Quality preservation (total phenolic content and antioxidant properties) of mas cotek (*Ficus deltoidea*) leaves by postharvest technology using microwave drying

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Abstract. Postharvest technology is one of the crucial aspects of quality control in herb processing. Herb such as *Ficus deltoidea* (also known as Mas Cotek) is one of the 10 prioritized herbs shortlisted by the government of Malaysia. In this study, the postharvest treatment of *Ficus deltoidea* by microwave drying is studied in order to determine the best microwave drying method to preserve the total phenolic content and antioxidant properties of the dried leaves with respect to the fresh leaves. Three microwave power levels (300, 600 and 800 W) were used to examine the quality changes of dried *Ficus deltoidea* leaves in terms of total phenolic content and antioxidant properties. Microwave power levels were found to significantly (p < 0.05) affect the quality of the dehydrated *Ficus deltoidea* leaves. It was found that the total phenolic content and antioxidant properties were higher at the microwave power level of 600 and 800 W as compared to 300 W (p < 0.05).

1. Introduction

*Ficus deltoidea* is categorized as one of the famous herbs that is conventionally use for health consumption in Malaysia. In Malaysia, the herb is commonly known as Mas Cotek. [1] has reported various advantages of *Ficus deltoidea* herb for human consumption especially the leaves of the herb. Amongst the health benefit of the herb are it can lower the blood glucose, stabilize the blood pressure, reduce cholesterol and lipids, help to cure severe headache, tighten the vagina muscle after giving birth, help reduce the possibility of early menopause and also help to reduce the chances of getting cancer [1]. The presence of natural phenolic compounds and antioxidants in the plant leaves are believed to provide the medicinal therapeutic properties of the plant [2][3][4].

Consumers usually consume *Ficus deltoidea* leaves in dried form. Drying is widely used method to preserve and extend the shelf-life of the herb. The suitable drying process must be applied in order to maintain and preserve the quality of the herb in term of the total phenolic content and antioxidant properties.

The natural drying process such as sun drying has limitations. Thus, the modern drying technology by using mechanical dryers are used to overcome the limitations by conventional dryers. Herb industries have been using the postharvest drying technology by using mechanical dryers. Three main drying that are commonly used in the industries are in the form of conventional, convection, conduction and radiation dryers which consist of freeze dryer, microwave dryer, vacuum dryers, and hybrid dryer. It was discovered that microwave drying is among the most favorable mechanical dryer due to the quick
drying time to dry the leaves which definitely reduce the operation cost. Several researchers have reported the benefits of microwave drying to the end products quality in terms of the phenolic content and antioxidant properties. For instance, [5] compared total phenolic content and antioxidant properties of green tea and black tea from four commercial brands in the market with microwaved green tea. The microwaved green tea, namely *Camellia sinensis* leaves were dried by using household microwave oven for about four minutes. It was revealed the dried microwaved green tea contains higher amount of total phenolic content and antioxidant properties as compared to the four commercial brands green and black teas. Furthermore, another research was conducted to determine the effect of different drying method on bioactive compounds and physical appearance of Eucommia male flower tea. It was found that both the bioactive compounds and physical appearance of microwave dried Eucommia male flower tea was superior than the conventional dried Eucommia male flower tea [6].

Several researchers have reported the effect of different drying treatments by using microwave dryer. In microwave drying, microwave power level is the main parameter that is being conditioned to determine the best quality of the final dried products. As for example, a study by [7] on borage leaves discovered that drying the leaves at 540 W microwave power level gives the best quality in term of the appearance, flavor, antioxidant activities and total phenolic content. However, a study on different microwave power level between 360 W to 900 W on parsley leaves discovered that there is no significant different in physical appearance in term of color of the dried parsley leaves [8]. As for now, there is no studies reported in open literature on the effect of microwave drying on *Ficus deltoidea* leaves.

2. Methodology

2.1. Preparation of raw *Ficus deltoidea* leaves

*Ficus deltoidea* plant was planted and grown at Universiti Malaysia Perlis (UniMAP). The leaves used in this experiment were obtained from this plot.

2.1.1. Handling of *Ficus deltoidea* leaves

In this experiment, the size and age of the harvested leaves were standardized. This is to ensure the consistency and accuracy of the experiment is maintained throughout the experiment. The leaves were thoroughly washed with tap water until all particle such as dirt are being removed. In order to prevent dehydration of the fresh leaves, the leaves were kept in sealed jar. It was then stored at 4 °C and were used within 24 hours.

2.2 *Ficus deltoidea* leaves drying experiments using microwave dryer

A household Panasonic microwave oven was used in this experiment. The microwave oven has nominal power of 1000 W and frequency of 2450 MHz. A sample of approximately 20 (±0.05) g of the fresh leaves was used in each treatment. The leaves were evenly spread on the provided tray inside the microwave oven. In this experiment, three microwave power level specifically 300 W, 600 W and 800 W were chosen as the drying conditions to dry the leaves. In each microwave power level, the leaves were dried until the weight of the leaves reduce to approximately only 10 % dry basis (d.b). Drying at all the three microwave power level were repeated three times.

2.3 Method of total phenolic content (TPC) analysis

A modified version based on method described by [9] was used to analyze the TPC of the fresh and dried leaves. The method used Folin-Ciocalteu reagent where approximately 1.25ml of Folin-Ciocalteu reagent that has been diluted with distilled water at 1:1 ratio was added to 0.25ml of the leaves extract. The solution was left for 3 min. After that, 1.0ml of sodium carbonate with concentration of 75 g/L was poured into the solution. The solution was then incubated for one hour at room temperature. UV-vis spectrophotometer was used to measure the absorbance of the sample at wavelength of 760nm. The standard used to estimate the TPC was gallic acid where the TPC was expressed as mg gallic acid equivalent per g dry matter (GAE/g DM).
2.4 Method of antioxidant properties analysis

The antioxidant properties or the antiradical activity of the fresh and dried leaves extracts was determined by using the 2, 2-Diphenyl-1- picrylhydrazyl (DPPH) method described by [10]. The preparation for the solution for analysis must be done in dark condition where 1 ml methanolic solution of 1 mM DPPH was added to 1 ml of methanolic solution of the leaves extract. The solution was then left to stand for 15 min at room temperature. UV-Vis spectrophotometer was used to measure the absorbance of the sample at the wavelength of 520nm.

3. Results and Discussion

3.1. Analysis of total phenolic content (TPC)

TPC of the fresh and dried leaves was determined by using Folin Ciocalteu assay. Gallic acid is the standard used as the reference. The TPC was expressed as mg gallic acid equivalent per g dry matter (GAE/g DM). The results are tabulated in Table 3.1.

Table 3.1. Concentration of TPC of Ficus deltoidea leaves (fresh and dried).

|                      | Concentration (mg GAE/g DM) |
|----------------------|-----------------------------|
| Fresh leaves         | 12.74±0.70a                 |
| Dried leaves         |                             |
| Microwave power (W)  | Concentration (mg GAE/g DM) |
| 300                  | 16.68±0.43b                 |
| 600                  | 17.68±0.16c                 |
| 800                  | 17.32±0.47c                 |

* Means ± standard deviation that do not share a letter in the same column are significantly different according to Tukey’s test 95% confidence level

Table 3.1 shows the TPC of fresh and also dried Ficus deltoidea leaves that was dried under different microwave power level. It can be seen that there is an increment of TPC in the dried leaves in the range of 29.83 % to 38.78 % when compared to the fresh leaves. A researcher, [11] reported similar observation where mallow leaves that was dried using microwave oven contained higher TPC as compared to the fresh mallow leaves [11]. The effect of different microwave power level on the TPC of the dried Ficus deltoidea leaves was also investigated and it was found that there is no definite trend. Ficus deltoidea leaves dried at microwave power level of 300 W was found to be the lowest and was significantly different as compared to leaves dried at 600 W and 800 W with TPC concentration of 16.68±0.43 mg GAE/g DM. From Table 3.1, it can be seen that the highest TPC was obtained at leaves dried at microwave power level of 600 W. Leaves dried at microwave power level of 800 W was lower than TPC of leaves dried at 600 W but there was no significant different.

Based on the result shown, it can be seen that TPC of Ficus deltoidea leaves dried at lower microwave power level namely 300 W as compared to the other two microwave power level (600 W and 800 W) is the lowest. At higher microwave power level, the structure of the leaves might be destroyed and this phenomenon resulted the TPC could easily be released. Therefore, during extraction of the dried leaves for TPC analysis, more phenolic compounds will be dissolved in the solvent.

3.2 Analysis of antioxidant properties
DPPH radical scavenging method was used to evaluate the antioxidant properties of fresh and dried *Ficus deltoidea* leaves. DPPH method is commonly used to measure the antiradical activity because it is low cost and simple analysis. DPPH is used to assess the capability of the compounds to act as free radical scavengers or hydrogen donors. The results of the antioxidant properties in term of percentage inhibition are tabulated in Table 3.2.

**Table 3.2. Antioxidant properties of *Ficus deltoidea* leaves (fresh and dried).**

|                      | % Inhibition  |
|----------------------|--------------|
| Fresh leaves         | 71.50±0.78a  |
| Dried leaves         |              |
| Microwave power (W)  | % Inhibition |
| 300                  | 72.61±0.38a  |
| 600                  | 76.80±0.45b  |
| 800                  | 76.70±0.36b  |

* Means ± standard deviation that do not share a letter in the same column are significantly different according to Tukey’s test 95% confidence level.

Table 3.2 shows the antioxidant properties of fresh and also dried *Ficus deltoidea* leaves dried at different microwave power level. The antioxidant properties of the fresh *Ficus deltoidea* leaves was found to be lower than the dried *Ficus deltoidea* leaves. The antioxidant properties of all the dried leaves at all microwave power level was higher by 0.95% to 8.13% as compared to the fresh leaves. However, the antioxidant properties of the dried leaves at 300 W is not significantly different from the fresh leaves even though the antioxidant properties is higher. The increment of the antioxidant properties of dried leaves as compared to the fresh leaves could be related to the increment of TPC as discussed previously.

As for the dried leaves comparison, there is no definite trend of the antioxidant properties. Dried leaves at 300 W microwave power level gives the lowest antioxidant properties of 72.61±0.38% while the highest antioxidant properties, 76.80±0.45% was obtained at 600 W microwave power level. An almost comparable result was reported by [7] where the highest antioxidant properties of microwaved dried borage leaves was found at drying condition at 540 W. Similar to the result of TPC, the antioxidant properties of dried leaves at 600 W and 800 W are significantly higher as compared to dried leaves at 300 W. This is probably to the higher phenolics compounds in the 600 W and 800 W dried leaves which contributes to the higher antioxidant properties.

4. Conclusion

The demand of high quality dried herbs for health consumption in Malaysia has pushed the herb industry to focus on the postharvest technology in order to preserve the quality of the dried herbs. Microwave drying is one of the artificial drying technology that has been proved to preserve the quality in terms of nutrition and appearance in order to fulfill the need of high quality products for consumers. This study is conducted to find the best drying conditions by optimizing the microwave power level focusing on preserving the total phenolic content and antioxidant properties which are the main nutrient that contribute to the medicinal properties of the dried *Ficus deltoidea* leaves.

As an overall observation on TPC analysis, it can be concluded that all dried *Ficus deltoidea* leaves dried at different microwave power was higher than the fresh leaves and all the TPC are significantly different.
For the antioxidant properties analysis, it can be concluded that the antioxidant properties of all dried Ficus deltoidea leaves was found to higher as compared to the fresh leaves. Among the dried leaves dried under different microwave power level, the highest antioxidant properties was found at microwave power level of 600 W with 76.80±0.45 % inhibition while the lowest antioxidant properties was found at microwave power level of 300 W with 72.61±0.38% inhibition.

This study can be a good foundation for further drying treatments of Ficus deltoidea leaves by using microwave dryer of hybrid dryer such as vacuum-microwave dryer or hot air-microwave dryer to enhance the quality of the dried products.

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