Effect of detergents on quality and flavor of fresh-cut perilla

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Abstract. The effect of detergents on the quality and flavor of fresh-cut perilla was evaluated. The acidic electrolyzed water and sodium hypochlorite extended the shelf life of the perilla to 11d. The sodium hypochlorite treatments was more effective to avoid the loss of the greenness of the perilla leaf compared with the acidic electrolyzed water treatment. The acidic electrolyzed water treatment was well maintained the original flavor of the perilla.

Introduction

Perilla (*Perilla frutescens* L.) is rich in protein, vitamins and minerals, and rosmarinic acid, polyphenols, flavonoids, perilla aldehyde, α-linolenic acid and other biologically active substances [1]. Recently, considerable attentions have been given to the health benefits of perilla, such as anti-allergic [2], anti-oxidation, anti-cancer [3], anti-tumor [4], antibacterial [5], and anti-HIV [6]. Consequently, perilla is widely fresh consumed due to its attractive color and flavor, high in medicinal value.

The processing of fresh-cut perilla includes the washing, sterilizing, cutting and packaging. The sterilizing is an important consideration for the safety and shelf life of the fresh-cut vegetable [7]. The detergents, such as the acidic electrolyzed water and sodium hypochlorite, have been widely applied for sterilization of the fresh-cut vegetable[8-10]. However, the comparison of acidic electrolyzed water and sodium hypochlorite on the quality and flavor of the fresh-cut perilla was not found to the best of our knowledge. Hence, the acidic electrolyzed water and sodium hypochlorite were applied as the detergents to sterilize the fresh-cut perilla. The shelf life, quality and flavor of the treated perilla were compared after being stored for 9 d.

Material and Methods

Preparation of fresh-cut perilla. Perilla was picked from our Tongzhou farm (Tongzhou District Beijing, 2014). The fresh leaf of the perilla was stored at 4 ^{o}C before use. The perilla was washed by the tap water at 4 ^{o}C to remove the soil and some inclusion.

Control: the washed perilla was washed by water again for 5 min at 4 ^{o}C and was cut manually. The cut leaf of about 15 g was packaged in a 20 cm ×18 cm polythene film and stored at 4 ^{o}C.

Acidic electrolyzed water: the washed perilla was sterilized by acidic electrolyzed water for 5 min at 4 ^{o}C and was cut manually. The cut leaf of about 15 g was packaged in a 20 cm ×18 cm polythene film and stored at 4 ^{o}C.

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Sodium hypochlorite: the washed perilla was sterilized by sodium hypochlorite of 100 ppm for 5 min at 4 °C and was cut manually. The cut leaf of about 15 g was packaged in a 20 cm ×18 cm polythene film and stored at 4 °C.

Determination of chlorophyll by spectrophotometry. To measure the chlorophyll content, 20 ml of 80 % acetone was added to 5 g of each sample and mixed with a homogenizer (IKA T10 Basic, Werke GmbH & Co. KG, Staufen, Germany) for 1 min at a high speed, then centrifuged at 8,000 rpm for 5 min at 4 °C, and then filtered through Whatman No. 1 filter papers. The volume was adjusted to 25 mL and the absorbance values were measured at 663 and 645 nm by a spectrophotometer (UV-1800, Shimadzu Corporation, Kyoto, Japan). The chlorophyll content of the sample was calculated followed by Equation 1.

$$Chlorophyll = \frac{(20.2 \times A_{645} + 8.02 \times A_{663}) \times D}{1000} \quad (1)$$

where chlorophyll content is mg/g fresh weight; A_{645} and A_{663} are the absorbance at 645 nm and 663 nm, respectively; D is the dilution factor of the sample.

Total microflora counts. Samples were serially diluted, plated in total count agar for total microflora counts, followed the recently reported method [11]. The plates were incubated at 37°C for 48 h and counted manually.

Flavor comparison. The flavor of the samples was compared by an electronic nose PEN2 (Airsense Analytics GmbH, Schwerin, Germany). The electronic nose was turned on for 30 min and flushed the testing system for 180 s. The sample of 2 ml was put in the testing tube. And then the electronic sensor was put into the testing tube to collect the results for 60 s. The response of the sensor in 48~52 s were evaluated by a principal component analysis.

Statistical Analysis. Analysis of variance (ANOVA) was used to compare mean differences of the results. If the differences in mean existed, multiple comparisons were performed using Duncan's Multiple Range Test. All analysis was conducted using SPSS for Window Version 19. All experiments were done in triplicates or more.

Results and Discussion

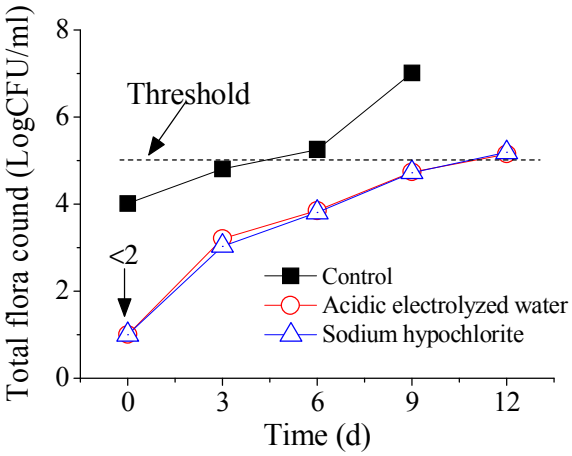

Figure 1 Effect of detergents on the total micorflora count of fresh-cut perilla

Effect of detergents on shelf life of fresh-cut perilla. The effect of detergents on the total micorflora count of fresh-cut perilla is shown in **Figure 1**. Up to know, the threshold of the fresh-cut vegetable is not defined in the world. In Beijing, most company set 5.0 LogCFU/g as the threshold of the fresh-cut vegetable. The total microflora count of the Acidic electrolyzed water and Sodium hypochlorite treatment was significant lower than that of the control. Specifically, the total

microflora count of the Acidic electrolyzed water and Sodium hypochlorite treatment exceeded the 5.0 LogCFU/g in the 11th day, while that of the control exceeded in the 4th d. Consequently, the Acidic electrolyzed water and Sodium hypochlorite treatment extended the shelf life of the fresh-cut perilla that was 11 days from the views of the microflora, which was longer than most of the fresh-cut vegetable [12-15]. The treated perilla in the 9th d was the main object in the following discussion.

Effect of detergents on chlorophyll content of fresh-cut perilla. The effect of detergents on the chlorophyll content of the fresh-cut perilla that was stored for 9 d was compared. The chlorophyll content was significantly reduced after stored for 9 d (**Figure 2**). The chlorophyll content of the Acidic electrolyzed water and Sodium hypochlorite treatment treatments was significant higher than that of the control, and that of the Sodium hypochlorite treatment was significant higher than that of the Acidic electrolyzed water. The chlorophyll content reflected the greenness of the sample [16, 17]. Hence, the Sodium hypochlorite treatment was effective to hold the greenness of the perilla.

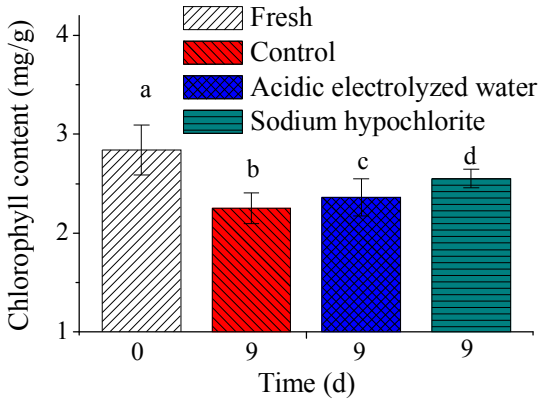

Figure 2 Effect of detergents on the chlorophyll content of fresh-cut perilla

Effect of detergents on flavor of fresh-cut perilla. The effect of detergents on the flavor of the fresh-cut perilla that was stored for 9 d is shown in **Figure 3**. The principal component analysis showed that the flavor of the sample was mainly contributed by the main component 1 and main component 2. The main component 1 and main component 2 contributed 91.14 % and 8.80 % for the flavor of the fresh-cut perilla. The main component 1 and 2 accounted 99.943 % of the total flavor, which was effective to reflect the flavor of the perilla. Each treatment leaded to a significant difference compared with the flavor of the fresh perilla. Remarkably, the flavor of the Acidic electrolyzed water treatment was more similar to that of the control. Hence, the flavor of the Acidic electrolyzed water treatment was well maintained after being stored for 9 d.

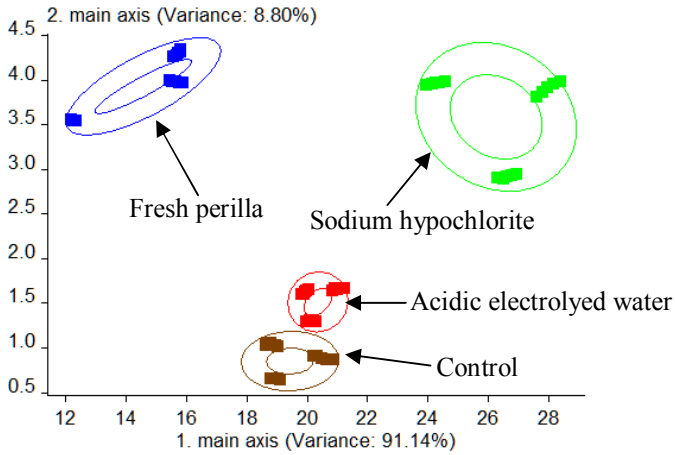

Figure 3 Effect of detergents on the flavor variety of fresh-cut perilla

Conclusions

The effect of detergents on the quality and flavor of fresh-cut perilla was evaluated. The acidic electrolyzed water and sodium hypochlorite treatments extended the shelf life of the perilla to 11d. The sodium hypochlorite treatments was more effective to avoid the loss of the greenness of the perilla leaf compared with the acidic electrolyzed water treatment. The acidic electrolyzed water treatment was well maintained the original flavor of the perilla.

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