The effect of storage duration on total xanthones and antioxidant activity of microencapsulation of mangosteen peel extract

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Abstract. Xanthones compounds in mangosteen peel extract have characteristics that are unstable, sensitive, easy to react and easily subject to oxidation. Microencapsulation has the ability to maintain the stability of herbal extracts during storage. The aim of this study was to determine the duration of storage of microencapsulated products of mangosteen peel extract against total xanthones and antioxidant activity. Mangosteen peel extracted using ethanol for 24 hours. Maltodextrin is synthesized from sugar palm starch using an enzymatic method. Mangosteen peel extract and maltodextrin are formulated at a ratio of 70:30, 60:40, 50:50, 40:60 and 30:70. Total xanthones levels and antioxidant activity of mangosteen peel extract microcapsules were measured using a UV-Visible spectrophotometer. The results showed that the microencapsulation process and the ratio of core material and encapsulant material significantly affected total xanthones levels and antioxidant activity of mangosteen peel extract microcapsules during storage. The M4 treatment produced the highest total xanthones and M2 treatment produced the most powerful antioxidant activity compared to other treatments.

Keywords: antioxidant activity, mangosteen, microencapsulation, storage, xanthones.

1. Introduction
Mangosteen fruit contains xanthones which has many health benefits for the body such as antibacterial, antifungal, antiviral, antiparasitic, antihyperglycemic, antidiabetic, anti-inflammatory, anticancer, antioxidant, antihistamine and antiobesity [1]. The most abundant secondary metabolite compound is found in the peel of the fruit. The xanthones derivative on mangosteen peel with the most abundant content is α-mangostin [2] which has good antibacterial activity but is difficult to dissolve in water [3]. Encapsulation method at the microparticle scale can increase the effectiveness and efficiency in the use of drug dosages (mangosteen peel extract), accelerate reaching target cells, increase drug solubility in cells [4].

The main key to the success of microencapsulation is the choice of coating material because it has an important role in maintaining the stability of microcapsule products. Various types of coating materials have been widely used such as Arabic gum, gelatin, and maltodextrin [5,6]. Maltodextrin is reported to be the best coating material because it is soluble, has low viscosity, colorless and non-toxic [7]. Maltodextrin is a good coating material in the microencapsulation
process because it dissolves easily, the dispersion process is fast, able to prevent crystallization, strong binding, low hygroscopic properties and maintain the stability of microencapsulation products [8]. Šturm et al. [9] reported that the ratio of core material to encapsulant material could influence the final outcome of the microencapsulation process. Microencapsulation is reported to increase the stability of products derived from natural materials during storage [10]. The aim of this study is to examine the effect of the storage duration of microencapsulated products of mangosteen peel extract on total xanthones and antioxidant activity.

2. Materials and method
Mangosteen peel obtained from Puspahiang, Tasikmalaya, soaked in ethanol for 24 hours. Maltodextrin is synthesized from sugar palm starch enzymatically using the α-amylase enzyme. Ethanol, aquades, HCl, NaOH, aquabides, xanthones standard and α-mangostin, tissue paper, sodium acetate and tween 80. Mangosteen peel extract and maltodextrin are microencapsulated using different ratios of 30:70, 40:60, 50:50, 60:40, 70:30 (M1 - M5 respectively). As a control, mangosteen peel extract was tested without encapsulation (M6) [11]. Each treatment was repeated 4 times and stored at different times, i.e. 0, 2, 4, 6 and 8 weeks. Testing of total xanthones and antioxidant activity was carried out by spectrophotometry [12].

3. Result and discussion
3.1. Total xanthones
Chemical quality testing such as total xanthones content of mangosteen peel extract microcapsules during storage needs to be carried out to determine the stability of bioactive compounds. The results of research on the effect of storage duration of mangosteen peel extract microcapsules on total xanthones levels are presented in Table 1 and Figure 1. The results of statistical tests show that all storage times have a significant effect on total xanthones. The M4 treatment showed a better effect than the other treatments. The average value of total xanthones M4 treatment showed that total xanthones was more stable during storage compared to M1, M2, M3, M5, and M6.

| Treatment | 0  | 2  | 4  | 6  | 8  |
|-----------|----|----|----|----|----|
| M1 (70% MPE : 30% MDX) | 27.47±0.71b | 27.08±0.60c | 26.10±0.43b | 24.78±0.51c | 23.30±0.57b |
| M2 (60% MPE : 40% MDX) | 27.09±0.51b | 26.41±0.03abc | 26.01±0.13b | 23.13±1.30a | 23.06±0.37b |
| M3 (50% MPE : 50% MDX) | 26.71±0.13a | 25.99±1.05ab | 25.03±0.25a | 25.19±0.60a | 23.87±0.24a |
| M4 (40% MPE : 60% MDX) | 28.07±1.28a | 26.80±0.15ab | 26.25±0.49ab | 25.28±0.16a | 24.85±0.48a |
| M5 (30% MPE : 70% MDX) | 26.77±0.15a | 26.16±0.44ab | 26.08±0.81ab | 25.14±0.52a | 24.13±0.25a |
| M6 (100% MPE) | 27.22±0.49ab | 25.80±0.11ab | 23.51±0.03a | 21.80±0.86a | 20.58±0.14a |

* Different superscripts in the same column show significant differences (P <0.05)

The M4 treatment contains the mangosteen peel extract and maltodextrin extract formulations at optimal levels so that the xanthones compound can be better protected during storage. These results are consistent with Astuti and Sasongko's [13] that the results of total chlorophyll test as a bioactive compound on the product of microencapsulation of suji leaf extract are strongly influenced by the type of coating material and the ratio between suji leaf extract and
coating material. The use of core and coating materials at optimal levels will be able to protect bioactive compounds during storage. This is caused by the role of maltodextrin in maintaining the stability of bioactive compounds. The microencapsulation process using maltodextrin has good effectiveness in maintaining antioxidant compounds and is able to maintain the integrity and stability of anthocyanins during the encapsulation process [14,15].

The M6 treatment that did not undergo a microencapsulation process had the most unstable total xanthones levels and decreased significantly during storage. This is caused by the process of microencapsulation able to maintain product stability compared to products that are not encapsulated. Microencapsulation process can maintain oxidation stability, antioxidant activity, phenolic content and thymoquinone levels in *Nigella sativa* oil.

The M5 treatment showed a lower xanthones total value than M4. This condition is suspected that the addition of coating material which is higher than optimal (M4) can reduce the bioactive compounds of the product. The use of a higher coating material can reduce the total chlorophyll in suji leaf powder so that the product becomes paler because of its decreased chlorophyll content [16].

![Figure 1. Total xanthones of microcapsule products](image)

### 3.2 Antioxidant activity

Test results of the effect of storage duration of mangosteen peel extract microcapsules on antioxidant activity are presented in Table 2 and Figure 2. The results showed that M2 produced the most stable antioxidant activity during storage compared to M6. This is due to M2 containing the most optimal formulation of mangosteen peel extract and maltodextrin so that it can inhibit reduced antioxidant activity or prevent damage to antioxidant compounds from external influences [17].

The longer storage time can cause an increase in the value of antioxidant activity from week 0 to week 8, causing the strength of its antioxidant activity to decrease. This is due to the antioxidant component of mangosteen peel very easily degraded by increased storage time. The
longer storage time causes greater physical influence so it can reduce product stability, especially antioxidant activity which is very unstable during storage.

**Table 2.** Effect of Long Storage of Mangosteen Peel Extract Microcapsule Products on Antioxidant Activity

| Treatment         | Antioxidant Activity (IC<sub>50</sub> ppm) |
|-------------------|-------------------------------------------|
|                   | 0  | 2   | 4   | 6   | 8   |
| M1 (70% MPE : 30% MDX) | 13.83±0.05<sup>a</sup> | 14.99±0.12<sup>b</sup> | 17.06±0.22<sup>bc</sup> | 19.93±1.36<sup>c</sup> | 18.06±0.47<sup>b</sup> |
| M2 (60% MPE : 40% MDX) | 14.99±0.41<sup>b</sup> | 15.53±0.57<sup>c</sup> | 15.86±0.47<sup>bc</sup> | 17.47±0.58<sup>c</sup> | 18.99±0.32<sup>c</sup> |
| M3 (50% MPE : 50% MDX) | 15.91±0.34<sup>a</sup> | 16.92±0.53<sup>a</sup> | 17.30±0.80<sup>a</sup> | 18.47±0.60<sup>a</sup> | 18.90±0.48<sup>a</sup> |
| M4 (40% MPE : 60% MDX) | 15.77±0.54<sup>b</sup> | 16.27±0.12<sup>b</sup> | 16.94±0.40<sup>bc</sup> | 18.33±0.08<sup>a</sup> | 18.91±0.24<sup>bc</sup> |
| M5 (30% MPE : 70% MDX) | 14.99±0.20<sup>b</sup> | 16.27±0.03<sup>b</sup> | 17.44±0.93<sup>bc</sup> | 18.88±0.45<sup>c</sup> | 19.02±0.29<sup>bc</sup> |
| M6 (100% MPE) | 16.17±0.89<sup>c</sup> | 16.99±0.70<sup>c</sup> | 18.43±0.77<sup>c</sup> | 18.86±0.28<sup>c</sup> | 23.07±1.09<sup>c</sup> |

Description: Different superscripts in the same column show significant differences (P <0.05)

The M6 treatment that does not undergo microencapsulation processes results in unstable antioxidant activity. This condition shows that the process of microencapsulation can stabilize antioxidant activity compared to mangosteen peel extract which is not encapsulated. This is caused by the process of microencapsulation capable of protecting antioxidant compounds in the core material protected by the coating material. Maltodextrin is reported to have several advantages as a coating material in the microencapsulation process including high encapsulation efficiency, good product protection from external influences, low cost, low viscosity at high solid concentrations, neutral taste and aroma and good protective antioxidant compounds [15].

![Figure 2. Antioxidant activity of microcapsule products](image)

4. **Conclusion**

The storage duration significantly affected the total xanthones and antioxidant activity of mangosteen peel extract microcapsules. The M4 treatment produced the highest total xanthones while the M2 treatment produced the strongest antioxidant activity compared to other treatments.
5. Reference

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