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Research Article
Potential of Storing Fresh Ground Red Chilies in Water as a Substitute for Home Refrigerators

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Abstract

Background and Objective: The use of water medium has traditionally been used for the storage of fresh ground chillies in West Sumatra, Indonesia. Until now there is no scientific information regarding the use of this technique, therefore changes in the quality of fresh ground red chilli stored in a water medium were studied to enrich knowledge related to storage techniques of fresh ground chilli. This study aimed to clarify the potentiality of water medium storage that is commonly used by the traditional farmer in West Sumatra, Indonesia. **Materials and Methods:** The fresh ground chillies were put into a polyethylene plastic bag and stored in a water medium in the experiment. The chillies were sampled periodically to observe their quality changes during the storage period. The observed qualities were focused on water content, colour and vitamin C. The refrigerator storage condition was used as a control treatment. **Results:** For one month of storage, it was observed that there was no significantly different in observed parameters of chillies stored in water medium and refrigerator. It can be hypothesized that using a water medium for storage might be useful for the storage condition of the ground chillies refrigerator instead. **Conclusion:** The utilization of water medium might be more applicable than refrigerator storage due to the lower operational cost and the bigger capacity. More critical parameters and extended storage periods need to be conducted further to clarify the possibility of utilizing water medium storage to be applied in the community.

Key words: Chilies, fresh ground, storage, quality, water medium

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Chillies are attractive commodities with high demand in national and international trade due to their distinct flavour and nutritional values[1,2]. Chillies are very susceptible to senescence because of factors such as moisture loss, sunscald and heat damage. Fresh chillies lose water quickly after harvesting and within a few days at room temperature, they begin to wrinkle and change colour. Many methods have been devised to keep chiles in good shape from farm to table.

In Indonesia, fresh chillies are ground to prolong the storage period and make them more applicable for cooking[3]. The grinding treatment would reduce the product's volume, thus, the storage condition will not require a large space compared to the storage condition for fresh chillies. Generally, storage of ground chillies also cannot be conducted at room temperature due to susceptibility to water loss. For household purposes, cold storage conditions such as a refrigerator are recommended to prolong the self-life of ground fresh chillies. Refrigerators for preserving agricultural commodities are based on controlling the storage temperature at low conditions. Generally, fresh produces will be stored at a temperature of 0-14°C[4]. In this condition, the enzyme activity will be suppressed so that all reactions will slow down and indirectly make the decay process will also slow down[5].

However, in Indonesia, especially in West Sumatra Province, the use of refrigerators is quite limited. The lack of refrigerator capacity and high electricity consumption are obstacles to preserving the fresh ground chillies for the following distribution process[6]. Therefore, some groups of farmers are trying to develop a technique for storing fresh ground chillies in a water medium. A conventional storage condition has been conducted to prolong the self-life of ground fresh chillies by using a water medium. They had claimed that the shelf life of ground fresh red chillies could be up to 4 months and refrigerator storage. There is no scientific information reported about the utilization of water medium in storage conditions of fresh commodities.

In this study, the quality change of ground fresh chillies during storage in a water medium was observed. The objective of this study was to compare the quality change of ground fresh chillies stored in a refrigerator and water medium. The finding from this research will inform the potentiality of the use of water medium for the preservation of fresh ground chilli. The utilization of water medium storage will be the first electric-free storage finding. Of course, this will benefit the community as a whole, particularly farmers in rural areas. Due to the uneven distribution of energy throughout Indonesia's territory, not all farmers have access to refrigerators for storage, particularly those with big capacities. As a result, this problem will be handled through the use of water as a medium.

MATERIALS AND METHODS

Study area: The study was carried out from December, 2021 to April, 2022. The study was conducted at the laboratory of crop processing, Department of Agricultural Product Technology, Faculty of Agricultural Technology, Andalas University.

Sample materials: Fresh red chillies were obtained from the local farmer at Padang City, West Sumatera Province Indonesia. The collected fresh red chillies were sorted and immediately ground for subsequent analysis in this study. One hundred grams of ground fresh red chillies were put into a polyethylene plastic clip bag and put into the chamber that contained a particular volume of water. The position of the sample was maintained to remain immersed in the water. The samples were sampled periodically to observe the change in their qualities. The sampling periods were set as 0, 7, 14 and 28 days. The cold storage condition in the refrigerator was used as the control treatment.

Analytical measurements: The quality parameters of treated samples were focused on water content, colour and vitamin C. The water content analysis was performed according to Azima *et al.*[7]. The colour values were obtained by measuring reflectance with a Hunterlab Colorflex Spectrophotometer using a 64 mm glass sample cup[8]. The vitamin C test was performed using the iodine titration method, the total number of Iodine (mL×0:01 N×(0.88 mg ascorbic acid)[9] was used to compute the vitamin C level. The results of triplicate measurements were given as mean values.

Statistical analysis: Statistical analysis was performed using the SPSS package program version 11.5 (SPSS Inc., Chicago, IL, USA). Data were analyzed by One-way Analysis of Variance (ANOVA), followed by Duncan's multiple ranges posthoc test. Results were expressed as Mean±SD of triplicate samples. Differences were considered significant at $p<0.05$.

RESULTS AND DISCUSSION

Chilli is one of the critical agricultural commodities for the community. Chilli has a concise shelf life, so a lot of processing is done to extend its shelf life[10]. In Indonesia, one form of processing that can extend the shelf life of chilli is to make it

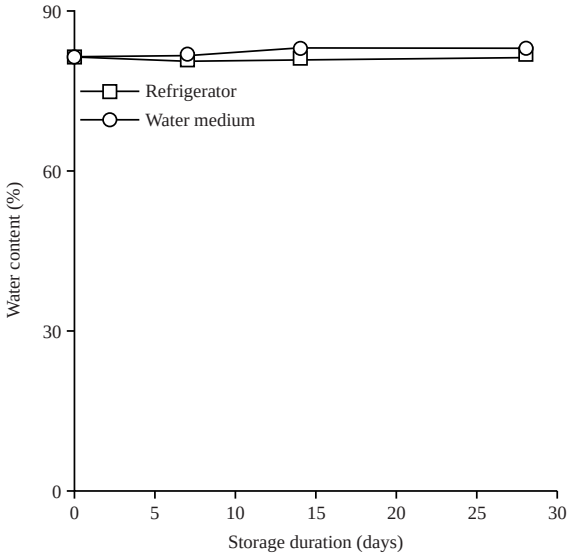

Fig. 1: Water content of ground fresh red chilli stored in water medium and refrigerator

in the form of ground chili[11]. Previous research stated that the storage of ground chillies could be helped by using a refrigerator to increase its shelf life[12,13]. However, people find it difficult to store with a refrigerator in practice because of the narrow space and cost of electricity[14,15]. The limitations of ground chilli storage techniques so far seem to be overcome by the storage behaviour of ground chillies in the area of West Sumatra, Indonesia, where ground chillies were stored in a water medium. Because there is no scientific research that explains the efficacy of this technique, research was being carried out to clarify this phenomenon.

The apparatus and storage conditions conducted in this study were described below. The samples were stored in a plastic clip-seal bag and put in the water and refrigerator. The water in the chamber was circulated to exchange the air in the water and remain fresh. It was hypothesized that the temperature in the water was low and resisted the water evaporation process. However, the temperature in the water would not be the same as in a refrigerator. The utilization of polyethylene plastic would allow gas to flow while blocking the water movement that facilitates the air exchange in the plastic bag. Thus, the fresh air circulation in the plastic bag was well maintained. Air circulation is a critical factor in the storage treatment of fresh produces[16-18]

The water contents of samples stored in a water medium and refrigerator were shown in Fig. 1. In this study, the storage period was conducted of one-month storage approximately. The initial water content of ground fresh red chilli was measured at around 81%. The water content of about 80% indicated the general characteristic of fresh commodities[19]. During one month of storage, the water content of ground fresh red chilli was maintained at 81%. There was no significant water content difference between water medium storage and refrigerator storage. The result suggested that water evaporation could be suppressed in water medium and cold storage (refrigerator).

The colour characterizations of the sample were expressed by the value of lightness (L) and hue/saturation (a = red/green coordinate and b = yellow/blue coordinate) in the L, a, b colour space that was measured with a spectrophotometry method. The colour characteristic of samples stored in a water medium and refrigerator were shown in Table 1. A different trend was observed between the colour characteristic of samples stored in a water medium and refrigerator. The values of lightness and yellow/blue coordinates (b) of the two samples were similar at ±33 and ±21, respectively. This condition means that there was no formation of new compounds that can affect the lightness characteristics of the samples stored in both systems. Generally, spoiled chilli will be characterized by the appearance of a brown colour, which is indicated by a decrease in the lightness level[20]. On the other hand, there was a slight difference in the two samples' red/green coordinate (a) values. The b values of samples stored in the refrigerator were stable at ±40, but in the sample stored in water media, its drops from 40 to 36. It seems that there is a carotenoid decomposition process that occurs in the storage in the pond. Carotenoids are pigments in red chillies that are susceptible to oxidation processes[21].

The changes in vitamin C contents on samples stored in a water medium and refrigerator were shown in Fig. 2. Vitamin C is one of the freshness indicators of fresh produces. Vitamin C is a potent antioxidant that breaks down easily with senescence during the postharvest treatment of fresh produces[22]. There was a similar trend of vitamin C content between that stored in water medium and refrigerator. The vitamin C decreased slightly during storage for all storage conditions. The result suggested that although there was no visible change in stored samples in the water medium and refrigerator, there were quality changes in the perspective of nutritional values. In this study, scientific data were obtained regarding the use of water as a storage medium for fresh ground chillies. The data obtained showed that the quality of ground chilli stored in the water medium was relatively similar to that of ground chilli stored in the refrigerator. The decrease in vitamin C levels in storage in water and refrigerator medium was the same from a concentration of 0.2 mg to 100 mg^{-1} to 0.1 mg to 100 mg^{-1}. These two storage conditions can

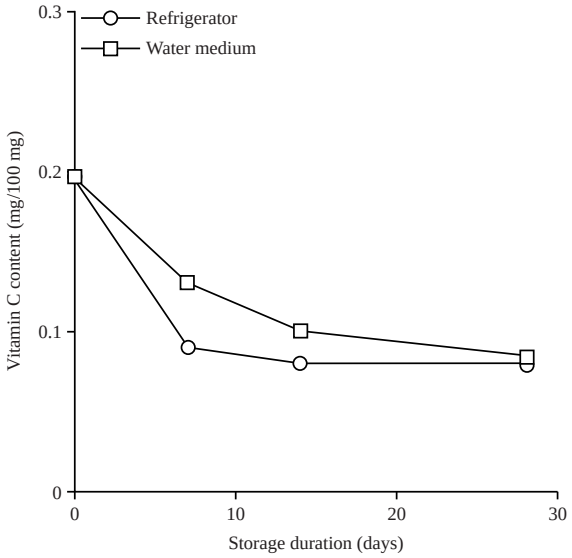

Fig. 2: Vitamin C content of ground fresh red chilli stored in water medium and refrigerator

Table 1: Colour characteristics of ground fresh red chilli stored in water medium and refrigerator

	Refrigerator			Water medium		
Days	L	a	b	L	a	b
0	33.76	41.45	21.78	33.76	41.45	21.78
7	34.06	40.83	22.21	35.35	42.09	22.97
14	34.23	40.79	22.33	32.69	36.55	21.22
28	34.35	40.10	21.89	32.19	36.15	21.04

maintain vitamin C levels at the same level after 30 days of storage. The use of a refrigerator can maintain the quality of a product by keeping the temperature cool (±6°C) so that it can slow down the enzymatic process[23,24]. However, in water media storage, the temperature is relatively warm (±26°C), so the principle of product preservation will be different from that of a refrigerator. Further research needs to be done to clarify the preservation principle that occurs in water media which has a higher temperature than the refrigerator.

CONCLUSION

In conclusion, the current study showed the scientific observation of the potentiality of utilizing water medium storage of ground fresh red chillies. The utilization of water medium for storage will accommodate a large-scale storage treatment because the provision of water medium is readily available in the community, such as wells, ponds and rivers.

SIGNIFICANCE STATEMENT

This study found the potential use of water media for the storage of fresh ground red chilli. These results can be used as basic data for the development of alternative storage other than refrigerators. This technique proposes the use of nature that is free from the use of electricity.

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