added to all treatments. Determination of the chosen treatment used was based on residue extract, anthocyanin analysis, and the pH value. The results showed that fresh Rosella extract with PC has a yield value of 7.60% and it was not significantly different from the extract with PCG which yielded 7.37%. Dried Rosella extract with PCG had the highest yield of 22.10% compared to the control (without enzyme) of 12.96%. However, the PCG addition generated a sticky product. Both fresh and dried Roselle extracts with PC contained the highest anthocyanin content of 156.64±1.30mgL⁻¹ and 35.09±0.04 mgL⁻¹, respectively. The pH values of fresh and dried Roselle extracts were 2.65 and 2.24, respectively. This research showed that the treatment of fresh and dried Roselle petals with the addition of P, PC, or PCG increased the extraction yield value. Additionally, these enzymes could also increase the anthocyanin content of the extracts.

Indexing

MENDELEY

turnitin

INDEXING JOURNAL

IPI Indonesian Publication Index

SINTA

GARUDA

Dimensions

Google Scholar

DOAJ DIRECTORY OF OPEN ACCESS JOURNALS

Crossref

4. Tangkapan layar proses submisi pada sistem OJS Jurnal Teknologi dan Industri Hasil Pertanian – bagian 4

Indexing

Keywords: anthocyanin content; enzyme treatment; extraction yield; pH value; roselle petal
Language: en

Supporting Agencies

Agencies: Ministry of Research, Technology, and Higher Education, Republic of Indonesia

References

de Ferreira, E. S., Rogez, H. L. G., & Herman, C. A. N. P. (2018). Effect of the combination of enzymatic preparations on the aqueous extraction yield of the oil from the pulp of *Euterpe oleracea* fruit. *Brazilian Journal of Chemical Engineering*, 35(4), 1193–1201. <https://doi.org/10.1590/0104-6632.20180354s20170305>

Halim, D., Sihning, E. J., & Tehupuring. (2019). The effect of roselle (*Hibiscus sabdariffa* Linn) flower extract to the SGPT activity in male wistar rats (*Rattus norvegicus*) induced by high dose paracetamol. *IOP Conference Series: Earth and Environmental Science*, 217(1). <https://doi.org/10.1088/1755-1315/217/1/012018>

Hanafi. (2009). Sifat aktivitas enzim selulase dan pectinase dalam mendegradasi dinding sel tanaman untuk tujuan ekstraksi pigmen. *Akademi Kimia Analis*.

Handique, J., Bora, S. J., & Sit, N. (2019). Optimization of banana juice extraction using combination of enzymes. *Journal of Food Science and Technology*, 56(8), 3732–3743. <https://doi.org/10.1007/s13197-019-03845-z>

Izquierdo-Vega, J. A., Arteaga-Badillo, D. A., Sánchez-Gutiérrez, M., Morales-González, J. A., Vargas-Mendoza, N., Gómez-Aldapa, C. A., Castro-Rosas, J., Delgado-Olivares, L., Madrigal-Bujaidar, E., & Madrigal-Santillán, E. (2020). Organic acids from Roselle (*Hibiscus sabdariffa* L.)—A brief review of its pharmacological effects. *Biomedicine*, 8(5), 1–16. <https://doi.org/10.3390/BIOMEDICINES8050100>

Jia, C., Han, F., Miao, X., Zhang, Q., Yan, A., & Wu, P. (2019). Study on optimization of extraction process of anthocyanin from cherry wine lees. 9(1), 18–27. <https://doi.org/10.15406/jnhfe.2019.09.00321>

Khoo, H. E., Azlan, A., Tang, S. T., & Lim, S. M. (2017). Anthocyanidins and anthocyanins: Colored pigments as food, pharmaceutical ingredients, and the potential health benefits. *Food and Nutrition Research*, 61, 1–21. <https://doi.org/10.1080/16546628.2017.1361779>

Crossref

COLLABORATE WITH

Patpi
supported by
iJRELAWAN
JURNAL INDONESIA

KEYWORDS

Asam amino, Jamur tiram putih, Senyawa aroma, Tekstur HACCP, Halal logos, Product quality, Purchasing decisions, Tempe chips Snack bars, antihypercholesterol cookies dahlia tuber flour edible film tapioka termodifikasi ikan tele dumbo instant chocolate, ASLT, Arrhenius, shelf life margarine modifikasi HMT modifikasi OSA pati bengkuang pati ganyong pati modifikasi quality control red dragon fruit peel ruspi, ikan rucah, sifat mikrobiologi, sensor dan kimia tepung talas Bogor

5. Tangkapan layar proses submisi pada sistem OJS Jurnal Teknologi dan Industri Hasil Pertanian – bagian 5

Kouakou, T. H., Konkon, N. G., Ayolié, K., Obouayeba, A. P., Abeda, Z. H., & Koné, M. (2015). Anthocyanin production in calyx and callus of Roselle (*Hibiscus sabdariffa* L.) and its impact on antioxidant activity. *Journal of Pharmacognosy and Phytochemistry JPP*, 4(43), 9–15. <http://www.phytojournal.com/archives/2015/vol4issue3/PartA/4-3-24.1.pdf>

Kumar, S. (2015). Role of enzymes in fruit juice processing and its quality enhancement. *Advances in Applied Science Research*, 6(6), 114–124.

Li, Y., Tao, F., Wang, Y., Cui, K., Cao, J., Cui, C., Nan, L., Li, Y., Yang, J., & Wang, Z. (2020). Process optimization for enzymatic extraction of anthocyanins from the mulberry wine residue. *IOP Conference Series: Earth and Environmental Science*, 559, 012011. <https://doi.org/10.1088/1755-1315/559/1/012011>

Lotfi, L., Kalbasi-Ashtari, A., Hamed, M., & Ghorbani, F. (2015). Effects of enzymatic extraction on anthocyanins yield of saffron tepals (*Crocus sativus*) along with its color properties and structural stability. *Journal of Food and Drug Analysis*, 23(2), 210–218. <https://doi.org/10.1016/j.jfda.2014.10.011>

Mardiah, Hasanah, R. N., Novidahlia, N., & Hasan, A. E. Z. (2018). Optimasi kondisi ekstraksi menggunakan enzim dengan response surface methodology (RSM) terhadap ekstrak kelopak bunga rosela (*Hibiscus sabdariffa* L.). *Jurnal Pertanian*, 9(2), 93–100.

Mardiah, Zakaria, F. R., Prangdimurti, E., & Damanik, R. (2014). The effect of roselle extract (*Hibiscus sabdariffa* Linn.) on blood glucose level and total antioxidant level on diabetic rat induced by streptozotocin. *IOSR Journal of Pharmacy*, 4(10), 08–16. <https://doi.org/10.9790/3013-0401008016>

Mardiah, Zakaria, F. R., Prangdimurti, E., & Damanik, R. (2015). Anti-inflammatory of purple Roselle extract in diabetic rats induced by streptozotocin. *Procedia Food Science*, 3, 182–189. <https://doi.org/10.1016/j.profoo.2015.01.020>

Nguyen, C. L., & Nguyen, H. V. N. (2018). The Quality of Mulberry Juice as Affected by Enzyme Treatments. *Beverages*, 4(41), 1–12. <https://doi.org/10.3390/beverages4020041>

Nurtiana, W. (2019). Anthocyanin as natural colorant: a review. *Food ScienTech Journal*, 1(1), 1–7. <https://doi.org/10.33512/fsj.v1i1.6180>

Oumer, O. J. (2017). Pectinase: substrate, production and their biotechnological applications. *International Journal of Environment, Agriculture and Biotechnology*, 2(3), 1007–1014. <https://doi.org/10.22161/ijeab/2.3.1>

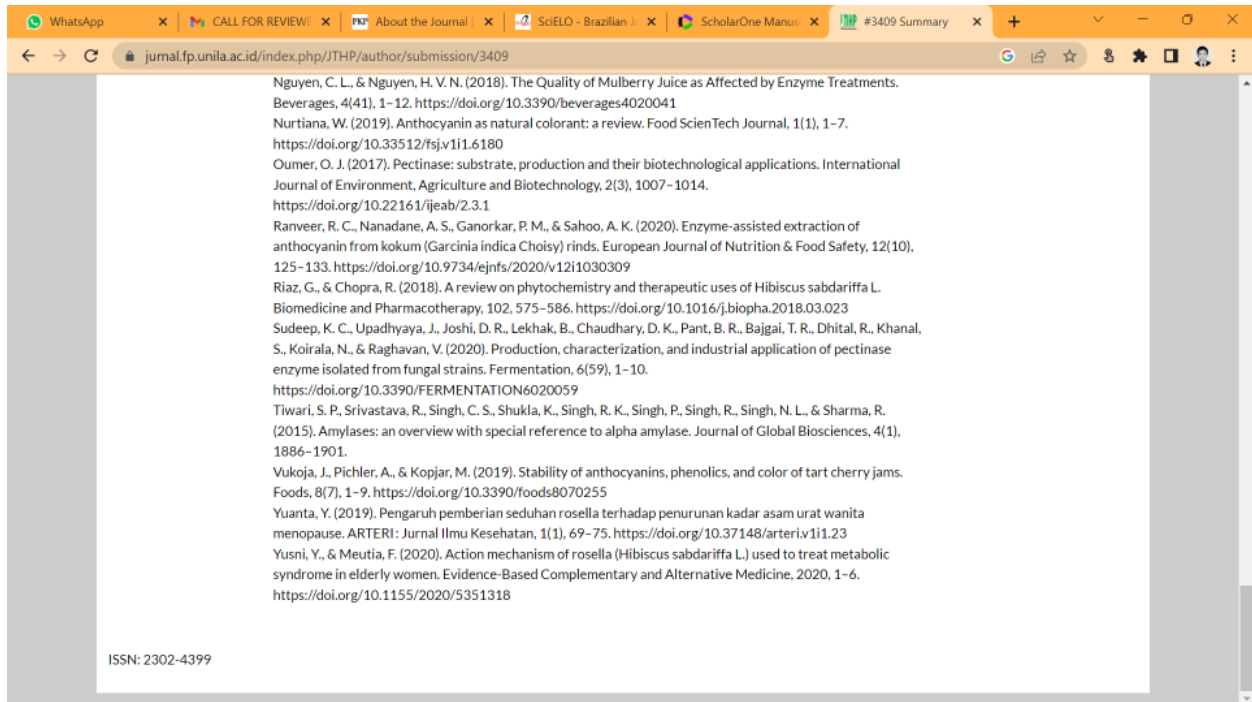
Ranveer, R. C., Nanadane, A. S., Ganorkar, P. M., & Sahoo, A. K. (2020). Enzyme-assisted extraction of anthocyanin from kokum (*Garcinia indica* Choisy) rinds. *European Journal of Nutrition & Food Safety*, 12(10), 125–133. <https://doi.org/10.9734/ejns/2020/v12i1030309>

Yellow pumpkin powder

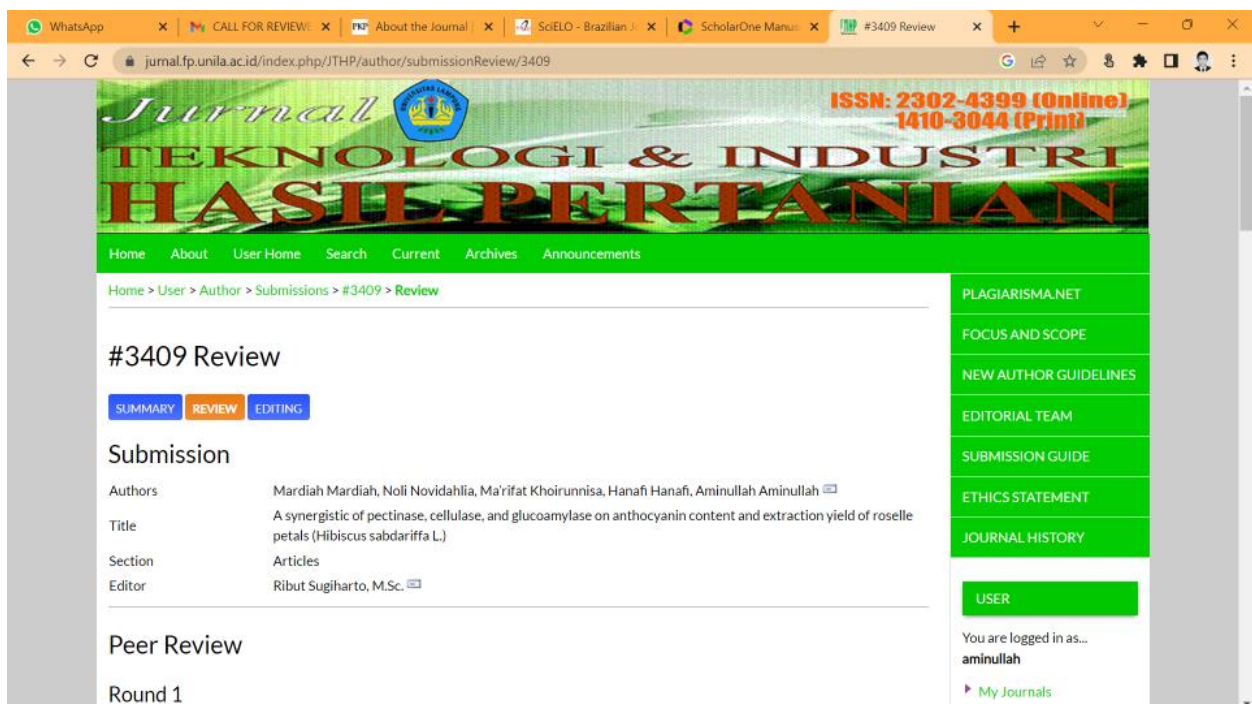
00488450
View My Stats

433,477 views
FLAG

6. Tangkapan layar proses submisi pada sistem OJS Jurnal Teknologi dan Industri Hasil Pertanian – bagian 6



7. Tangkapan layar proses review pada system OJS Jurnal – bagian 1



8. Tangkapan layar proses review dan proses revisi pada system OJS Jurnal – bagian 2

The screenshot shows the 'Peer Review' section for submission #3409. It is divided into 'Round 1' and 'Editor Decision'.

Round 1

Review Version	3409-8301-2-RV.DOC	2019-12-12
Initiated	2019-12-12	
Last modified	2020-09-10	
Uploaded file	Reviewer A 3409-8946-1-RV.DOC	2020-01-07
	Reviewer B 3409-11478-2-RV.DOCX	2020-09-10

Editor Decision

Decision	Accept Submission	2021-03-22
Notify Editor	Editor/Author Email Record	2021-03-08
Editor Version	3409-8825-1-ED.DOCX	2021-03-22
Author Version	3409-9624-1-ED.DOC	2020-03-23 DELETE
	3409-9624-2-ED.DOC	2020-11-15 DELETE
	3409-9624-3-ED.DOCX	2021-03-16 DELETE

Upload Author Version: No file chosen

ISSN: 2302-4399

Right sidebar: You are logged in as... aminullah. My Journals, My Profile, Log Out. JOURNAL CONTENT. Search: Search Scope: All . Browse: By Issue, By Author, By Title, Other Journals. Cover Letter & Checklist.

9. Tangkapan layar proses editing and poses proof pada system OJS Jurnal – bagian 1

The screenshot shows the '#3409 Editing' page. It features a header for 'Jurnal TEKNOLOGI & INDUSTRI HASIL PERTANIAN' with ISSN 2302-4399 (Online) and 1410-3044 (Print). The navigation menu includes Home, About, User Home, Search, Current, Archives, and Announcements.

Home > User > Author > Submissions > #3409 > Editing

#3409 Editing

SUMMARY REVIEW EDITING

Submission

Authors	Mardiah Mardiah, Noli Novidahlia, Ma'rifat Khoirunnisa, Hanafi Hanafi, Aminullah Aminullah
Title	A synergistic of pectinase, cellulase, and glucoamylase on anthocyanin content and extraction yield of roselle petals (<i>Hibiscus sabdariffa</i> L.)
Section	Articles
Editor	Ribut Sugiharto, M.Sc.

Copyediting

[COPYEDIT INSTRUCTIONS](#)

Right sidebar: PLAGIARISMA.NET, FOCUS AND SCOPE, NEW AUTHOR GUIDELINES, EDITORIAL TEAM, SUBMISSION GUIDE, ETHICS STATEMENT, JOURNAL HISTORY, USER. You are logged in as... aminullah. My Journals.

10. Tangkapan layar proses editing and poses proof pada system OJS Jurnal – bagian 2

The screenshot displays the 'Copyediting' section of the OJS submission editing interface. The page is titled 'Copyediting' and includes a 'COPYEDITING INSTRUCTIONS' link. Below this, there is a table with the following structure:

REVIEW METADATA	REQUEST	UNDERWAY	COMPLETE
1. Initial Copyedit File: None	–	–	–
2. Author Copyedit File: None <input type="button" value="Choose File"/> No file chosen <input type="button" value="Upload"/>	–	–	<input type="checkbox"/>
3. Final Copyedit File: None	–	–	–

Below the table, there is a 'Copyedit Comments' section with 'No Comments'.

The 'Layout' section is also visible, showing a table with the following structure:

Galley Format	FILE	
1. PDF VIEW PROOF	3409-14102-1-PB.PDF	2021-07-25 226
Supplementary Files	FILE	None

Below the layout table, there is a 'Layout Comments' section with '2021-07-26'.

The 'Proofreading' section is partially visible at the bottom of the screenshot.

On the right side of the interface, there is a sidebar with the following elements:

- You are logged in as... **aminullah**
- My Journals
- My Profile
- Log Out
- JOURNAL CONTENT**
- Search
- Search Scope: All
- Search
- Browse
- By Issue
- By Author
- By Title
- Other Journals
- Cover Letter & Checklist

11. Tangkapan layar proses editing and poses proof pada system OJS Jurnal – bagian 3

The screenshot displays the 'Proofreading' section of the OJS submission editing interface. The page is titled 'Proofreading' and includes a 'PROOFING INSTRUCTIONS' link. Below this, there is a table with the following structure:

REVIEW METADATA	REQUEST	UNDERWAY	COMPLETE
1. Author	2021-07-25	2021-07-26	<input checked="" type="checkbox"/> 2021-07-26
2. Proofreader	–	–	–
3. Layout Editor	–	–	–

Below the table, there is a 'Proofreading Corrections' section with 'No Comments'.

The 'Layout' section is also visible at the top of the screenshot, showing a table with the following structure:

Galley Format	FILE	
1. PDF VIEW PROOF	3409-14102-1-PB.PDF	2021-07-25 226
Supplementary Files	FILE	None

Below the layout table, there is a 'Layout Comments' section with '2021-07-26'.

The 'ISSN' is listed as 2302-4399.

On the right side of the interface, there is a sidebar with the following elements:

- Browse
- By Issue
- By Author
- By Title
- Other Journals
- Cover Letter & Checklist
- Article Template
- RECOMMENDED TOOLS**
- MENDELEY
- turnitin
- INDEXING JOURNAL**
- Indonesian Publication Index

Tangkapan layar penerbitan pada system OJS Jurnal

The screenshot shows a web browser window displaying the OJS journal website. The browser's address bar shows the URL: `jurnal.fp.unila.ac.id/index.php/JTHP/issue/view/362/showToc`. The website header features the journal title "Jurnal TEKNOLOGI & INDUSTRI HASIL PERTANIAN" in large, bold letters, with the ISSN numbers "ISSN: 2302-4399 (Online)" and "1410-3044 (Print)" to the right. Below the header is a navigation menu with links for Home, About, Login, Register, Search, Current, Archives, and Announcements. The main content area displays "Home > Archives > Vol 26, No 2 (2021)" and "Vol 26, No 2 (2021)" in large text, followed by "Jurnal Teknologi & Industri Hasil Pertanian" and "Table of Contents". A list of articles is shown, with the first article titled "A synergistic of pectinase, cellulase, and glucoamylase on anthocyanin content and extraction yield of roselle petals (Hibiscus sabdariffa L.)" by Mardiah Mardiah, Noli Novidahlia, Ma'rifat Khoirunnisa, Hanafi Hanafi, and Aminullah Aminullah, with a page range of 65-71. A sidebar on the right contains a vertical menu of links: PLAGIARISMA.NET, FOCUS AND SCOPE, NEW AUTHOR GUIDELINES, EDITORIAL TEAM, SUBMISSION GUIDE, ETHICS STATEMENT, and JOURNAL HISTORY. At the bottom of the sidebar, there is a "USER" section with a "Username" field containing the text "aminullah". The browser's taskbar at the bottom shows several open PDF files, including "2021_Aminullah_E...pdf", "2021_Aminullah_A...pdf", and "2020_Aminullah_S...pdf".

Tangkapan layar proses Dari email

The screenshot shows a Gmail interface with a search bar containing 'jthp'. The email is titled 'Article Revision 3409-8301-2-RV' and is from Aminullah A (aminullah@unida.ac.id) to Jurnal, Mardiah. The email content includes a greeting to the Editor in Chief at JTIHP Univ of Lampung, a statement that the manuscript has been revised based on reviewer comments, and the authors' details: Department of Food Technology and Nutrition, Faculty of Halal Food Science, Djuanda University, Bogor-Indonesia. An attachment is visible at the bottom, labeled '3409-8301-2-RV-...'. The browser address bar shows a URL with various parameters.

The screenshot shows a Gmail interface with a search bar containing 'neti'. The email is titled 'format revision is required' and is from NETI YULIANA (neti.yuliana@fp.unila.ac.id) to me. The email content includes a decision regarding a submission to Jurnal Teknologi & Industri Hasil Pertanian, stating that a new format revision is required. The sender's details are: Prof. Ir.Ph.D Neti Yuliana (Scopus ID:57193898408), Department of Agricultural Product Technology, Faculty of Agriculture, Lampung University. At the bottom, there are three buttons: 'Noted with thanks.', 'Thank you for informing me.', and 'Thanks a lot.'. Below these are 'Reply' and 'Forward' buttons. The browser address bar shows a URL with various parameters.

Revisi artikel Mardiah et al - am... x +

mail.google.com/mail/u/0/#search/neti/KtbxLxgdFjvFRNSCQMZdVqZmfGIZzLTVv

neti

Active

3 of 15

Revisi artikel Mardiah et al

Aminullah A <aminullah@unida.ac.id>
to NETI, Mardiah, Mardiah, Noli

Wed, Jul 14, 2021, 5:33 PM

Kepada Yth
Ketua editor Jurnal Teknologi dan Industri Hasil Pertanian
di tempat

Berikut kami kirimkan revisi dari artikel kami yang berjudul "A synergistic of pectinase, cellulase, and glucoamylase on anthocyanin content and extraction yield of roselle petals (Hibiscus sabdariffa L.)". Terima kasih

Salam hormat,
Aminullah
Department of Food Technology and Nutrition
Faculty of Halal Food Science
Djuanda University
Bogor-Indonesia

One attachment • Scanned by Gmail

Revisi2_A synergL...

[JTIHP] Proofreading Request (A... x +

mail.google.com/mail/u/0/#search/neti/FMfcgzGkZZnGbHLDtkNfpVkJTqmhzdF

neti

Active

2 of 15

[JTIHP] Proofreading Request (Author) External Inbox x

Prof. Ir.Ph.D Neti Yuliana <neti.yuliana@fp.unila.ac.id>
to me, M.Sc.

Mon, Jul 26, 2021, 6:22 AM

Aminullah Aminullah:

Your submission "A SYNERGISTIC OF PECTINASE, CELLULOSE, AND GLUCOAMYLASE ON ANTHOCYANIN CONTENT AND EXTRACTION YIELD OF ROSELLE PETALS (Hibiscus sabdariffa L.)" to Jurnal Teknologi & Industri Hasil Pertanian now needs to be proofread by following these steps.

1. Click on the Submission URL below.
2. Log into the journal and view PROOFING INSTRUCTIONS
3. Click on VIEW PROOF in Layout and proof the galley in the one or more formats used.
4. Enter corrections (typographical and format) in Proofreading Corrections.
5. Save and email corrections to Layout Editor and Proofreader.
6. Send the COMPLETE email to the editor.

Submission URL:
<http://jurnal.fp.unila.ac.id/index.php/JTIHP/author/submissionEditing/3409>
Username: aminullah

Prof. Ir.Ph.D Neti Yuliana
(Scopus ID:57193898408)
Department of Agricultural Product Technology, Faculty of Agriculture,
Lampung University
neti.yuliana@fp.unila.ac.id