EFFECT OF DIFFERENT STORAGE CONDITIONS ON THE QUALITY OF CURRY LEAVES (*Murraya koenigii*)

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Abstract

Aromatic herb such as *Murraya koenigii* or curry leaves packed in different thickness of packaging materials and stored at different storage conditions were studied. Unsuitable storage conditions of curry leaves play a major role in reducing its internal and external quality. Besides that, proper packaging material used also important in reducing postharvest losses since it acts as a protective barrier from external environmental factors that accelerates the senescence process. Therefore, it is important to study the suitable storage condition and packaging material for this herb in preserving its quality and extending the shelf life. Treatments were curry leaves packed in 0.04µm polypropylene (PP) plastic and further placed at 5°C, 0.04µm polypropylene (PP) plastic at room temperature, 0.04µm high density polyethylene (HDPE) plastic at 5°C, 0.04µm high density polyethylene (HDPE) plastic at room temperature, 0.08µm high density polyethylene (HDPE) plastic at 5°C and 0.08µm high density polyethylene (HDPE) plastic at room temperature. The curry leaves were stored for one month. The parameters evaluated were percentage weight loss, surface color, ascorbic acid and chlorophyll contents, antioxidant activity and sensory evaluation. The results indicated that 0.08µm HDPE plastics, followed by 5°C storage temperature was found to be the best storage condition among all of the treatments by having higher retention of ascorbic acid, chlorophyll content, sensory evaluation score, antioxidant activity and lower percentage of weight loss in curry leaves during one month storage period.

Keywords: Curry leaves, packaging materials, quality, storage conditions, temperature

BACKGROUND

Curry leaves (*Murraya koenigii*) is one of the aromatic herbs that had been widely used as a flavoring agents in cooking and traditional medicine that can treat various metabolic and infectious diseases (Kumutharanjam, et al., 2015). The increasing demand for curry leaves in market for its purposes as antioxidant and anticarcinogenic activity was previously reported (Palaniswamy et al., 2002). The internal quality of fresh commodity such as ascorbic acid content, antioxidant activity and total phenolic content may be influenced by postharvest storage and temperature (Serea et al., 2014). Vegetables will start to loss the quality as soon as after being harvested because they are highly perishable commodity (Yeole et al., 2009). In addition, study by Masand et al. (2014) stated that exposure of raw herbs towards light, oxygen and microbes will cause direct effect on the quality. Unsuitable storage condition of curry leaves such as storage temperature had caused loss in internal quality including ascorbic acid content, chlorophyll content and volatile compounds in curry leaves by oxidation process (Palaniswamy et al., 2002). Packaging is important in reducing postharvest losses since it can act as protective barrier of the fresh produces from external environmental factors that can rapid the senescence process. In other hand, packaging can help in protecting the vegetables from heat and maintaining the quality during storage period (Yeole et al.,

2009). Apart from that, storage temperature also can help in maintaining the quality of the herbs by slowing down the physiological process. Exposure to excessive heat of herbs can reduce the quality by enhancing the decomposition of nutritive values (Masand et al., 2014). Thus, it is important to study the suitable storage condition of the herbs including curry leaves in extending the shelf life and preserving the quality. The purpose of this study is to determine the effect of different storage conditions on the quality of curry leaves (*Murraya koenigii*) including the thickness of packaging materials and storage temperatures. Results from this study will provide information on the suitable storage condition in retaining the internal and external quality of curry leaves.

METHODS

Preparation of Samples

The selection of curry leaves was based on the suitability for assessment, which free from defect and decay characteristics. The samples were washed under running tap water and let dried with clean tissue paper. 10g of samples were weighed for each treatment and packed in different packaging materials; 0.04µm PP, 0.04µm HDPE and 0.08µm HDPE plastics and stored at two different temperatures; 5^{o}C and room temperature. The samples were stored up to one month and assessed at five days interval for further assessment.

Percentage of Weight Loss

Percentage of weight loss of curry leaves was determined by weighing the final and the initial weight of the samples (10g). The percentage of weight loss was calculated by using formula:

$$\frac{Initial\ weight - Final\ weight}{Initial\ weight} \times 100$$

Surface Color Determination

Surface color of curry leaves was determined by using Konica Minolta Chromameter. The value of lightness (L) indicates the lightness of curry leaves color from darker (0) to lighter (100), a* value represents the red-green chroma perception and b* value represents yellow-blue chroma perception.

Ascorbic Acid Determination

Ascorbic acid content was determined by titration with DCPIP solution. Extract of curry leaves was added with oxalic acid and NaOH solution. Then, the mixture was titrated by 2,6-dichloroindophenol (DCPIP) solution until the solution turn into slightly pink.

Chlorophyll Measurement

The measurement of chlorophyll a and chlorophyll b content in the curry leaves were determined by using the method of Inskeep and Bloom (1985). Curry leaves were added with magnesium oxide powder and acetone, and then centrifuged for 5 minutes at 2000 rpm. Then, the mixture was made up to volume with acetone in 50ml centrifuge flask. The absorbance of the extract was determined by using UV-Vis spectrophotometer at 645nm and 663nm.

Antioxidant Activity (DPPH Assay)

The DPPH (2,2-diphenyl-1-picrylhydrazyl) free radicals scavenging activity of samples was measured by using UV-Vis spectrophotometer based on the method of Shekhar and Anju (2014). The extract was added with 0.1mM solution of ethanolic DPPH. Then, the mixture was left at room temperature for 30 minutes in dark. The absorbance of the solution was measured at 517 nm. The changes of color of DPPH solution from purple to yellow indicate the efficiency of samples. Then, the free radical scavenging activity was calculated by using the following equation:

$$\frac{Absorbance\ control - Absorbamce\ samples}{Absorbance\ control} \times 100$$

Sensory Evaluation Score

Sensory evaluation on the curry leaves was made based on overall acceptance, smell, texture and appearance by 30 untrained panels. The evaluation was made based on hedonic scale (1: very poor, 2: poor, 3: fair, 4: good, 5: very good).

Statistical Analysis

The data were analyzed using statistical analysis (Analysis of Variance, ANOVA) SPSS version 21.0. The significance of differences between the mean were estimated using Tukey's test at $p< 0.05$.

RESULT AND DISCUSSION

Percentage of Weight Loss

The percentage of weight loss of curry leaves were increased gradually during the storage period for all treatments (Fig 1). Increasing in percentage of weight loss was low in samples packed in 0.08µm HDPE at 5°C storage temperature, followed by 0.04µm HDPE at 5°C, 0.04µm PP at 5°C, 0.04µm HDPE at room temperature and 0.08µm HDPE at room temperature. There were significant differences between 0.08µm HDPE and 0.04µm PP for the samples ($P < 0.05$, P=0.025), while there was no significant different between 0.04µm PP and 0.04µm HDPE for the samples during one month of storage period. The increasing percentage of weight loss of curry leaves during storage time might be due to the physiological process such as transpiration and respiration in the samples (Arafa & Dewidar, 2014). Compared to other packaging materials, curry leaves packed in HDPE plastic at 5°C storage temperature has lowest percentage of weight loss, which represent the better protection against water vapor infusion in thicker HDPE plastics (Singh & Sagar, 2010). Higher percentage of weight loss in 0.04µm HDPE and 0.04um PP plastics might be due to the characteristics of the plastic film which is more permeable to water vapor. Based on the result obtained, percentage of weight loss is higher at room temperature than 5°C storage temperature. This is because higher temperature will cause decreasing in degradable tissue of curry leaves and higher respiration rate (Arafa & Dewidar, 2014). By reducing the storage temperature, the biochemical reactions such as respiration rate of plants will be reduced (Arafa & Dewidar, 2014).

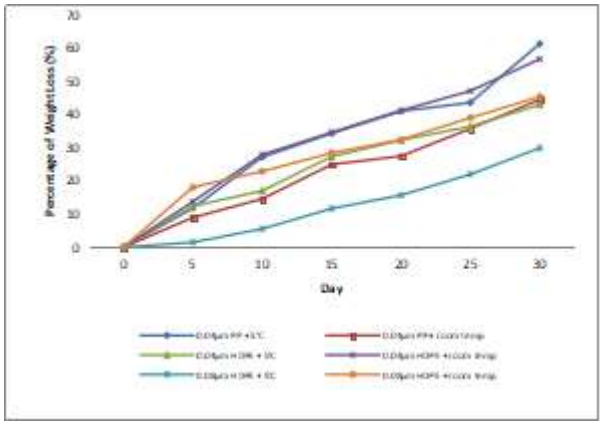

Figure 1: Effect of different storage conditions on the weight loss of curry leaves during storage period

Surface Color Determination

From the data that had been analyzed, there was no significant difference in the surface color determination of curry leaves packed in different storage conditions in terms of lightness (L*). The changes of surface color of curry leaves were not significantly influenced by different packaging materials and storage temperatures. Fig 2a shows the L* value of curry leaves during one month storage period. However, the changes of surface color of curry leaves can be observed by visual appearance at the end of storage period for samples packed in 0.08μm HDPE at room temperature. This is because deterioration of leafy vegetables can be observed

Via the changes in color appearance (Masand et al., 2014). However, there were significant differences between a* value of curry leaves in 0.08μm HDPE and 0.04μm HDPE plastic ($P < 0.05$, P=0.000), while there was no significant difference between 0.04μm PP and 0.04μm HDPE plastics. a* value indicates the red-green perception of samples, which proved by changes of a* value of curry leaves during storage period as shown in Fig 2b. Similar result was obtained for b* values of curry leaves, which there were significant differences between 0.08μm HDPE and 0.04μm HDPE ($P < 0.05$, P=0.000) and between 0.04μm HDPE and 0.04μm PP plastics ($P < 0.05$, P=0.003). b* value represent the yellow-blue perception for samples, which can be observed by visual appearance of curry leaves become yellowing during storage period. Figure 2c shows the changes of b* values during the storage period.

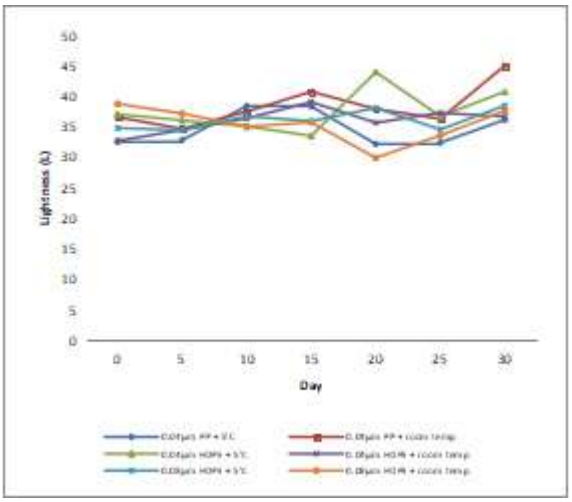

Figure 2a: Effect of different storage conditions on condition L* value of curry leaves

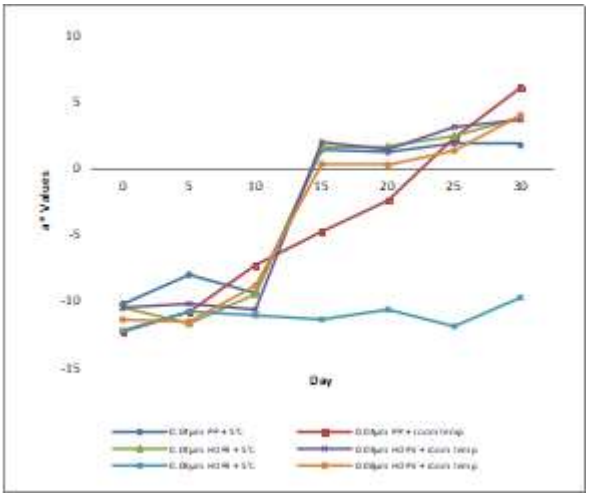

Figure 2b: Effect of different storage on a* value of curry leaves

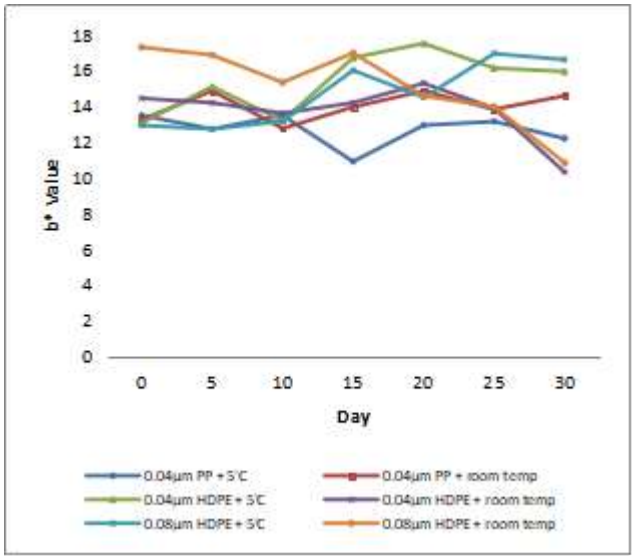

Figure 2c: Effect of different storage conditions conditions on b* value of curry leaves

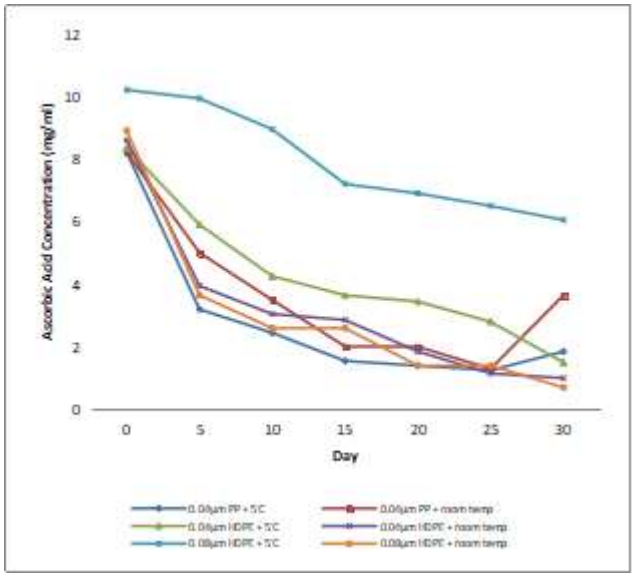

Figure 3: Effect of different storage on ascorbic acid content of curry leaves

Ascorbic Acid Determination

As illustrates from Fig 3, the content of ascorbic acid decreased in curry leaves packed in all storage conditions during the storage period. The retention of ascorbic acid content of curry leaves was better in 0.08µm HDPE plastics stored at 5°C temperature (6.70±1.53) compared to other storage conditions. There were significant differences between 0.08µm HDPE and 0.04µm PP ($P < 0.05$, P=0.012), while there was no significant difference between 0.04µm PP and 0.04µm HDPE plastics ($P < 0.05$, P=0.283). The decreasing in ascorbic acid content of curry leaves might be due to the oxidation process of ascorbic acid (Seevaratnam et al., 2012). Higher content of ascorbic acid in curry leaves packed in 0.08µm HDPE stored at 5°C at the end of storage period because thicker HDPE plastics has more barrier towards oxygen, thus preventing from oxidation of ascorbic acid occur. With regard to storage temperature, the decreasing of ascorbic acid content is higher at room temperature than 5°C, might be due to the rapid oxidation process that had been catalyzed by heat in the packaging materials (Seevaratnam et al., 2012). A study from Singh and Sagar (2010) had found that similar trend in ascorbic acid content of dehydrated vegetables that packed in different packaging materials and storage temperature.

Chlorophyll Measurement

Chlorophyll content of curry leaves decreased along the storage period. Retention of chlorophyll a and chlorophyll b content slightly different among storage conditions, which the highest values of chlorophyll content was found in curry leaves packed in 0.08µm HDPE at 5°C. There were significant differences in chlorophyll a content between 0.08µm HDPE plastics and 0.04µm PP plastics ($P < 0.05$, P=0.034), while there was no significant difference between 0.04µm PP and 0.04µm HDPE plastics ($P < 0.05$, P=0.961). Figure 4a shows the calculated chlorophyll a content of curry leaves during storage period, which decreasing along the storage time that represents degradation of chlorophyll. In addition, there was significant different in the chlorophyll b content of curry leaves packed in 0.08µm HDPE and 0.04µm PP ($P < 0.05$, P=0.039). There was no significant different of chlorophyll b content between 0.04µm PP and 0.04µm HDPE ($P < 0.05$, P=0.471). As shown in Fig 4b, the changes in chlorophyll b content in curry leaves decreased during the storage period. Difference in the chlorophyll content of curry leaves among the packaging materials might be due to the permeability of packaging materials towards oxygen entrance into the packaging materials

during storage which lead to the oxidation process. In addition, the reduction of chlorophyll content of curry leaves might be caused by chlorophyllase activity which converts chlorophyll into pheophytin (Singh & Sagar, 2010).

Antioxidant Activity

Determination of antioxidant activity was made based on DPPH free radical scavenging method, which the reduction of DPPH radicals occurs as the removal of H atoms by antioxidants content in the samples (Safriani et al., 2011). The DPPH free radical scavenging activity represents the antioxidant activity of samples. As illustrates in Figure 5, antioxidant

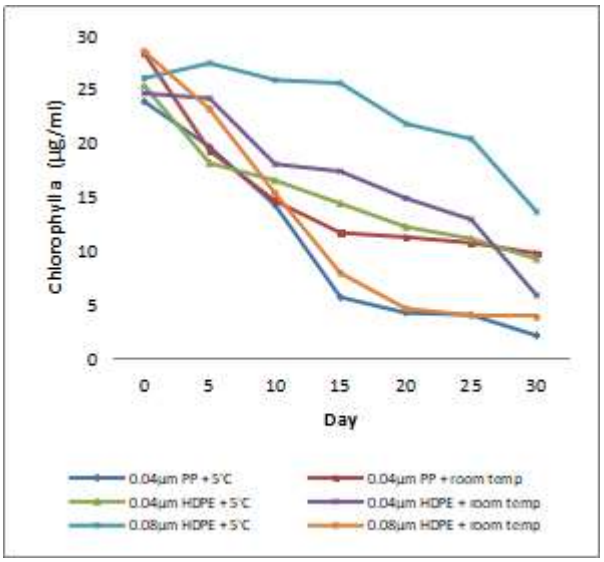

Figure 4a: Effect of different storage conditions conditionson chlorophyll a content of curry leaves

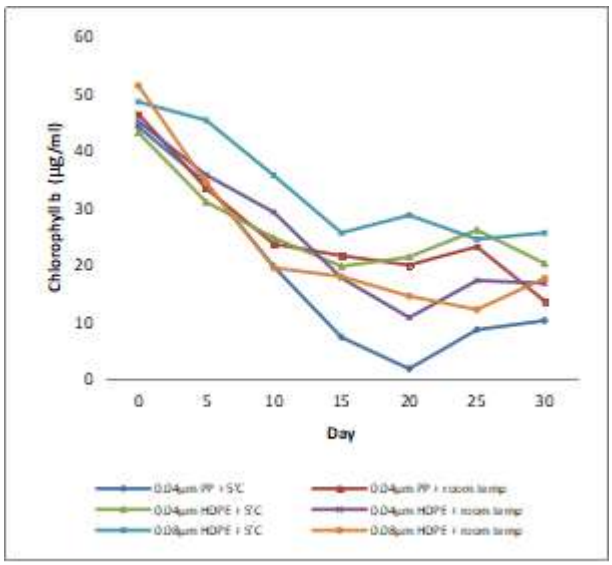

Fig. 4b: Effect of different storage on chlorophyll b content of curry leaves

Activity of curry leaves decreasing along with storage period. There were significant differences between 0.08µm HDPE and 0.04µm HDPE ($P < 0.05$, P=0.031), while there was no significant difference between 0.04µm PP and 0.04µm HDPE ($P < 0.05$, P=0.289). Different in the antioxidant activity might be due to the characteristics of antioxidant which is sensitive towards heat and oxygen. Higher antioxidant activity in curry leaves packed in 0.08µm HDPE at 5^{o}C storage temperature indicates higher retention of antioxidant content, which might be due to the barrier of plastics towards oxygen thus reducing the degradation process.

Sensory Analysis

The decreasing in sensory score indicates that the reduction in the overall acceptance of untrained panels in term of smell, texture and appearance. There were significant differences between 0.08µm HDPE and 0.04µm PP ($P < 0.05$, P=0.002), 0.08µm HDPE and 0.04µm HDPE ($P < 0.05$, P=0.002), while there was no significant different between 0.04µm PP and 0.04µm HDPE ($P < 0.05$, P=0.269). Results show the decreasing in the score which indicates the poor conditions of smell, texture and appearance during the storage period. As shown in Figure 6, highest score was obtained for the curry leaves packed in 0.08µm HDPE plastics at 5^{o}C temperature among all of different storage conditions. Decreasing in score for smell of curry leaves indicates that the decreasing of volatile compounds (Arafa & Dewidar, 2014) which responsible for its aromatic characteristics. External factors such as higher temperature had cause changes in volatile compounds in plants (Coutinho et al., 2009). In addition, less gas permeability characteristic of 0.08µm HDPE plastics stored at 5^{o}C had reduced physiological activity of curry leaves, thus maintaining the acceptability of quality. Apart from that, visual appearance of curry leaves in terms of color might be influenced by moisture loss or chlorophyll degradation (Hong & Kim, 2004).

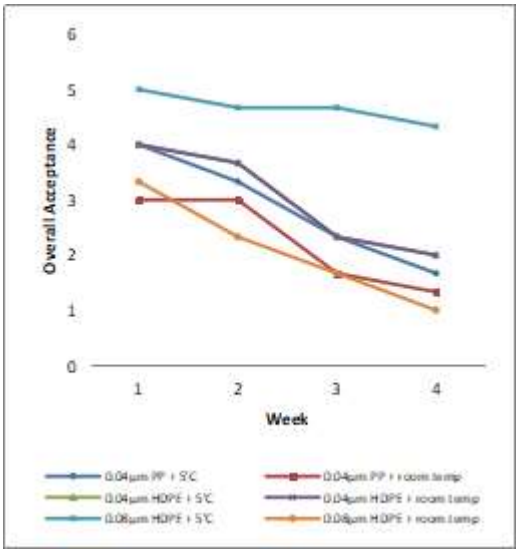

Figure 5: Effect of different storage conditions on antioxidant activity of curry leaves

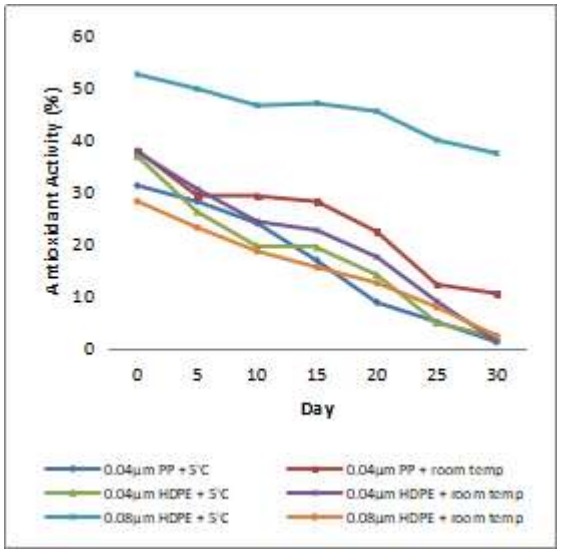

Fig. 6: Effect of different storage conditions on sensory evaluation score of curry leaves

CONCLUSION

In conclusion, the current finding on this study might take into the consideration in terms of storage conditions of curry leaves for better quality during storage period. This study might be new information for producers or growers to implement the application of storage conditions on aromatic herbs including curry leaves. Curry leaves are rich in antioxidant properties which can give a lot of benefits towards human consumption other than being used in culinary industry. Although the reduction of quality in curry leaves can be observed during one month storage period, the retention in terms of ascorbic acid content, antioxidant activity, chlorophyll content and overall acceptance by consumers can be maintained with proper storage condition. Future research should go along with suitable storage conditions, which more specific for herbs especially aromatic herbs. This will give more knowledge into the long-term changes and innovation in technology connected with fresh commodity quality. In addition, suitable storage conditions of aromatic herbs including curry leaves can help in commercializing the commodity for bigger agriculture industry and widely used across the country.

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