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Use of ambient upland rice fermented vinegar vapor to extend shelf life of sweet basil (*Ocimum basilicum* Linn.)

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The effectiveness of ambient upland rice fermented vinegar vapor containing 4% acetic acid to extend shelf life of sweet basil (*Ocimum basilicum* Linn.) was evaluated. Fresh leaves of sweet basil were fumigated with upland rice fermented vinegar vapor for 0 (control), 2, 5, 10 and 15 min and packed in PE bags with 8 holes of diameter 0.7 cm at storage of 10 °C. The leaf weight loss, chilling injury symptom and shelf life were recorded. The results show that use of ambient upland rice fermented vinegar vapor for 10 min was most effective to extend shelf life of sweet basil (19.5 days), compare to control (14.5 days). After 19 days of storage sweet basil fumigated with upland rice fermented vinegar vapor for 10 min also showed the least leaf weight loss recorded were 26.59 % whereas control recorded were 35.69 %.Quality evaluations of sweet basil of all treatments retained good to excellent quality (rating = 5) when stored up to 5 days. However, after 7 days sweet basil for all postharvest treatments overall quality decreased by formation of brown specks and due to chilling injury symptoms. The obtained results suggest that sweet basil on extended shelf life by using upland rice fermented vinegar vapor for 10 min was most effective.

Keywords: shelf life, sweet basil (*Ocimum basilicum Linn*.), upland rice vinegar, weight loss

Introduction

Sweet basil (*Ocimum basilicum* Linn.) or Horapa is commonly used ingredient for Thai cooking, noodles with chicken and pork, stir-fries and curries. Sweet basil is a popular herb often marketed in bunches of shoots and has exported every year. But postharvest deterioration will cause the loss of commercial significance. After the harvest, it is the loss of water with affects the quality of vegetables and a major cause of the deterioration and weight loss, which makes the invasion of pathogens and increased susceptibility to chilling

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injury (Genanew, 2013).

In addition to deterioration in exports of fresh vegetables, problems of exporting fresh vegetables were found contaminated by bacteria such as *Salmonella* and *Escherichia coli* (Poubol, J. and Jitareerat, P., 2010). It affects exporters and manufacturers greatly. The productivity deterioration rate is relatively fast, postharvest management is necessary to maintain the quality and extend the shelf life of fresh vegetables to consumers while vegetables are good quality. Upland rice fermented vinegar was produced by the fermentation of ethanol by acetic acid bacteria. It has vitamins and a mineral including iron from glutinous rice used in fermentation including acetic acid has bactericidal properties (Solieri, L. and Giudici, P., 2009). The use upland rice fermented vine to extend shelf life should help reduce damage from previous methods and because it is a natural product is safe for consumers. And using upland rice fermented vinegar vapor at room temperature, it is the substance of choice for extending the shelf life of sweet basil.

Objectives: Studies using of ambient upland rice fermented vinegar vapor on the quality and to extend shelf life of sweet basil.

Materials and methods

Fresh leaves of sweet basil were purchased from a local commercial vegetable production in Pathum Thani province, Thailand and were taken immediately (within about 2 h of harvest) to the laboratory at the Department of Plant Production Technology, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand. Before treatment, samples of sweet basil of uniform size without blemish of plant diseases were selected and then washed and cut the length of about 15-20 cm After that, three sweet basil shoots were placed in plastic box (25x30x25 cm) and fumigated with upland rice fermented vinegar vapor for 0 (control), 2, 4, 6, 8 and 10 minutes. Ambient fermented vinegar vapor was prepared by bubbling external air through upland rice fermented vinegar (acetic acid content 4%) contained in 500 mL bottle at room temperature. The upland rice fermented vinegar vapor in the headspace of the bottle was delivered to the box. The rate of vapor production was calculated from the rate of weight loss of the as 0.032±0.02 g of vinegar/min (Figure 1). After the vapor treatment sweet basil were packed in polyethylene bags (PE) with 8 holes of diameter 0.7 cm then sealed, weighed and stored at 10 °C. The fresh weight loss, chilling injury assessment, and shelf life were recorded till the end of the experiment.

Shelf life evaluation

Sweet basil Leaves were assessed daily for visual browning and freshness. Shelf life of sweet basil was considered terminated when leaves showed more than 50% browning.

Weight loss

The loss in weight was recorded 2 days intervals till the end of the experiment. The fresh weight loss was determined by the following formula and expressed as percentage (Gharezi *et al.,* 2012).

$$\textbf{Weight loss (\%)} = \frac{\text{(Initial weight -Weight on the day observation)}}{\text{Initial weight}} \times 100$$

Chilling injury assessment

Evaluations of overall appearance, wilting, leaf color, necrosis (darkened areas) were assessed daily. For each assessment, subjective ratings were assigned (leaves change color from dark green to brown). The chilling injury scale ranges from 1 to 5 as follows: 5 = no damage; 4 = several dark spots; 3 = black stains on 30% of the leaf area; 2 = black stains on 30-50% of the leaf area; and 1 = black stains on more than 50% of the leaf area (Meir *et al*., 1997).

Statistical Analysis

Five treatments of four replicates each were in a completely randomized design. Analysis of variance was calculated for all data and comparisons between treatments were made at probability level $p \leq 0.05$ using Tukey's Studentized Range Test.

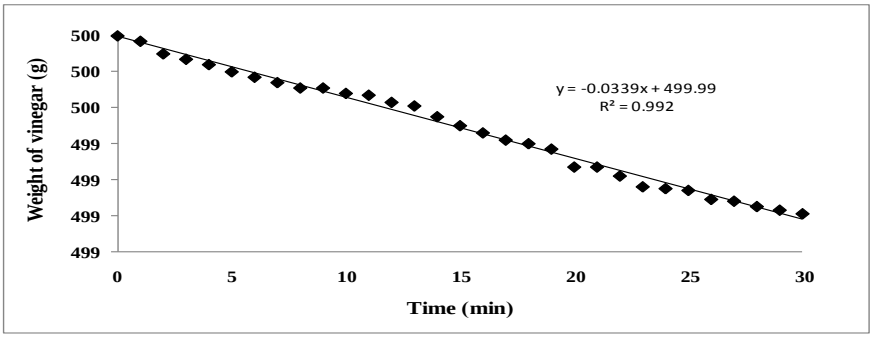

Figure 1. Vapor rates of upland rice fermented vinegar.

Results

Shelf life

Shelf life extension of sweet basil with upland rice fermented vinegar vapor was found that the fumigation with upland rice vinegar vapor for 10 minutes had the longest extended shelf life about 19 days when compared to the control, which has a shelf life of 14.5 days (Table 1).

Table 1. Effect of upland rice fermented vinegar vapor on shelf life of sweet basil

Treatment	Shelf life (days)
0 min	14.5 ± 1.30 c*
2 min	16.0 ± 0.89 bc
5 min	16.5 ± 0.84 bc
10 min	19.5 ± 1.58 a
15 min	17.5 ± 0.84 ab

Values are mean ± standard deviation of four replications. *Mean followed by different letters in the same column for the same cultivar is significantly different ($P<0.005$).

Weight loss

Weight loss of sweet basil increased continuously during storage (Figure 2). The weight loss rates of all upland rice vinegar vapor treatments were lower than the control. The fresh weight loss of control sweet basil rapidly increased within the first three days after storage. Control sweet basil on 19 day after storage showed 35.69 % loss in weight compared to 0 day and, the same day sweet basil treated with upland rice vinegar vapor showed 26.59-32.94 % loss in weight compared to 0 day. The fumigation with upland rice vinegar vapor for 10 minutes had the lowest weight loss.

Chilling injury assessment

During storage, sweet basil leaves were evaluated for chilling injury appearance. The chilling injury appearance greatly depended on storage time. The chilling injury symptoms of sweet basil did not occur during the first 5 days of storage. After 11 days of storage, chilling injury appearance had increases in control leaf and at the end of 19 days chilling injury appearance of sweet basil was scored as 1.00 (Figure 3). The chilling injury appearance of upland rice vinegar vapor treated sweet leaves increased as storage time increased and were scored as 1.33 for 2 min, 1.67 for 5 min, 2.67 for 10 min

and 2.33 for 15 min at 19 days of storage. Upland rice vinegar vapor treated sweet leaves for 10 showed a slight chilling injury symptom (Figure 4).

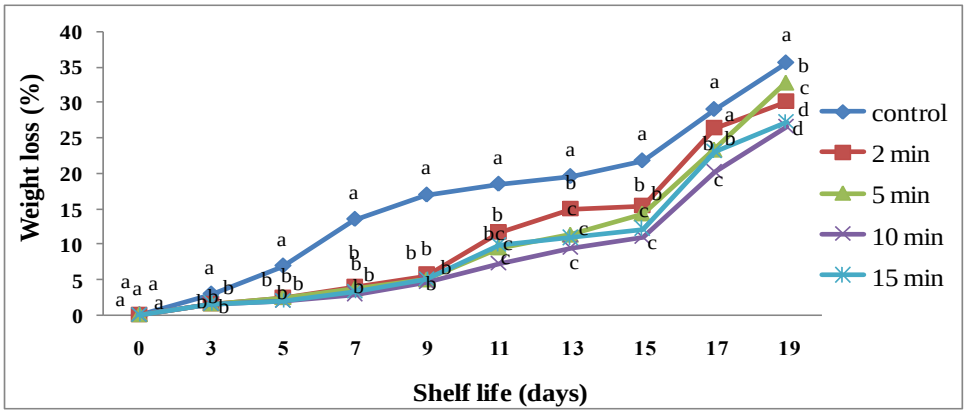

Figure 2. Effect of upland rice fermented vinegar vapor on weight loss of sweet basil.

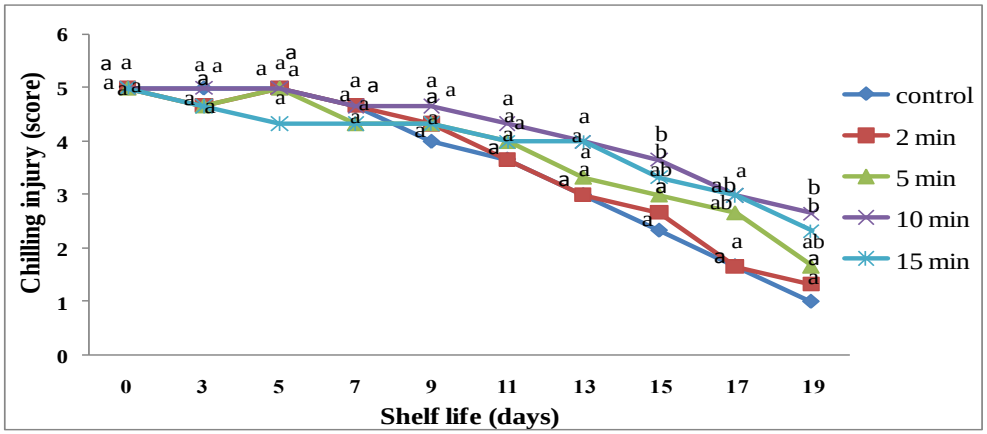

Figure 3. Effect of upland rice fermented vinegar vapor on chilling injury of sweet basil.

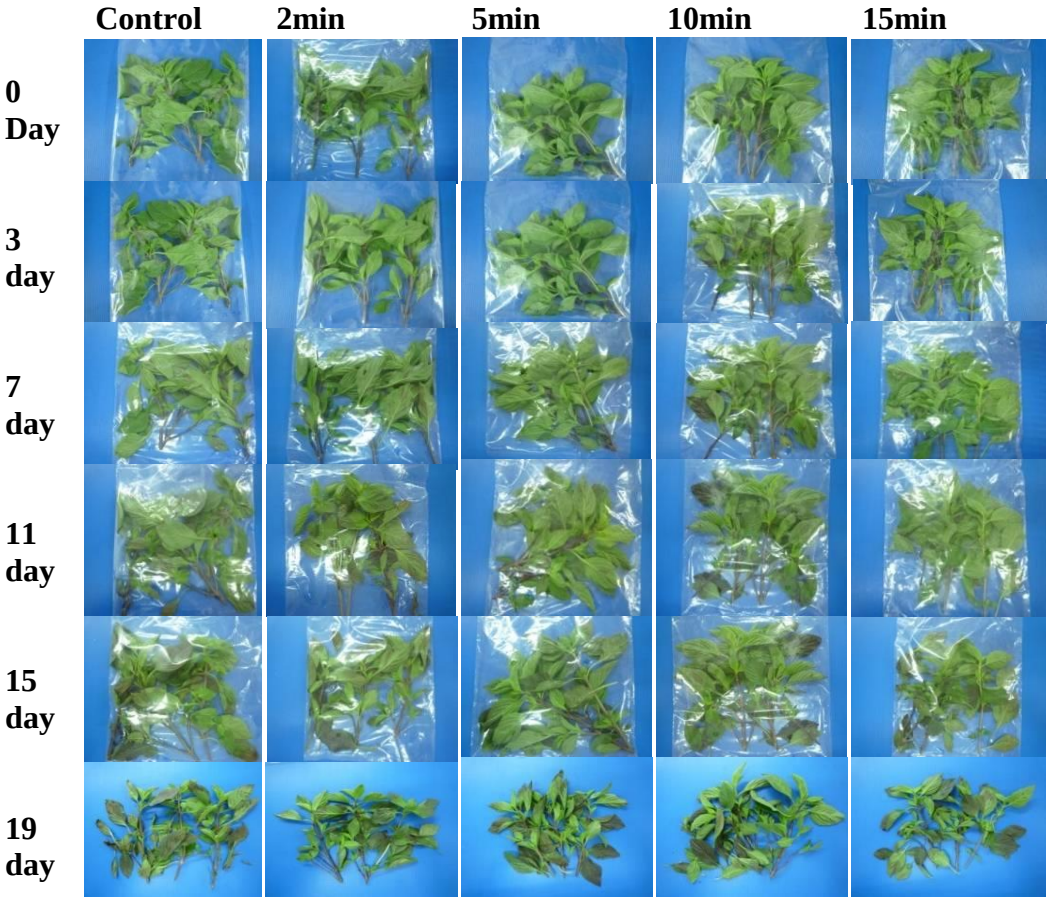

Figure 4. Effect of upland rice fermented vinegar vapor on quality evaluations of sweet basil.

Discussions

Thefumigation with upland rice fermented vinegar vapor for 10 minutes had the longest extended shelf life of sweet basil, the lowest weight loss and decreased chilling injury symptom. These results confirmed that application of fermented vinegar vapor has been successfully used to extend postharvest life of coriander leaves (Krusong *et al*., 2015), strawberry (Krusong *et al*., 2015) and stone fruit (Sholberg *et al*., 2000)

Water loss is a common storage problem of many fresh fruits (Nunes and Emond, 2007; Fattahi *et al*., 2010), flowers (Seglie *et al*., 2011; Asrar, 2012; Ahmada and Dole, 2014) and vegetables (Nunes and Emond, 2007; Berry *et al*., 2010) which affects commercial marketing of horticultural crop. The results of the this study also indicate that fresh weight loss of leaves during storage was

improved since the treatment of upland rice fermented vinegar vapor for 10 min minimized the weight loss and chilling injury symptom and maintained visual quality and this may be a reason for the increased shelf life of the sweet basil leaves. These results indicated that upland rice fermented vinegar vapor treatment could be a good candidate for extending shelf life, maintaining visual quality and reducing loss of weight in sweet basil.

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