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Effect of Packaging Materials on *Orthosiphon Stamineus* Dried-Leaf Quality During Storage

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Abstract. The experiment was conducted to determine the effects on the total phenolic content, antioxidant capacity, moisture content and total different color (ΔE) when the *O. stamineus* dried whole-leaf were packed in different packaging materials (plastic bag, paper bag and glass container) and stored under room temperature (±25 °C) and relative humidity (±65 %RH) for 8 weeks. The total phenolic compounds and antioxidant activity were measured using the Folin-Ciocalteu method and 2,2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging activity assay respectively, and analyzed using UV/VIS Spectrophotometer. The moisture content changes were examined using a moisture analyzer and the color changes were analyzed using colorimeter. The results showed that packing *O. stamineus* dried whole-leaf in different packaging materials significantly affected the herbal leaves quality. After 8 weeks of storage period, the total phenolic content and antioxidant capacity exhibited the increase values during storage. Meanwhile, the moisture content of the samples decreased by storage period for the samples packed in plastic bag and glass container. The moisture content of the samples packed in the paper bag fluctuated along the 8 weeks of storage period. The total different color (ΔE) of the *O. stamineus* dried whole-leaf increased by storage period. The highest changes of ΔE belonged to the samples packed in the glass container, followed by paper and plastic bags. The selection of the packaging materials can be considered as an important element to control the quality of raw herbal materials for further processing and the herbal finished products.

1. Introduction

The secondary metabolite compounds produced by herbal plants are widely used for medicinal purposes. The roles of the secondary metabolites are mainly for protection purposes in response to specific environmental stimuli such as attacked by pathogens or harmful microbes, insects and herbivores [1], [2]. The common examples of secondary metabolite groups are phenolic compounds, alkaloids, terpenoids and glycosides [3]. Some of these groups of compounds are important medicinal bioactive. Proper post-harvest handlings at the drying and storage stages are two important operations for maintaining the concentration of bioactive compounds [4], [5]. In actual practice most of the dried herbs are commonly stored for certain time before processing stages. The selection of proper storage conditions, including packaging, can be one of great importance. Packaging can directly influence food quality by protecting the product from both oxygen and light and also in maintaining it in optimum temperature and relative humidity [6]. *Orthosiphon stamineus* is known as one of the commercialized

herbs in Malaysia. The plant is also known as misai kucing. It can grow to a height of 1.2 m and can be harvested in 2 to 3 months after transplanting. It is known that *O. stamineus* contains several chemically active components such as terpenoids like diterpenes and triterpenes, polyphenols like lipophilic flavonoidsand phenolic acids, and sterols [7]. It is also known that, leaves of this plant have been used traditionally for treating diuretic, and to treat rheumatism, abdominal pain, kidney and bladder inflammation, edema, gout and hypertension [8], [9]. To maintain the quality of herbal dried leave, the important factors that should be considered during storage are the types of packaging materials used, light intensity, relative humidity, oxygen and temperature [10]. Lack of the good post-harvest storage information on *O. stamineus* dried leaves can affect the commercial quality of the final products. Appropriate storage time and good choice of types of packaging container are important aspects for extending the storage life of *O. stamineus* dried leaves.

2. Materials and methods

2.1 Preparation of Raw Material

Orthosiphon stamineus plants were obtained from Sustainable Agrotechnology Institute, Universiti Malaysia Perlis (UniMAP) crop field. The cleaned plants were air dried at ambient temperature for 7 to 10 days. Only part of leaves was utilized in this experiment to control the consistency of further analysis.

2.2 Storage Treatment

To determine the effects of types of packaging materials on *O. stamineus* dried whole-leaf quality (moisture content, color, antioxidant capacity and total phenolic content), the different storage treatments were prepared by manipulating types of storage packaging materials and storage period. 10 g of *O. stamineus* dried whole-leaf samples were stored into three different types of storage packaging materials. The samples were prepared into three replication. The packaging materials used in this experiment were plastic bag, paper bag and glass container. The dried whole-leaf samples were stored for 8 weeks under room temperature (±25 °C) and relative humidity (±65 %RH). The samples quality changes were analyzed at 0, 4 and 8 weeks of storage period. Each sample was considered as independent samples.

2.3 Sample Extraction

1 g of *O. stamineus* dried whole-leaf was extracted by 100 ml of methanol for 3 hours at 40 °C and 200 rpm using a shaker water bath (Thermolab, Germany). The extracted solution was filtered using Whatman No.1 filter paper and then were sealed in the bottles and stored in a freezer (-20 °C) for chemical quality analysis.

2.4 Determination of Total Phenolic Content

200 µl of Follin-Ciocalteu reagent (FCR) and 200 µl of extract solution were mixed with 1.58 ml distilled water and shook rigorously for 4 minutes before adding 1 ml of 20 % sodium carbonate. The mixed solution was allowed to react for 2 hours in a dark place. The concentration of total phenolic content was quantified using UV/VIS spectrophotometer (Shimadzu. Japan) and the absorbance was read at λ=760nm. The caffeic acid was used as standard and the concentration of total phenolic content was expressed in caffeic acid equivalent (CAE).

2.5 Determination of Antioxidant Capacity

The antioxidant capacity of the extracts was determined using the modified DPPH method as described by Akowuah [11] with slight modification. About 2 ml of 2,2-diphenyl-1-picrylhydrazyl (DPPH) was mixed with 200 µl aliquots of samples. Methanol was used to mark up the mixture to 3 ml. The mixed

solution was allowed to react in a room temperature for 1 hour. The control was also prepared. After 1 hour, the absorbance value was calculated using a UV/VIS spectrophotometer (Shimadzu, Japan) at λ=517nm. The antioxidant capacity of samples was estimated by utilizing the following equation:

$$\text{Antioxidant capacity} = \left[\frac{(A-B)}{A}\right] \times 100 \quad (1)$$

Where A and B are control absorbance and sample absorbance, respectively.

2.6 Determination of Moisture Content

The MS-70 moisture analyzer (A&D, Japan) was used to read the 1 g sample's moisture.

2.7 Determination of Color

An average of six readings was taken from individual sample of *O. stamineus* dried herbal leaves using colorimeter CR-400 (Konica Minolta, Japan). The collected data were available in the form of L*, a* and b* color space (CIELAB). The total color difference (ΔE) was calculated by using the following equation:

$$\Delta E = \sqrt{[(L^* - L_0)^2 + (a^* - a_0)^2 + (b^* - b_0)^2]} \quad (2)$$

Where L_0, a_0 and b_0 are the control values for the initial leaves color before storage.

2.8 Statistical Analysis

All measurements were carried out in triplicate and the results are statistically analyzed using JMP pro 11 package to determine the average value and standard error.

3. Results and discussion

The experiment was carried out to study the effect of packaging materials (plastic, paper and glass) on the *Orthosiphon stamineus* dried whole-leaf quality during storage. The samples were stored for 8 weeks and the changes of the *O. stamineus* dried whole-leaf quality (total phenolis content, antioxidant capacity, moisture content and total color different) were analyzed every 4 weeks. Figure 1 shows the changes of the total phenolic content of the *O. stamineus* dried whole-leaf during 8 weeks of storage period. The initial mean value of total phenolic content of the *O. stamineus* dried whole-leaf samples was 83.68 ± 2.93 mg/g. The total phenolic content of the samples packed in a plastic and paper bags increased insignificantly to 83.14 ± 5.59 mg/g and 84.72 ± 1.22 mg/g, respectively when stored at room temperature for 4 weeks. The increment of the total phenolic content of the samples packed in the plastic and paper bags could be seen for the next 4 weeks of the storage period. However, the contrary results was obtained when the samples were packed in the glass container. The total phenolic content of the samples kept in the glass container exhibited a decrement to 70.79 ± 4.30 mg/g from the initial value of 83.68 ± 2.93 mg/g after 4 weeks of the storage period. Nevertheless, the content of phenolic increased drastically to 108.30 ± 4.69 mg/g during 8 weeks of storage period. The quantity of the total phenolic

content of the *O. stamineus* dried whole-leaf for all treatments (plastic, paper and glass) were insignificantly different at the end of experimental (8 weeks). According to the previous research, the usage of glass as a primary packaging material could sustain the quality of the food product compared to the others type of packaging material [12].

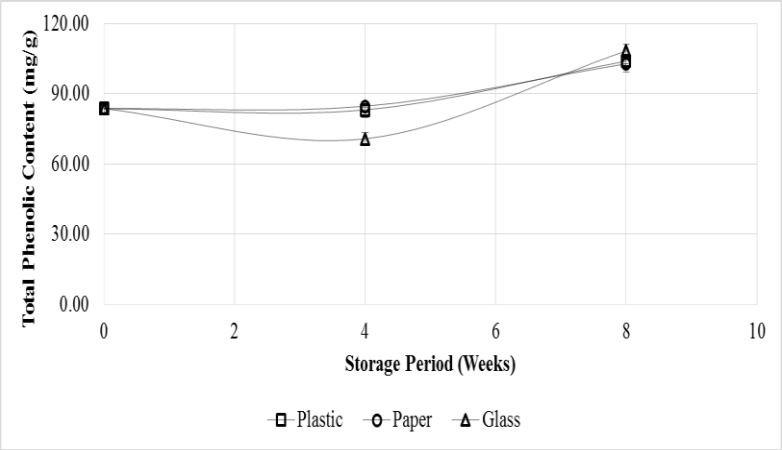

Figure 1. The changes of total phenolic content of *O. staminues* dried whole-leaf during storage

Figure 2 shows the changes of the antioxidant capacity of the *O. stamineus* dried whole-leaf during 8 weeks of storage period. The initial mean value of antioxidant capacity of the *O. stamineus* dried whole-leaf samples was 76.38 %. The samples packed in the plastic bag, paper bag and glass container exhibited a similar pattern throughout experimental storage period (8 weeks). The capacity of antioxidant increased steadily during 8 weeks of storage period. It was about 9 to 10 % increment for all samples. The other researcher also reported about the increment of the antioxidant capacity [13]. However, they found that the packaging materials not affected the quality during the storage.

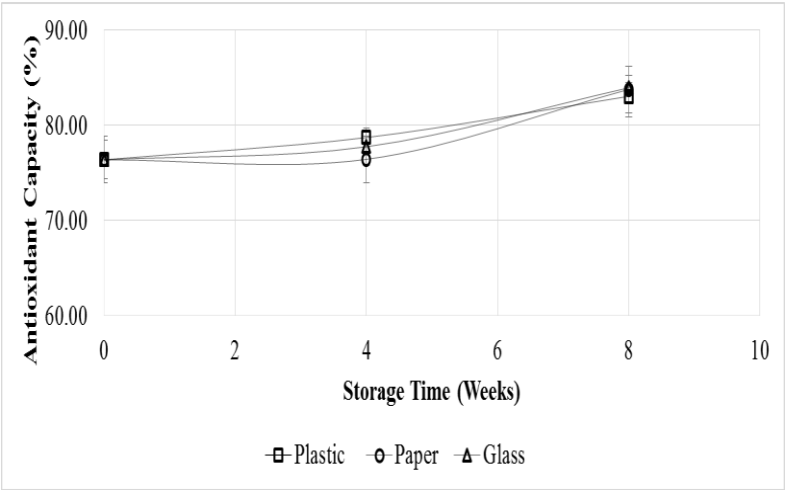

Figure 2. The changes of antioxidant capacity of *O. staminues* dried whole-leaf during storage

Figure 3 shows the changes of the moisture content of the *O. stamineus* dried whole-leaf during 8 weeks of storage period. The initial mean value of moisture content of the *O. stamineus* dried whole-leaf samples was 12.99 %. The samples packed in the plastic bag obviously exhibited the decrement of moisture content and the total mean of moisture content at 8 weeks of storage period was 11.40 %. It was followed by the samples packed in the glass container which the value mean of the moisture content at the end of storage period (8 weeks) was 11.69 %. The changes of the moisture content for the samples

packed in the paper bag exhibited a dissimilar pattern compared to the samples packed in the plastic bag and glass container. The moisture content decreased drastically to 11.46 % at 4 weeks of storage compared to the initial mean value of 12.99 %. However, the moisture content of the samples packed in the paper bag significantly increased to 12.14 % at the end of storage period (8 weeks).

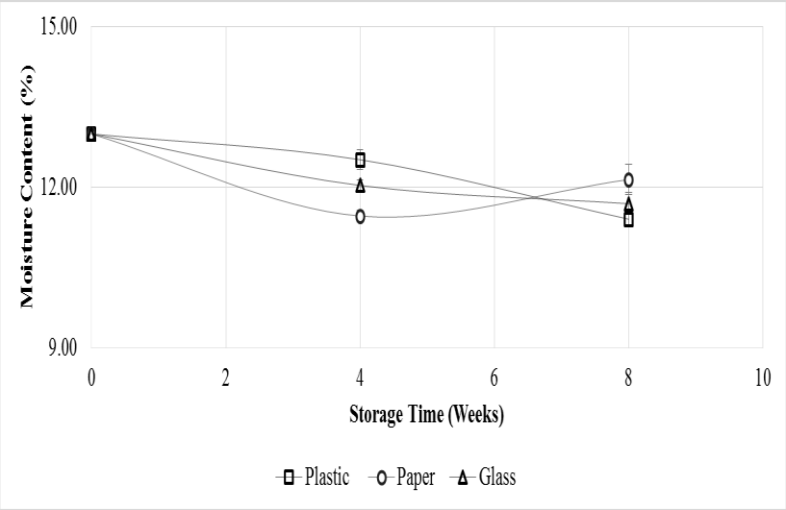

Figure 3. The changes of moisture content of *O. staminues* dried whole-leaf during storage

Figure 4 shows the changes of the total different color (ΔE) of the *O. stamineus* dried whole-leaf during 8 weeks of storage period. All the samples exhibited a similar trend of increment of the total different color (ΔE). The highest changes showed by the samples packed in a glass container (7.69 ± 2.01), followed by the samples packed in paper and plastic bags (6.98 ± 1.10 and 5.76 ± 1.37, respectively). The inceasing of the ΔE might be influenced by the adsorption and desorption process during storage. The dried whole-leaf turned out brown color. This results similar as reported by [5]. They reported that the changes of *Casia alata* color could be attributed by the conversion of chlorophyll to pheophytins at high relative humidity.

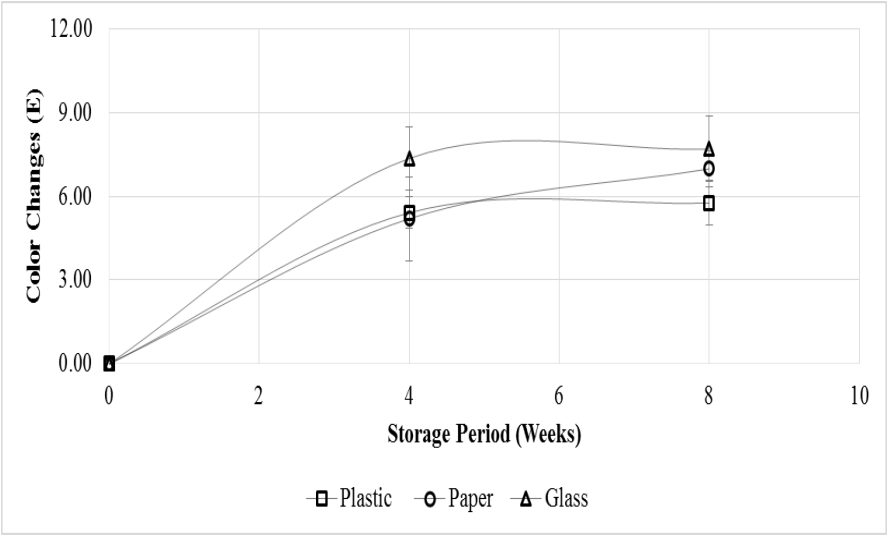

Figure 4. The changes of total different color (ΔE) of *O. staminues* dried whole-leaf during storage

4. Summary

As a conclusion, the data collected in this paper showed that the type of packaging material significantly affected the quality of *O. stamineus* dried whole-leaf herbal during 8 weeks of storage period. The total phenolic content, antioxidant capacity and total different color of the samples increased along the storage period. The moisture content of the samples decreased by storage period except for the samples packed in the paper bag. These finding might be used as an indicator for similar local dried herbal leaves to control the quality of raw herbal material in producing a great quality of herbal finished products.

5. Acknowledgement

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