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Comparison of Nutritional Content of *Mangifera indica* L. var. *Wirasangka* with Three Other Varieties in Tegal Regency

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Abstract. *Mangifera indica* L. var. *wirasangka* or *wirasangka* mango, a local plant in Tegal Regency, has a low population because it is rarely planted by people as its unknown nutritional content. To increase people's interest in planting, it is necessary to know the nutritional content of *wirasangka* mango. The aim of the study was to compare the nutritional content of *wirasangka* mango with three other varieties in Tegal Regency. This study used a one-factor completely randomized design. The factor was the mango variety which included six varieties, namely the varieties of *wirasangka* from three areas, *okyong*, *tengkoeh*, and *golek*. The variables observed were content of water, fiber, fructose, β-carotene, potassium and iron, as well as vitamin C and antioxidant activity. Normally distributed data were analyzed using One-Way Analysis of Variance and Least Significant Difference (LSD) test. Besides, the non-normally distribution data were analyzed using Kruskal Walis and continued with post-hoc test, i.e. Mann-Whitney. The results showed that the levels of water, dietary fiber, fructose, β-carotene, and iron were significantly different at the significance level of 0.1. *Wirasangka* mango has a higher fiber, and fructose content, but lower of β-carotene and iron content compared to *okyong*, *tengkoeh* and *golek* mangoes. The levels of vitamin C, potassium, and antioxidant activity of *wirasangka* mango were equivalent to the three other varieties studied. Thus the *wirasangka* mango has advantages which are expected to increase the interest of people in Tegal Regency to plant this variety. As a result, its population in the future will also increase.

Key words: nutritional content; antioxidant activity; *Wirasangka mango*; Tegal

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INTRODUCTION

Mango (*Mangifera indica* L.) is known as one of the most popular fruits in the world. The varieties of mango are various and each has a specific character. The *wirasangka* variety mango was chosen as the typical plant of Tegal Regency and has been declared as a local variety by the Agriculture Ministry of Republic of Indonesia. The acknowledgment should captivate the people's concern in planting *wirasangka* trees, so then multiply its population and enlarge the existence. However, the opposite is true. In reality, this variety is rarely cultivated. Preliminary observation showed that in all areas of Tegal Regency, the number of *wirasangka* mango trees is only around 130 trees, much smaller than other mango varieties.

The small population of *wirasangka* mango is caused by the low interest of the community in planting this mango. This is due to the fact that this variety is not well known among the people, so its selling power is low. This is strongly presumed because most people do not know the nutritional content of *wirasangka* mango (Rahayu & Martin, 2018). In addition, in some people of Tegal Regency, there is an opinion that the *wirasangka* mango is identical to three other varieties, namely *golek*, *okyong*, and *tengkoeh*. However, the results of research by Rahayu et al. (2019) showed that the three varieties differ based on microsatellite markers. Information about nutritional content is very useful to attract people to buy a commodity, and high buying interest will increase selling power which will also improve the desire of cultivating *wirasangka* mango.

Several stdies analyzing the chemical content of many varieties of mango have been carried out in various countries. The nutrients in mangoes can be categorized into three categories, namely macronutrients (carbohydrates, proteins, amino acids, lipids, and fatty and organic acids), micronutrients (vitamins and minerals), and phytochemicals (phenolic, polyphenol, pigments, and volatile) (Maldonado-Celis et al., 2019). Mango fruit also contains structural fiber which is composed of pectin. In addition, mangoes also contain bioactive components, including pigments. The best known pigments in this fruit are chlorophylls and carotenoids. Volatile compounds are also contained in this fruit. The volatile compounds make mangoes smell specific (Guiamba, 2016). Man-

goes contain macro minerals such as potassium and micro minerals such as iron (Maldonado-Celis et al., 2019) The potassium content of local Tanzania mangoes (dodo mango) is 192.76 mg/100gram. Potassium is an intracellular ion and is associated with an exchange mechanism with sodium. Dodo mango contains iron of 0.52 mg/100gram (Peter et al., 2007; Kothalawala & Jayasinghe, 2017). Moreover, the peel and seed of mango can act as an alternative in blood sugar control (Putri et al., 2017)

Other studies have been carried out on several varieties of mangoes in Indonesia. The mango varieties of *podang urang* and *podang lumut* contain 80% of water, about 15% of total sugar, and various vitamins, such as vitamins A, B, and C. The fructose levels of the two varieties are respectively 1.086 g/100g and 0.901g/100g measured using the UV-Vis spectrophotometric method (Yuliati & Kurniawati, 2017). In the *golek* mango, the vitamin C content is 79.3 mg/100g in ripe fruit (Rahman et al., 2015). Vitamin C of the *arum-manis* mango fruit is 62.75% (Mulangsari at al., 2017). Vitamin C can act as an antioxidant to prevent free radical oxidation. The compound commonly used as a model for measuring free radical scavenging power is 1,1-diphenyl-2-picrihydazyl (DPPH). It is a stable free radical compound, as a result, when it is used as a reagent in the free radical scavenging test it is sufficient to dissolve and when it is stored in dry conditions with good storage conditions it will be stable for years (Tristantini et al., 2016)

As a typical plant of Tegal Regency, the nutritional content of the *wirasangka* mango had not been known before. Based on this fact, this research aimed to analyze the nutritional content of *wirasangka* mango variety. Research on the nutritional content of the typical fruit of a regency had never been conducted before. In this study, the nutritional content of the *wirasangka* mango was compared with the *okyong*, *tengkoeh*, and *golek* varieties which are often considered identical to the *wirasangka* mango. The results of this study were expected to be useful for increasing the motivation and interest of the people of Tegal Regency in cultivating the *wirasangka* mango.

METHODS

This study used a one-factor completely randomized design (CRD), namely mango varieties consisted of six varieties (*wirasangka* from Pangkah District, *wirasangka* from Slawi District, *wirasangka* from Talang District, *okyong*, *tengkoeh*, and *golek)*. The research was conducted with six replications. The variables observed were content of water, dietary fiber, fructose, potassium, iron, β-carotene, vitamin C, and antioxidant activity. The research was conducted at the Biochemistry Laboratory of the Department of Biology, Faculty of Mathematics and Natural Sciences, UNNES and Food Technology Laboratory of Soegijapranata Catholic University Semarang from November 2019 to January 2020.

The research materials used were the mango varieties of *wirasangka*, *okyong*, *tengkoeh* and *golek* which were taken when they were ripe on the tree, with a distinctive strong aroma, and greenish or yellowish orange color. The mangoes were harvested from trees growing in Pangkah, Slawi and Talang Districts, Tegal Regency. Fresh mango samples that were free from pests were washed with distilled water to remove dust. After that, the mango fruits were peeled and cut into small pieces to test their nutritional content.

Nutritional content analysis used certain relevant techniques. The analyses used were oven method for water content, gravimetric method for crude fiber content, modified method from Pratiwi et al. (2018) for fructose, UV-Vis spectrophotometry method for β-carotene, Skoog method for vitamin C levels, and UV-Vis spectrophotometry method for antioxidant activity (Patel et al., 2016),

The normally distributed data were analyzed using One-Way Analysis of Variance to determine the differences in the nutritional content of fruit between varieties. When the results of the analysis of variance were significant, the analysis was followed by the Least Significant Difference (LSD) test. The data were analyzed using Kruskal Wallis, followed by a post-hoc Mann Whitney test when they did not normally distribute.

RESULTS AND DISCUSSION

The nutritional properties of mango varieties in Tegal, i.e. *wirasangka, golek, tengkoeh*, and *okyong* (Figure 1) were analyzed and compared. Each value in table 1 and 2 represents the average from six replications and the results are expressed as mean values ± standard deviations (SD).

Figure 1. Four varieties of mango studied. From left to right: the *wirasangka*, *golek*, *tengkoeh*, and *okyong* varieties.

The results of statistical tests showed that the levels of water, fiber, fructose, β-carotene, and iron were significantly affected by varieties (Table 1 and Table 2), while the other parameters were not significantly different at the significance level of 0.1 (Table 2). This result is in accordance with several previous studies that the content of certain nutrients in mangoes varies between varieties (Okoth et al. 2013, Leghari et al., 2013; Guiamba, 2016).

Table 1. Means and deviation standard of contents of water, fiber, fructose, and β-carotene of various mango variety

Variety	Content			
	water (%)	fiber (%)	fructose (%)	β-carotene (mg/100g)
WM1	82.32 a ± 0.53	2.11 a ± 0.05	1.22 b ± 0.35	0.043 c ± 0.009
WM2	72.25 b ± 1.56	2.22 a ± 0.07	1.20 b ± 0.54	0.039 c ± 0.019
WM3	82.49 a ± 0.56	1.93 ab ± 0.06	1.54 a ± 0.16	0.038 c ± 0,006
Tengkoeh	83.94 a ± 2.00	2.06 a ± 0.06	0.29 c ± 0.22	0.115 a ± 0.1 33
Okyong	75.40 b ± 0.21	1.25 c± 0.08	1.61 a ± 0.15	0.023 c ± 0.009
Golek	79.52 a ± 1.84	1.79 b± 0.02	1.21 b ± 0.15	0.085 b ± 0.002

WM: wirasangka mango; 1 from Pangkah, *2* from Slawi, *3* from Talang
*Values in one column followed by the same letter are not significantly different at sig. 0.1

Table 2. Means and deviation standard of contents of vitamin C, antioxidant activity, potassium, and iron of various mango variety

Variety	vitamin C content (ppm)	antioxidant activity (%)	Potassium content (mg/g)	Iron content (mg/g)
WM1	114.69±4.21	35.95±11.12	83.14±49.74	0.193 c ± 0.055
WM2	117.64±3.18	41.71±18.22	95.67±16.21	0.239 c ± 0.068
WM3	110.84±3.49	55.67±16.67	81.39±19.99	0.204 c ± 0.064
Tengkoeh	110.84±3.86	58.71±18.25	144.85±32.44	0.211 c ± 0.057
Okyong	110.54±2.19	48.26±27.84	91.23±50.41	0.355 a ± 0.079
Golek	109.96±2.04	20.61±1.11	97.61±58.05	0.271 b ± 0.017

WM: wirasangka mango; 1 from Pangkah, *2* from Slawi, *3* from Talang
*Values in one column followed by the same letter are not significantly different at sig. 0.1

Mango is a climacteric fruit. In general, climacteric fruit ripening is a physiological, biochemical, and molecular change characterized by a number of events, such as changes in aroma, taste (sugar and acid levels), color, and texture (Bouzayen et al., 2010). In addition, harvesting techniques can also affect the total content of carotenoids, phenolic compounds, vitamin C, antioxidant capacity, and organoleptic properties (Maldonado-Celis et al., 2019).

Water content

The results of this study showed that the water content varied between varieties with a range between 72.25 and 83.94% (Table 1). The *wirasangka* mango from Slawi has the lowest moisture content. In several other studies, the water content of mango was equivalent to the results of this study, such as in several varieties of mangoes in Kenya (between 79.96 - 85.83%) (Okoth at al., 2013), *lali jiwa* mango in Blora (83.15%) (Haskarini et al., 2019), and in a number of mango varieties in various countries (78.0 - 82.8%) (Maldonado-Celis, 2019).

The water content of the fruit is determined by the amount of water in the fruit cells. In the process of fruit ripening, genes control the degradation of cell membranes and cell walls (Bouzayen et al., 2010). This occurs due to the release of galactose, de-esterification and de-polymerization of xyloglucan, hemicellulose, and other polysaccharides which reduce the strength of the cell walls. As a result, the cell wall is elastic, water can enter, and the cell wall expands so that the cells and fruit become large and the texture become softer (Bouzayen et al., 2010).

Water is an important component in mangoes because it affects the appearance, texture, and taste of the fruit and determines the freshness and durability of the fruit. In general, the durability of fruit is closely related to the water content. This durability determines the shelf life, the higher the water content, the shorter the fruit shelf life. Thus, it can be said that WM2 (*wirasangka* mango from Slawi) has a longer shelf life than other varieties.

Fiber content

The results showed that the dietary fiber content varied between varieties, ranging from 1.25 to 2.22%, and *wirasangka* mangoes from Pangkah and Slawi were the highest among them (Table 1). This level is lower than the fiber content of the *garifta* mango variety as much as 2.11-3.66 (Irfianti & Sunarharum, 2019), but higher than the fiber content of several mango varieties in Kenya, which are 0.16-0.45% (Okoth, 2013) and from various countries (0.85-1.06%) (Maldonado-Celis et al., 2019). Based on this fact, it can be stated that the *wirasangka* mango is a fruit that supports the digestive health of human because it contains high enough fiber.

Fructose levels

Fructose content varied among the mango varieties studied, ranging from 0.29 to 1.61%. The fructose of *wirasangka* mango varieties from Talang was equal to *okyong* and higher than others (Table 1). The range of fructose levels in this study was equal to the fructose levels in the *podang urang* and *podang lumut* varieties, namely 1.086% and 0.901%, respectively (Yuliati & Kurniawati, 2017).

Fructose is a type of monosaccharide isomer of glucose ($C_6H_{12}O_6$) which contains a ketone carbonyl group (Desmawati, 2017). In most fruits, the taste development that occurs at the ripening is an increase in sweetness, which is the result of various metabolic changes that lead to the accumulation of monosaccharide sugars (Bonghi & Manganaris, 2012; Beauvoit et al., 2018) that are stored in vacuoles (Bouzayen et al., 2010). The form of monosaccharide deposits that are widely found in fruit, include mango, is fructose. For humans, fructose sugar is generally safer for health because it does not cause high blood sugar levels.

Levels of β-carotene, vitamin C, and antioxidant activity

Among the four mango varieties studied, the β-carotene content varied with a range of 0.023 to 0.115 mg/100g or 23-115 µg/100g; *wirasangka* mango contains 38-43 µg/100g (Table 1). Mangoes in various countries contain β-carotene of around 640 µ/100 g (Maldonado-Celis, 2019). This means that the *wirasangka* mango has a lower β-carotene content.

The β-carotene compound is one of the carotenoids, which is a large group of lipophilic pigments that cause yellow, orange, and red colors. Carotenoids are generally found in chloroplast and chromoplast membranes (Garcia & Alejo, 2013; Beauvoit et al., 2018). In addition to play a role in pigmentation, carotenoids are also important for human health as a source of vitamin A and antioxidant components. These compounds are synthesized in the fruit at high speed during the transition from chloroplast to chromoplast.

In the mango varieties studied, vitamin C levels varied with a range of 109.96 to 117.64 ppm, but this difference was not statistically significant (Table 2). *Wirasangka* mango has a vitamin C content of 110.84-117.64 ppm. This amount is higher than that the *gadung* mango at 101.8 ppm (Nerdy, 2013), *podang lumut* mango at 111.39 ppm (Yuliati & Kurniawati, 2017), and *lali jiwa* mango at 60 ppm (Haskarini et al., 2019); but lower than *podang urang* variety at 122.82 ppm (Yuliati & Kurniawati, 2017). Factors that affect vitamin C levels are maturity level, location of growth, fertilization evidence, and varieties (Rahman et al, 2015). Like β-carotene, vitamin C also has strong anti-oxidant properties (Pakaya, 2014).

The results showed that the antioxidant activity varied between the mango varieties studied, ranging from 20.61 to 58.71%, but this difference was not statistically significant (Table 2). *Wirasangka* mango has antioxidant activity between 35.95-55.67%. This amount is higher than the antioxidant activity of the *arum manis* mango, which is 34.64% (Nurdianti & Rahmiyani, 2016) and in five commercial mango varieties in Mexico, Peru, Brazil, and Ecuador, ranging from 3.09-39.02% (Manthey & Veazie, 2009). The results of this study are in line with Suwardike et al. (2019) that the types and potential content of antioxidant compounds in mangoes vary according to varieties.

Antioxidants are substances that can avoid free radicals that are formed from the results of oxidative metabolism (Mandal et al., 2009). This element is unstable and very reactive, therefore it tends to react with other molecules to achieve stability. Radicals with high reactivity can start a chain reaction, giving rise to abnormal compounds and initiating chain reactions that can damage important cells in the body (Badarinath et al., 2010). Based on the description above, it can be stated that the β-carotene and vitamin C content of *wirasangka* mangoes is higher than several other varieties in Indonesia. As a result, the antioxidant activity is also higher. This is an advantage that consuming *wirasangka* mangoes will be able to better maintain human health.

Potassium and iron levels

The results showed that the potassium content varied between varieties, ranging from 81.39 to 144.85 mg/100g, but the difference was not statistically significant. *Wirasangka* mango had potassium levels between 81.39-95.67 mg/100g (Table 2). This amount was much higher than the average potassium content of mangoes in various mango of the worlds (0-40 mg/100g) (Maldonado-Celis, 2019), but lower

than the *arum manis* mango which has a potassium content of 189 mg/100g (Nurdianti & Rahmiyani, 2016) and *dodo* mango at 192.76 mg/100g (Peter et al., 2007)

The results showed that the iron content varied between varieties, ranging from 0.193 to 0.355 mg/100 g. *Wirasangka* mango has iron levels between 0.193-0.239 mg/100g (Table 2). This amount is in the moderate category range compared to the average iron content of mangoes in various countries, which is 0.090-0.410 mg/100 g, equivalent to mango *golek* which contains 1.90mg/100g Fe content (Rahman et al. 2015), and lower than that *dodo* mango at 0.52mg/100gr (Peter et al., 2007).

Generally, it can be stated that the *wirasangka* mangoes from three locations of Tegal Regency have no significant difference from one to the other. The only difference is that the *wirasangka* mango from Slawi has lower water content, and the one from Talang has higher fructose content than the two other places. This is presumably due to differences in micro environment conditions and maintenance intensity. Compared to *okyong*, *tengkoeh*, and *golek* mangoes, *wirasangka* mangoes have higher water, fiber, and fructose content, lower β-carotene and iron content, and equal vitamin C, potassium, and antioxidant activity

Compared to varieties of *tengkoeh, golek and okyong*; the *wirasangka* mango has equality, superiority, and inadequacy. The vitamin C, antioxidant activity, and potassium content of *wirasangka* mangoes are generally equivalent to *tengkoeh, golek and okyong.* The fiber content is higher than *golek and okyong*. The levels of fructose of *wirasangka* from Talang and *okyong* are higher than other varieties studied, otherwise the iron content of *wirasangka* mango is lower than other varieties studied.

Based on the superiority and inadequacy of nutrient content, it is very feasible that the *wirasangka* mango had been chosen as a typical plant of Tegal Regency. Therefore, it is hoped that the community will not hesitate to plant the *wirasangka* mangoes. As a result, it is expected that in the future the population of *wirasangka* mango will increase.

CONCLUSION

It was concluded that *wirasangka* mangoes had relatively higher fiber and fructose content, but lower β-carotene and iron content compared to *okyong*, *tengkoeh* and *golek* mangoes. Content of vitamin C and potassium, and antioxidant activity of *wirasangka* mangoes had equivalent levels with the three other varieties studied.

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REFERENCES

Badarinath, A., Rao, K., Chetty, C.S., Ramkanth S., Rajan, T., & Gnanaprakash K. (2010). A review on in-vitro antioxidant methods: comparisons, correlations, and considerations. *International Journal of PharmTech Research*, 2(2), 1276-1285.

Beauvoit, B., Belouah , I., Berlin, N., Cakpo, C., Colombie, S., Dai, Z., Gautier, H., Genard, M., Moing, A., Roch, L., Vercambre, G., & Gibon, Y. (2018). Putting primary metabolism into perspective to obtain better fruits. *Jurnal Ann Bot.*, 122(1), 1-21.

Bonghi, C., & Manganaris, G.A. (2012). *Systems Biology Approaches Reveal New Insights into Mechanisms Regulating Fresh Fruit Quality (OMICs Technologies)*. CRC Press: United States

Bouzayen, M., Latché, A., Pavendra, N., & Pech, J.C. (2010). *Plant Developmental Biology - Biotechnological Perspectives.* Springer: Berlin, Heidelberg

Desmawati. (2017). Pengaruh Asupan Tinggi Fruktosa Terhadap Tekanan Darah. *Majalah Kedokteran Andalas, 40*(1), 31-39.

Garcia, M. & Alejo, N.O. (2013). B*iochemistry and molecular biology of carotenoid biosynthesis in chili peppers (Capsicum spp.). International Journal of Molecular Science*, 14(9), 19025-19053.

Guiamba, I. (2016). Nutritional Value and Quality of Processed Mango Fruits (*Thesis for The Degree of Doctor of Philosophy Food and Nutrition Science).* University of Technology Göteborg, Sweden

Haskarini D, Nugraheni, D., & Susila A. (2019). Karakteristik proksimat buah mangga lali jiwo (*mangifera indica*) dari desa karangjati, kabupaten blora. Dalam *Prosiding Seminar Nasional Kesiapan Sumber Daya Pertanian dan Inovasi Spesifik Lokasi Memasuki Era Industri 4.0*. Kabupaten Semarang, 09 October 2019. Semarang: Kementerian Pertanian Republik Indonesia. Pg 536- 540

Irfianti, A. & Sunarharum, W.B. (2019). Eksplorasi karakteristik kimia dan fisik serta komponen gula pada mangga garifta (*Mangifera indica*). *Jurnal Pangan dan Agroindustri,*7 (2), 47-52.

Kothalawala S.G. & Jayasinghe J.M.J.K. (2017). Nutritional evaluation of different mango varieties available in sri lanka. *International Journal of Ad-*

vanced Engineering Research and Science, 4(7), 128-131.

Leghari, M., Sheikh, S., Memon, N., Soomro, A. & Khooharo, A. (2013). Quality attributes of immature fruit of different mango varieties. *Journal of Basic and Applied Sciences*, 9(2013), 52-56.

Maldonado-Celis, M.E., Elhadi M.Y., Bedoya, R., Landázuri, P., Loango, N., Aguillón, J., Restrepo, B., & Ospina, J.C.G. (2019) Chemical composition of mango (*Mangifera indica* L.) fruit: nutritional and phytochemical compounds. A Review. *Frontiers in Plants Science*, 10 (2019), 1-21.

Mandal S., Yadav S., & Nema R. (2009). Antioxidants: A Review. *Journal of Chemical and Pharmaceutical Research*, 1(1), 102-104.

Manthey, J.A. & Veazie, P.P. (2009). Levels of β-carotene, ascorbic acid, and total phenols in the pulp of five commercial varieties of manggo (*Mangifera indica* L.). In *Proc. Fla. State Hort. Soc*. 122. Florida, 7-9 June 2009. Florida: Florida State Agricultural Society. Pg 303-307.

Mulangsari, D.A., Budiarti, A., & Saputri, E.N. (2017). Aktivitas antioksidan fraksi dietileter buah mangga arumanis (*Mangifera indica* L.) dengan metode DPPH. *Jurnal Pharmascience*, 4(1), 85-93.

Nerdy (2013). Determination of vitamin c in several varieties of melon fruits by titration method. *Jurnal Natural*, 17(2), 118-121.

Nurdianti, L. & Rahmiyani, I. (2016). Uji aktivitas antioksidan krim ekstrak daun mangga (*Mangifera indica* L) terhadap DPPH (1,1-diphenyl-2-picrylhydrazil). *Jurnal Kesehatan Bakti Tunas Husada*, 16(1), 50-56.

Okoth, E. M., Sila, D.N, Onyango, C.A., Owino, W.O, Musyimi, S.M. & Mathooko, F.M. (2013). Evaluation of chemical and nutritional quality attributes of selected mango varieties at three stages of ripeness, grown in lower Eastern province of Kenya – part 2. *Journal of Animal &Plant Sciences*, 17(3), 2619-2630.

Pakaya, D. (2014). Peranan vitamin C pada kulit. *Jurnal Ilmiah Kedokteran*, 1(2), 45-54.

Patel, P., Sunkara, R., Walker L.T., & Verghese , M. (2016). Effect of drying techniques on antioxidant capacity of guava fruit. *Food and Nutrition Sciences*, 7(07), 544-554.

Peter, M., Leonard, F., Bernard, C., Joyce, K., Victor, G., & Kaswija, M. (2007). *Physical and chemical characteristic of off vine ripened mango (Mangifera indica L.*) Fruit (Dodo). *African Journal of Biotechnology*, 6(21), 2477-2483.

Pratiwi, Y.H., Ratnayani, O., Wirajana, I.N. (2018). Perbandingan metode uji gula pereduksi dalam penentuan aktivitas α-l-arabinofuranosidae dengan substrat janur kelapa (*Cocos nucifera*). *Jurnal Kimia*, 12(2), 134 – 139.

Putri, N.P., Nursyamsi, K.S., Prayogo, Y.H., Sari, D.R., Budiarti, E., & Batubara, I. (2017). Exploration of mango fruits (*Mangifera indica*) as α-glucosidase inhibitors. *Biosaintifika*, 9(3), 554-559.

Rahayu, E.S., & Martin, F.P, (2018). *Flora Identitas Kota/Kabupaten di Jawa Tengah: Karakteristik dan Kuantitas Populasinya*. Semarang: FMIPA UNNES.

Rahayu, E.S., Retnoningsih, A., & Abdullah. (2019). Identifikasi penanda morfologi, agronomi, dan molekuler serta pengembangan teknik propagasi mangga *wirasangka*. *PTUPT Research Report.* First year. Semarang: Institute for Research and Community Service UNNES.

Rahman, N., Ofika, M., & Said, I. (2015). Analisis kadar vitamin c mangga gadung (*Mangifera sp*) dan mangga *golek* (*Mangifera indica* L) berdasarkan tingkat kematangan dengan menggunakan metode iodimetri. *J. Akademika Kim*., 4(1), 33-37.

Suwardike P., I Nyoman Rai, I.R., Dwiyani R., & Kriswiyanti, E. (2019). Antioksidan pada mangga. *Agro Bali (Agricultural Journal)*, 6(2), 120-126.

Tristantini, D., Ismawati, A., Pradana, B.T., & Jonathan, J.G. (2016). Pengujian aktivitas antioksidan menggunakan metode DPPH pada daun tanjung (*Mimusops elengi* L). Dalam *Prosiding Seminar Nasional Teknik Kimia Kejuangan 'Pengembangan Teknologi Kimia untuk Pengolahan Sumber Daya Alam Indonesia'*. Yogyakarta, 17 Maret 2016. Yogyakarta: UPN. Pg G1-1 – G1-7.

Yuliati, N., & Kurniawati, E. (2017). Analysis of vitamin c and fructose content in mango (*Mangifera indica* L.) variety podang urang and podang lumut using spectrophotometric uv-vis method. *Jurnal Wiyata*, 4(1), 49-57.