Antioxidant potential ingredient of kecombrang plants
(*Elingera elatior*)

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Abstract. Kecombrang (*Elingera elatior*) is a plant that has been widely known and used by humans as food and medicine. The stems, leaves, and rhizomes of kecombrang as well as flowers contain bioactive compounds such as polyphenols, alkaloids, flavonoids, steroids, saponins and essential oils which have a potency as antioxidants. This study aims to determine the effect of the parts of kecombrang plants and the type of fraction extracted from the part of the kecombrang plant on the total phenol, antioxidant activity and physicochemical properties of the preparation. This study used a completely randomized design (CRD) with 8 combinations with 4 replications to obtain 32 experimental units. The factors tested included fragmented plant parts, namely flowers, stems, leaves, and rhizomes, and the types of stratified extraction fractions, namely ethyl acetate, and ethanol. The variables observed included physicochemical properties, total phenol and antioxidant activity of kecombrang preparations. Data were analyzed by analysis of variance (F test) followed by DMRT 5%. The results showed that the total value of phenol and the highest antioxidant activity was the part of kecombrang stems fractionated using ethanol, namely 15,894.07 mg/100g and 89.12%, respectively.

1. Introduction

Food damage is generally caused by microorganisms through enzymatic and oxidation processes, especially those containing protein and fat while carbohydrates are decomposed. Related to that and also the increasing public awareness to health, alter alternative preservatives and natural antioxidants are increasingly attractive to develop [1]. Research on antioxidant activity shows that many plants have antioxidant activity, including kecombrang [2,3]. Kecombrang is a plant that the flower and its stems are often used by the community for medicinal purposes because of the active substances contained in it, such as saponins, flavonoids, and polyphenols, namely as a remover of body odor and bad breath [4]. Flowers and young leaves are used as flavor givers in dishes, such as urab, pecel, chili sauce and other dishes. The stems are used as flavor in meat dishes.

Valianty [5] has initiated research on the antibacterial activity of kecombrang flowers. Research shows that kecombrang flower oil is able to inhibit the growth of *Escherichia coli* (Gram negative) and *Bacillus cereus* (Gram positive) bacteria. Furthermore, Naufalin et al. [6], in their research extracting kecombrang flowers in stages using nonpolar (hexane), semi-polar (ethyl acetate), and polar (ethanol) solvents. The results showed that ethyl acetate extract formed a broad spectrum of inhibition against Gram-positive, Gram-negative, and spore formation. Putri et al. [7] and Latifasari et al. [8] states that...
from the parts of the kecombrang plant, it turns out that the flower and leaves part has the highest antibacterial activity against *E. coli* and *Pseudomonas aeruginosa* compared to the inner stem, fruit, and rhizome of kecombrang.

According to Tampubolon et al. [9], the compounds contained in kecombrang flowers are alkaloids, flavonoids, polyphenols, terpenoids, steroids, saponins, and essential oils. Kecombrang flowers, among others, contain 0.4 percent essential oil and 1 percent tannins. Like flowers, other parts of kecombrang plants such as stems, leaves, and rhizomes are thought to have potential as antioxidants as well as alternatives to natural preservatives. Bioactive compounds from the kecombrang plant parts need to be extracted to test their activity. The choice of solvent must be based on the polarity of the compound to be isolated. In this study, stratified extraction was carried out with nonpolar, semipolar and polar solvents so that it is expected to produce optimal bioactive components [10]. Based on the above description, the purpose of this study is to determine the parts of kecombrang plants and the types of fractions against the potential of natural antioxidants from the extracted fraction of the parts of kecombrang plants during storage.

**2. Research methodology**

2.1. Preparation and production of kecombrang leaf powder

The sorted leaves were washed with running water then cut into small pieces dried using a cabinet dryer for 2 hours with a drying temperature of 70°C until the dried kecombrang leaves are broken. The dried leaves were then ground using a *disc mill* to obtain a homogeneous kecombrang leaf powder.

2.2. Making liquid extract of kecombrang leaves

The extraction method used in this research was the extraction method using microwave assisted extraction (MAE). The homogeneous kecombrang leaf powder was put into 500 mL beaker glass, then distilled water was added with a ratio of 1:10 w/v. The extraction process was carried out in accordance with the treatment of the micro wave power and the specified length of time. After that, the extract was filtered using a filter cloth to separate the filtrate and pulp, then filtered again using filter paper. After obtaining the filtrate, it was evaporated using a rotary evaporator for 20 minutes at a temperature of 60°C.

2.3. Experimental design

The experimental design used was a completely randomized design (CRD) with 16 combinations and 2 replications, as well as testing at week 0, 2, 4, 6 and 8 of the storage period in order to obtain 32 experimental units. The treatments tried were parts of the kecombrang plant (B) which included flowers (B₁), inner stems (B₂), leaves (B₃), and rhizomes (B₄), and the second factor was the type of solvent fraction (F) including ethyl acetate (F₁) and ethanol (F₂), the third factor is the type of packaging (P) including the clear white glass bottle packaging (P₁), and the plastic bottle packaging (P₂).

The variables observed in this study included the antioxidant potential, namely the total phenol and the antioxidant activity of the extracted fraction of kecombrang plant parts in the packaging which was observed at 0, 2, 4, 6, and 8 weeks of storage. The analysis of day 0 includes yield and physicochemical properties, namely color, solubility of extracts of kecombrang plant parts in aquadest and oil [11], specific gravity and refractive index [12] and wavelength at maximum absorbance.

2.4. Statistical analysis

The data obtained from the research results were analyzed by means of the test of variance (F test) at the 5% level and if the results of the analysis show a significant difference, then proceed with the *Duncan’s Multiple Range Test* (DMRT).
3. Result and discussion

3.1. Yield and physicochemical properties of extract of kecombrang plant parts

In this study, the extracted fraction of kecombrang plant parts was obtained from stratified extraction using a nonpolar solvent, namely hexane, a semi-polar solvent, namely ethyl acetate and a polar solvent, namely ethanol. The yield and physicochemical properties of the fraction on day 0 can are presented in Table 1.

|   | fraction | fraction | fraction | fraction | fraction | fraction | fraction | fraction |
|---|----------|----------|----------|----------|----------|----------|----------|----------|
| Rendemen | B₁F₁ | 6.85% | Brownish yellow | 53.16% | 17.71% | 0.88 | 1.36 | 0.79 |
|   | B₁F₂ | 22.84% | maroon | 99.95% | 15.80% | 0.94 | 1.34 | 0.48 |
| Color | B₂F₁ | 1.00% | Greenish brown | 92.83% | 25.53% | 0.99 | 1.36 | 0.82 |
|   | B₂F₂ | 3.47% | Brownish red | 83.86% | 19.19% | 1.00 | 1.36 | 0.88 |
| Solubility in distilled water | B₃F₁ | 2.76% | Black | 42.03% | 1.09 | 1.51 | 1.13 |
|   | B₃F₂ | 9.23% | Greenish black | 67.89% | 21.94% | 1.48 | 1.79 | 0.82 |
| Oil solubility | B₄F₁ | 4.22% | Brown | 83.13% | 4.36% | 1.41 | 0.82 |
| Specific gravity | B₄F₂ | 5.336% | Reddish brown | 86.15% | 2.11% | 1.46 | 3.09 |
| Refractive index |   |   |   |   |   |   |   |   |
| λ at maximum absorbance |   |   |   |   |   |   |   |   |

Note:  B₁F₁: flowers, ethyl acetate solvent; B₁F₂: flowers, ethanol solvent
B₂F₁: inner stem, ethyl acetate solvent; B₂F₂: inner stem, ethanol solvent
B₃F₁: leaf, ethyl acetate solvent; B₃F₂: leaf, ethanol solvent
B₄F₁: rhizome, ethyl acetate solvent; B₄F₂: rhizome, ethanol solvent

Physicochemical testing is one of the quality requirements for commodities in trade, especially for oil. Related to that, it is important to detect adulteration, evaluate the quality and purity of an oil, detect the type of oil, and use of oil [13]. The ethanol flower extracted fraction gave the largest rendemen, namely 22.8%. It shows that the presence of polar components in the ethanol flower fraction is higher than in the ethyl acetate flower fraction. Likewise for the other extracted fractions, the ethanol fraction showed a greater yield than the ethyl acetate fraction, which was semipolar. According to Sudarmadji et al. [10], in principle, a material will dissolve easily in a solvent with the same polarity. Polar compounds dissolve more easily in polar solvents and non-polar compounds are easier to dissolve in non-polar solvents. The yield value of the fraction is used to compare the relative amounts of active compounds present in the dry powder and the fractions. The difference in polarity of the extract of kecombrang plant parts resulted in the content of different bioactive components in the ethyl acetate and ethanol extracts.

In each fraction extraction, kecombrang plant parts had different colors. This is thought to be related to the compounds in each part of the plant which are different so that they give different colors, especially flavonoid compounds. Flavonoids are found in green plant parts such as roots, stems, leaves, wood, flowers and fruit. Naufalin et al. [6] stated that the phytochemical components of kecombrang flowers were extracted with ethyl acetate, namely steroids, terpenoids, alkaloids, flavonoids, and glycosides while the phytochemical components extracted with ethanol solvents were phenolics, steroids, terpenoids, alkaloids, saponins and glycosides. The color of the ethyl acetate flower fraction was brownish yellow, the inner stems gave a greenish brown to reddish brown color, and the leaves gave a black to greenish black color, while the rhizome gives a brown to reddish brown color. The ethanol flower fraction gave a dark red color due to anthocyanin compounds. According to Naufalin et al. [6],
Anthocyanins include flavonoid compounds in the form of red pigments, found in kecombrang flowers. Anthocyanins are natural pigments that are widely known to be abundant in plants and cause the colors orange, red, blue and purple. Anthocyanin pigments are flavanoid compounds that have active groups that dissolve more easily in distilled water. The green leaves are due to the chlorophyll pigment. The yellow color is caused by the xanthophyll pigment, and the orange color is caused by the carotene pigment [14].

The physicochemical properties that were also measured in this study were solubility. This solubility measurement is intended to make the extracted fraction can be applied in food. The fraction of kecombrang plant parts were tested for their solubility in distilled water and oil. The results obtained (Table 1), showed that the flower fraction with ethanol solubility gave the highest solubility value in distilled water (99.95 percent), while the leaf fraction of ethyl acetate solubility gave the lowest solubility value (42.03 percent). The highest oil solubility was obtained in the ethyl acetate solvent leaf fraction (84.57 percent), while the lowest value was obtained in the ethanol solvent rhizome fraction (2.11 percent). This shows that the ethanol fraction is more soluble in distilled water and the ethyl acetate fraction is more soluble in oil. According to Houghton and Raman [15], polar compounds are easier to dissolve in polar solvents and non-polar compounds are easier to dissolve in non-polar solvents. It is suspected that the polar part of the ethyl fraction causes some of the fraction to dissolve in distilled water, but the ethanol fraction which is polar is difficult to dissolve in oil.

Specific gravity shows the weight of the fraction component per unit volume. The specific gravity of essential oils generally ranges from 0.800 to 1.180 [13]. The highest density was shown by the ethanol rhizome extract with a value of 1.16, while the ethyl flower fraction gave the lowest specific gravity value, namely 0.88. This shows that the fraction with a certain weight which has a higher density will have a lower volume than the fraction of the same weight which has a lower density. Specific weights differ due to differences in plant parts, according to the results of research by Saroso [16], which states that the essential oil of kecombrang flower guard leaves has a specific gravity of 0.6638 - 0.7923, while the essential oil of kecombrang flower arrangements has a specific gravity of 0.6743 – 0.8424. This shows that the chemical components of the essential oil of flower protection leaves have a different weight compared to the chemical components of the essential oil of kecombrang flower arrangements.

Refractive index includes physical properties that can determine the quality of a substance, generally used for oil quality analysis [17]. Refractive index can reflect the density of the substances contained in it. The highest refractive index value was shown by the ethyl acetate leaf fraction of 1.51, while the lowest value was given by the ethanol flower fraction of 1.34. The refractive index of the extracted fraction of different kecombrang plant parts shows a difference, for example, the refractive index of the essential oil of protective flower leaves is 1.385 to 1.408, while the essential oil of flowers is 1.381 to 1.442 [16]. It means that the components of the essential oil in the flower protection leaves are more tenuous than the components of the essential oil of the flower.

The results showed that the ethanol rhizome fraction gave the highest maximum absorbance wavelength value of 3.09, while the ethanol flower fraction gave the lowest maximum absorbance wavelength value of 0.48. This shows that kecombrang plants have different chemical components for each of their parts. Wavelength testing is carried out to improve the quality standard of a substance because each substance has its own wavelength according to its constituent components [16]. This test can be used to determine the presence or absence of adulteration because when a substance is added another substance will produce a wavelength at the maximum absorbance.

3.2. Antioxidant activity and levels

3.2.1. Total phenol. The results of the analysis of variance showed that during storage, the parts of kecombrang plants and the type of fraction had a very significant effect on the total phenol, while the type of packaging and the interaction of the three had no significant effect. The mean values of total phenol during storage for flowers ranged from 484.59 - 959.73 mg/100 g; for deep stems ranging from
462.92 – 1,205.47 mg/100 g; for leaves ranged from 1,338.06 – 8,636.15 mg/100 g; while for the rhizome it ranges from 510 – 2,453.41 mg/100 g (Figure 1).

Overall, the extracted fraction of kecombrang leaves had the highest total phenol during storage compared to flowers, internal stems and rhizomes. This means that the extracted leaf fraction contains higher phenolic compounds than other parts of the kecombrang plant. It is suspected that the chlorophyll content also affects the high total phenol produced by kecombrang leaves, because even though it is not a phenol compound, hydrophilic chlorophyll is able to be extracted in a polar ethanol solution and could be detected at the time of measurement. According to Pragdimurti et al. [18], chlorophyll is present in large quantities in plants, namely an average of 1% dry weight. Hydrolyzed chlorophyll becomes easily soluble in water. Research on the antioxidant activity of suji leaf extract shows that the total chlorophyll content of suji leaf extract using water and tween 80 is 2,540 mg/10 ml and has high antioxidant activity [18].

![Figure 1. Effect of kecombrang plant parts on total phenol during storage](image)

Based on the analysis of variance, the type of fraction greatly influenced the total phenol value. The mean total phenol value of the ethyl acetate fraction during storage ranged from 522.08 – 1,776.08 mg/100 g and for the ethanol fraction ranged from 854.10 – 4,851.30 mg/100 g (Figure 2). According to Estiasih and Kurniawan [19], phenol is a polar compound so that its solubility is the highest in polar solvents. Polar solvent (ethanol) is able to extract higher phenol so that the total phenol value of the ethanol fraction is higher. Ethanol is an organic solvent which has a high polarity, which corresponds to the degree of the dielectric. Ethanol solvent has a dielectric degree of 24.30 while ethyl acetate is 6.02 [15]. The phenol component contained in the fraction of the kecombrang plant parts is thought to have a polarity close to that of ethanol, so the use of ethanol solvent is more effective in dissolving phenol compounds. The ethyl acetate fraction has a smaller total phenol value than the ethanol fraction. This is presumably because the phenolic group compounds in the parts of kecombrang plants are more soluble in ethanol solvents than in ethyl acetate solvents. The ethyl acetate fraction is composed of semi-polar compounds which may still contain non-polar compounds. These non-polar compounds can block the extracted phenolic compounds [20].

The independent treatment of the packaging type showed that the average total phenol during storage the extracted fraction in a clear white glass bottle ranged from 741.54 to 3,175.16 mg/100 g, while in a plastic bottle coated with black duct tape it ranged from 705.80 to 3,452.23 mg/100 g. Based on the results of the analysis of variance, it turned out that the type of packaging had no significant effect on the total phenol value, presumably due to damage to the extracted fraction during storage in either clear white glass bottles or plastic bottles. Damage can be caused by environmental factors, such as light, temperature and oxygen and internal factors in the extracted fraction itself. Some phenol compounds are easily oxidized by oxygen, especially in alkaline conditions or by the enzyme polyphenoloxidase [21]. Storage temperature is room temperature that quite hot in which can triggers phenol damage. The
presence of light also contributes to the damage to phenol, and internal factors, namely the occurrence of natural reactions in the extracted fraction that allow the amount of damage to bioactive compounds. Overall, the decrease in total phenol during storage for clear white glass bottles from week 0 to 8 was 2,427.27 mg/100 g and for plastic bottles coated with black duct tape the decrease was 2,746.42 mg/100 g. Plastic bottles coated with black duct tape tend to be better than clear white glass bottles because plastic bottles coated with black duct tape which block the entry of light.

![Figure 2](image2.png)

**Figure 2.** Effect of fraction type on the total value of phenol during storage

The interaction between parts of kecombrang plants and type of fraction (BXF) gave a very significant effect. The largest mean value of total phenol was shown by the interaction of B3F2 (ethanol leaf fraction), which ranged from 2,047.58 – 15,894.07 mg /100 g, while the other interactions did not really affect the total phenol (Figure 3). This is presumably because the components in kecombrang leaves dissolve more easily in ethanol solvent. In addition to the bioactive compounds commonly found in kecombrang plant parts, it is suspected that chlorophyll compounds in leaves also play a role in the high total phenol. According to Prangdimurti et al. [18], natural chlorophyll is lipophilic, so it is likely to be more soluble in ethyl acetate, but chlorophyll which undergoes hydrolysis to chlorophyllin and chlorophyllide is water soluble, so it is more soluble in ethanol than in ethyl acetate. Chlorophyll may be hydrolyzed more so that it dissolves in ethanol. This chlorophyll also causes the color of the leaf fraction to turn greenish black.

![Figure 3](image3.png)

**Figure 3.** The interaction effect of kecombrang plant parts and fraction types on total phenol during storage. B1: flowers; B2: inner stem; B3: leaf; B4: rhizome; F1: ethyl acetate fraction; and F2: ethanol fraction
The results of the analysis of the various influences of kecombrang plant parts, type of fraction and type of package (BxFxP) did not affect the total phenol. The average value of total phenol during storage for flowers was 381.48 – 1,757.43 mg/100 g; for the stem in the amount of 293.67 – 1,687.00 mg/100 g; for leaves of 372.07 – 16,931.08 mg/100 g; while kecombrang rhizome was 234.52 – 3,274.79 mg/100 g. It means that the interaction of the three treatments gives a total phenol result that is not significantly different. Both clear white glass bottles and duct tape-coated plastic bottles provide the same protection against the extracted fractions.

The highest total phenol value during storage was seen at week 0. Furthermore, during 8 weeks of storage, the bioactive components in the extracted fraction of kecombrang plant parts with both types of solvent and packaging were damaged so that the total phenol value tended to decrease during storage. This is thought to be caused by several factors, including extreme storage conditions with hot room temperatures, the influence of light, oxygen and internal reactions of fractions that resulted in changes during storage. Clear white glass bottles cause a fraction of exposure to light so that phenol is more damaged than duct tape-coated plastic bottles, however, there is no difference in the result due to the selective nature of the plastic which is permeable to oxygen [22].

3.2.2. Antioxidant activity. Measurement of antioxidant activity carried out by the ferritocyanate method which is based on the formation of peroxide as the result of oxidation of linoleic acid. The results of the analysis of variance showed that during storage, the parts of kecombrang plants greatly affected the antioxidant activity, while the type of fraction had a significant effect on antioxidant activity. The type of packaging and the interaction of the three did not affect antioxidant activity.

The mean values of antioxidants during storage of the extracted fraction of kecombrang plant parts (Figure 4) for flowers ranged from 61.61 to 83.17 percent; for internal stems ranging from 57.43 to 84.65 percent; for leaves ranged from 40.64 to 60.40 percent; while for the rhizome it ranges from 58.40 to 69.66 percent. The highest value for each part of the plant was at week 0 and decreased during storage.

![Figure 4. Effect of kecombrang plant parts on antioxidant activity during storage](image)

Based on the results of the study, the flower and stem parts were better in inhibiting linoleic oxidation, when compared to kecombrang leaves and rhizomes. This shows that the flowers and stems have bioactive compounds that can act as antioxidants more than leaves and rhizomes. This is presumably because the stem is the growing point of a plant. Flowers are also the youngest which has more active part that grows than the old leaves and rhizomes that are at the base of the plant. Flowers consist of a flower base where other flower organs grow [16].
According to Laila [23], betel leaf contains essential oils which play a very important role as an antimicrobial substance in which one-third of essential oils are phenols. Phenols are bioactive compounds that can act as antioxidants. The quantity of essential oils is higher in the parts that are more actively grown [12]. In the growing part, it is suspected that phenol is in a more simple form than leaves and rhizomes. The simple form causes a lower molecular weight and reactive H atoms so that antioxidant activity is higher. The simple phenolic compound group consists of the amino acids tyrosine, DOPA, catechols, and caffeine acids [14].

The type of fraction based on the analysis of variance affects the value of antioxidant activity. The average value of antioxidant activity during storage for ethyl acetate fraction ranged from 62.30 to 73.87 percent, while the ethanol fraction ranged from 47.47 to 75.07 percent (Figure 5).

Figure 5. Effect of fraction types on antioxidant activity during storage

Figure 6. Illustration of protection against linoleic acid by ethyl acetate fraction

The group of polar-phenolic compounds, flavonoids and alkaloids that have potential as antioxidants, are thought to be more extracted by ethanol that also a polar compound [20]. The dominant bioactive components in the semi-polar fraction are flavonoids, while those in the polar fraction are phenols [15]. Flavonoids that bind to sugar tend to dissolve in water, while less polar aglycones such as isoflavones, flavanones, flavones, and flavonols tend to be more soluble in semi-polar solvents [24]. Flavonoids are thought to have the ability to change or reduce free radicals so that they have potential as antioxidants [25]. Not all polar compounds can play a good role in protecting linoleic acid because linoleic acid is non-polar, so that the bioactive components in the ethanol fraction provide lower activity than the ethyl acetate fraction. The results showed that the ethyl acetate fraction was more able to protect linoleic acid than the ethanol extract. This is presumably because the ethyl acetate fraction (semi polar) has HLB
(Hydrophilic-Lypophilic Balance) properties, namely the balance of water properties (hydrophilic) and oil properties (lipophilic) which contribute to high antioxidant activity.

In tests using linoleic acid, the two properties of the ethyl acetate fraction form internal and external protection can protect linoleic acid from oxidation. It is suspected that because linoleic acid is an oil, the lipophilic properties of ethyl acetate can directly adhere to it and become internal protection, while hydrophilic properties coating the internal (external) barrier, which can be seen in Figure 6 [26].

The results of various types of packaging analysis did not have significant effect on the value of antioxidants during storage, presumably due to damage to the extracted fraction during storage, both in clear white glass bottles and plastic bottles coated with duct tape. The mean value of antioxidant activity during storage for clear white glass bottles ranged from 52.36 to 73.94 percent, while for duct tape-coated plastic bottles ranged from 57.41 to 75.00 percent. The damage to the bioactive components which act as antioxidants in the extracted fraction can be caused by environmental factors, such as light, temperature and oxygen and internal factors in the extracted fraction itself. Some phenolic compounds are easily oxidized by oxygen [21]. Storage temperature is room temperature that contains heat which also triggers the damage to bioactive components. The presence of light also contributes to the damage, and internal factors, namely the occurrence of natural reactions in the extracted fraction, also allow the amount of damage to bioactive compounds.

![Figure 7. The interaction effect of kecombrang plant parts and fraction types on antioxidant activity during storage. B1: flowers; B2: inner stem; B3: leaf; B4: rhizome; F1: ethyl acetate fraction; and F2: ethanol fraction](image)

The interaction between parts of kecombrang plants and type of fraction (BXF) affects the value of antioxidant activity (Figure 7). The largest average value of antioxidant activity was shown by the interaction of B1F1 treatment (ethyl acetate flower fraction), which was 75.57 percent, while the B3F2 treatment interaction gave the lowest value, which was 42.44 percent. This is presumably because the interaction of ethyl acetate and kecombrang flowers is able to produce more bioactive components (which have optimum antioxidant activity against linoleic acid) than other interactions. This is in line with Naufalin et al. [6] which states that a compound that has optimum polarity will have maximum antimicrobial activity, because for the interaction of an antibacterial compound with bacteria, hydrophilic-lipophilic balance (HLB), is required. It is suspected that the bioactive content in flowers that have HLB is higher than that of the inner stems, leaves and rhizomes. In addition, it is possible that the bioactive compounds in the ethyl acetate fraction act more as antioxidants than the ethanol fraction, in line with the statements of Naufalin et al. [6] and Teguh [24], that ethyl acetate extract has better antibacterial activity than ethanol. It is suspected that the semipolar fraction has a higher HLB value which can protect linoleic acid from damage than the polar fraction.

4. Conclusion
Treatment interactions between parts of kecombrang plants, fraction types and packaging types did not significantly affect total phenol and antioxidant activity. Treatment interactions that produced the
highest total phenol and antioxidant activity were seen at week 0. The flower and stem parts in kecombrang provide high antioxidant activity until the 8th week of storage, which was above 50%.

Acknowledgments
The authors thank to DRPM DIKTI in Applied research scheme 2020 who has provided funds and facilities for this research and all parties who have helped to make it happen this research.

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