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Evaluation of Vitamin C Content in Microwave-Dried Guava (Psidium Guajava L)

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ABSTRACT

This study is carried out to evaluate the effect of different microwave powers on the quality of microwave-dried guava in term of vitamin C degradation. The effect of microwave heating on the vitamin C content of microwave-dried guava using three microwave power levels of 300 W, 450 W and 600 W was determined by using High-Performance Liquid Chromatography (HPLC). All microwave-dried guava using three different power levels fell in the desired final moisture content range which was 16.01 – 16.05 %. The percentage loss of vitamin C in the microwave-dried guava was 6 %, 63.8% and 85.93% at 300 W, 450 W and 600 W microwave power levels respectively. The vitamin C content of the microwave-dried guava decreased with the increase of microwave power level. Microwave-dried guava using 300 W power level shown the highest vitamin C content with a peak area of 691909 µV while drying using 600 W power level gave the least vitamin C content with a peak area of 103555 µV. Vitamin C is easily destroyed by the excessive heat and water, as well as exposure to air. For retention of vitamin C in dried fruit, it is recommended to apply lower microwave power level in fruit drying. Therefore, the optimum microwave power level for better quality microwave-dried guava production assessed is 300 W.

Keywords: Guava, Microwave Drying, Vitamin C.

1. INTRODUCTION

Guava (*Psidium guajava* L.) is one of the tropical fruits that grow in all subtropical areas. In fact, guava is a highly nutritious tropical fruit with low calories and fats while carrying numerous essential vitamins, antioxidant polyphenolic, flavonoid compounds, and minerals which play an important role in preventing cancers, anti-aging, and fight against infections. Besides, guava is an excellent source of antioxidant vitamin C. Guava contains abundant of health-promoting fiber, antioxidants, minerals, and vitamins. According to the research, the concentration of vitamin C in guava is (228 mg/100 g) and 165 mg per average size fruit/slice which is three times more than the required DRI (daily-recommended intake) [1].

Vitamin C is the most vital vitamin in human nutrition needs, usually obtained from vegetables and fruits. Among antioxidant vitamins, water-soluble vitamin C has many biological activities in the human body that help to decrease the amount of C-reactive protein (CRP); an indicator of inflammation and also might be a sign of heart illness [1]. Vitamin C plays a significant role in protecting cells from oxidative destruction and thus fights against chronic cancer and minimizes the risk of arteriosclerosis [2].

Microwave drying is one of the drying techniques works by generating heat from the interior of a food product which leads to the build-up of an internal vapour pressure that drives the moisture out of the product. As compared to other drying techniques, microwave drying is proven to improve

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the quality of dehydrated fruit and more economical than freeze drying. Thus, microwave drying is applied in this research for better quality dried fruit production. Microwave drying is widely applied particularly in fruit preservation. It is a rapid process of removing the moisture content from fruits in order to inhibit microbial activity [3]. If fruits are dried accordingly and properly stored, the dehydrated fruits are shelf stable which means they are safe for storage at room temperature. The quality characteristics of fruit such as vitamin C content are however altered due to high microwave power. In fruit drying, the commonly used microwave power range using the conventional microwave is from 240W – 600 W [4, 5]. Lowering the microwave power is able to enhance the quality of dried fruit. Nevertheless, the drying time and operation cost will be unbearable [6]. Therefore, the optimum microwave power for dried guava production is assessed.

2. MATERIALS AND METHODS

2.1 Preparation of Guava Samples

Fresh guavas that free from any brown spots and bruises were purchased from the local market. The guava samples were washed with tap water and hand peeled with a knife in the laboratory. The guava seeds were scooped out with a spoon. The seedless guavas were cut into thin slices with the same thickness of 5 mm measured with vernier caliper [7]. The initial moisture content of the fresh guava samples was determined using a moisture meter and was recorded. The initial weight of guava slices was measured by digital balance and was recorded.

2.2 Determination of Vitamin C Content in Fresh Guava Sample

50 g of fresh guava slices were weighed and blended into guava pulp for vitamin C determination. Determination of vitamin C in fresh guava samples was performed using high-performance liquid chromatography (HPLC) with UV detection at 254 nm in the laboratory. The separation was performed using a C-18-ODS column with a mobile phase consisting of a mixture of 1% orthophosphoric acid, H_3PO_4, 15% methanol, CH_3OH and 84% of distilled water. Subsequently, the mobile phase was pumped at the flow rate of 0.9 mL/min by a high-pressure pump. The guava extract (guava pulp) that was prepared previously was introduced into the HPLC column by sample injector for vitamin C determination. As the guava samples were eluted from the HPLC, the vitamin C concentration of the samples was determined by the detector. The chromatograph of vitamin C was displayed by the data processing unit. The whole process took around 7 minutes to ensure all peaks were eluted [8].

2.3 Drying of Guava Sample

Subsequently, 50 g of guava slices were weighed and dried in a laboratory microwave oven. The guava samples were arranged properly on the petri dish before placing into the microwave oven in order to ensure uniform drying. The microwave dryer was set at three different output power levels which were 300 W, 450 W and 600 W. The moisture content was calculated by recording the change in weight of guava samples. The weight of microwave-dried samples was recorded every 1 minute before achieving the standard final moisture content of guava [9]. The drying procedure was continued until the moisture content of the samples was reduced to 16 – 18 % in wet basis which is the standard final moisture content of dried guava. Three replication were performed for microwave drying of guava samples according to each preset microwave output power levels [10].

2.4 Determination of Vitamin C Content in the Microwaved-Dried Guava Sample

As the dried guavas were in solid form, the vitamin C content of dried guava was unable to be directly analysed by High-Performance Liquid Chromatography (HPLC) which required a mobile phase in liquid form. Therefore, sample preparation for vitamin C determination was required.

After microwave drying, dried guava samples were cut into small pieces and were blended into a fine powder using a blender. In order to ensure uniform particle size, the blended samples were sieved using a filter. The microwave-dried guava powder of 250 mg samples was weighed and dissolved separately in 50 mL of the mobile phase. The mixtures were centrifuged at 3000 rpm for 5 minutes at room temperature (20°C). The supernatants were collected for vitamin C determination using HPLC in the following step. The sample preparation technique is important as it eliminates contaminants and ensures the better performance.

Vitamins are usually accompanied by excess compounds that have the same chemical characteristics. Hence, identification and quantification are both necessary for the vitamin detection in food. Vitamin C is labile compounds which is sensitive to high temperatures, oxygen, and light [9]. Determination of vitamin C for microwave-dried guava samples was performed by high-performance liquid chromatography (HPLC) with UV detection at 254 nm. The separation was performed using a C-18-ODS column with a mobile phase consisting of a mixture of 1% orthophosphoric acid, H_3PO_4, 15% methanol, CH_3OH and 85% of distilled water. Subsequently, the mobile phase was pumped at the flow rate of 0.9 mL/min by a high-pressure pump. The supernatants that prepared previously were introduced into the HPLC column by sample injector for vitamin C determination. Subsequently, the vitamin C of the microwave-dried guava samples was determined by the detector as they eluted from the HPLC. The chromatograph of vitamin C was displayed by the data processing unit. The whole process took around 7 minutes to ensure all peaks are eluted [11].

2.5 Analysis of Data

The vitamin C degradation analysis was evaluated by calculating the percentage of vitamin C reduction from the respective peak area on chromatograph.

3. RESULTS AND DISCUSSION

Microwave drying process can stimulate several physical and chemical changes in guava slices that affect the vitamin C retention. This is due to vitamin C are labile compounds which is sensitive to high temperatures, oxygen, and light. In this paper, vitamin C or ascorbic acid degradation of microwave-dried guava were discussed based on the peak area from the combination chromatograph in Figure 1.

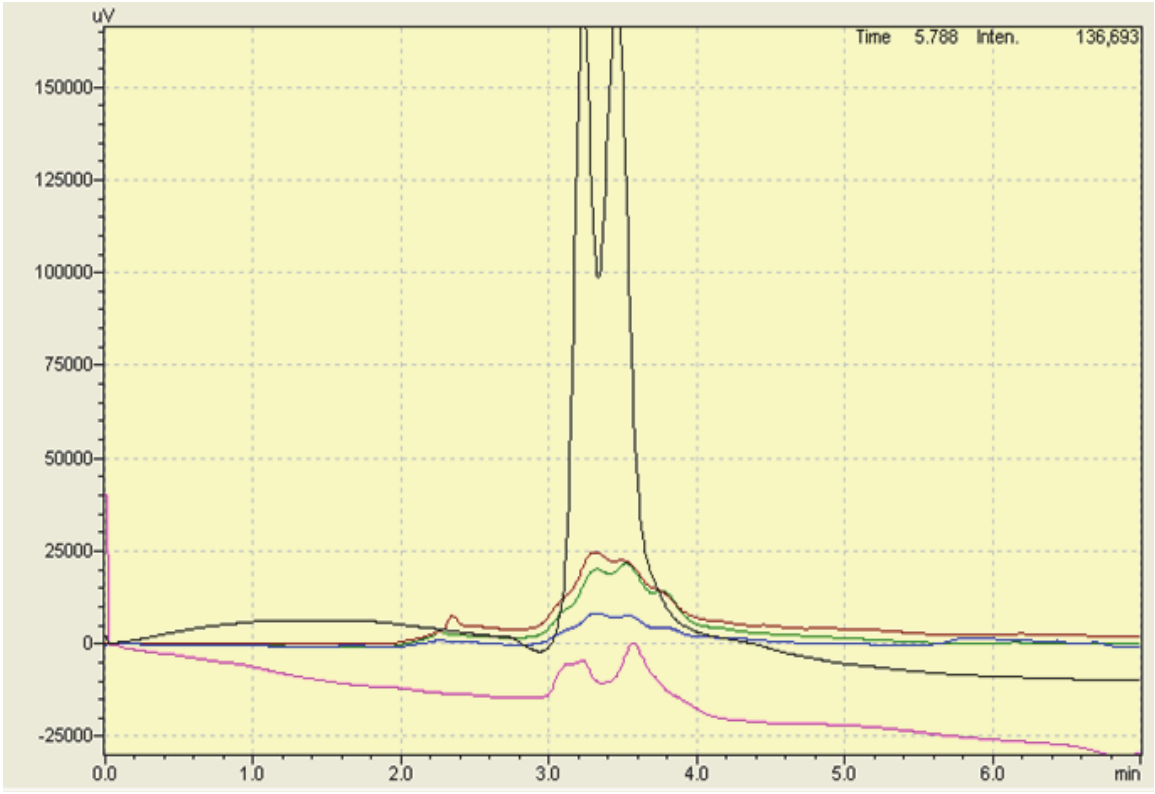

Figure 1. Combination chromatograph of standard ascorbic acid, the ascorbic acid of both fresh guava and microwave-dried guava using 300 W, 450 W, and 600 W power levels.

The overall results demonstrated the satisfactory and consistent performance of the HPLC method. Based on the chromatograph of standard ascorbic acid (black colour peaks) in Figure 1, the peaks showed a retention time of 3.23 minutes with a peak area of 3718149 µV. Retention time is the time taken for a particular compound to travel through the column to the detector. For a sample containing several compounds, each compound in the sample will spend a different amount of time on the column depending on its chemical composition. Therefore, ascorbic acid from all samples will yield the peak with the same range of retention time with ±0.5 % variation with standard ascorbic acid. On the other hand, peak area is an indicator of the ascorbic acid concentration whereby the greater the peak area, the higher the ascorbic acid concentration that particular solution contains. Standard ascorbic acid contains 99% of pure ascorbic acid and thus it gave the greatest peak area. However, there were two peaks yielded from standard ascorbic acid solution. This might due to the presence of impurities in the standard ascorbic acid solution.

In contrast, from the chromatograph of ascorbic acid of fresh guava (brown colour peak), the peak showed a retention time of 3.31 minutes with a peak area of 736138 µV. The peak yielded from the ascorbic acid of fresh guava indicated the vitamin C concentration of fresh guava before microwave drying. Meanwhile, the retention time for ascorbic acid of fresh guava was fall in the range of ±0.5 % variation with that of standard ascorbic acid.

On the other hand, the green colour peak which illustrated the chromatograph of microwave-dried guava using 300 W power level showed a peak with retention time of 3.52 minutes and a peak area of 691909 µV. As compared to the peak area of ascorbic acid of fresh guava, it was reduced about 6% of peak area which can be considered as relatively low vitamin C degradation. Similarly, the retention time for ascorbic acid of microwave-dried guava using 300 W power level was fall in the range of ±0.5 % variation with that of standard ascorbic acid.

For the blue colour peak which demonstrated the chromatograph of microwave-dried guava using 450 W power levels showed a peak with retention time of 3.32 minutes and a peak area of 266490 μV. The peak area was decreased drastically of about 63.8 % as compared to the peak area of ascorbic acid of fresh guava. The huge reduction of peak area indicated the great loss of vitamin C concentration. This was due to the high microwave power level that destroys the heat-sensitive ascorbic acid structure. Moreover, the retention time for ascorbic acid of microwave-dried guava using 450 W power levels was fall in the range of ±0.5 % variation with that of standard ascorbic acid.

In addition, the purple colour peak which illustrated the chromatograph of microwave-dried guava using 600 W power levels showed a peak with retention time of 3.23 minutes and a peak area of 103555 μV. The peak area was dropped tremendously by about 85.93 % as compared to the peak area of ascorbic acid of fresh guava. The small peak area of ascorbic acid of microwave-dried guava using 600 W power levels indicated that there was an abundant amount of vitamin C has been destroyed by the high microwave power level. This was due to vitamin C is water-soluble and easily leached into the water and then degraded by heat. Meanwhile, the retention time for ascorbic acid of microwave-dried guava using 600 W power levels was fall in the range of ±0.5 % variation with that of standard ascorbic acid. Besides, the presence of impurities in the supernatant of microwave-dried guava using 600 W power level resulted in two peaks were eluted on the chromatograph.

Based on the results, the retention time for ascorbic acid of both fresh guava and microwave-dried guava using 300 W, 450 W and 600 W power levels are acceptable as they were falls in the range of ±0.5 % variation with that of standard ascorbic acid. In view of peak area which was an indicator of vitamin C concentration, it can be seen that higher microwave power level yielded lower peak area. This phenomenon showed that microwave drying of guava using higher microwave power level will lead to greater vitamin C degradation and affected the quality of microwave-dried guava. This was due to the high thermal energy released has damaged the heat-labile vitamin C compounds. Hence, higher microwave power level resulted in greater vitamin C degradation. The result obtained was consistent with the previous work by Ali [12].

4. CONCLUSION

The effect of microwave drying on the vitamin C concentration of microwave-dried guava at different microwave power levels of 300 W, 450 W, and 600 W were evaluated. Based on the plotted chromatograph, the peak area of ascorbic acid was decreased as the microwave power level increased. Peak area is an indicator of vitamin C concentration in which greater peak area indicated higher vitamin C concentration of that particular solution contains. Thus, the reduction of peak area with increasing microwave power level demonstrated that microwave drying of guava using higher microwave power level will result in greater vitamin C degradation. Upon all the results have been discussed, the optimum microwave power level for microwave-dried guava production assessed was 300 W as it caused the least vitamin C degradation. This study is important in improving the quality of dried guava in term of vitamin C content through the optimum microwave power assessment.

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