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THE WEIGHT REDUCTION AND THE QUALITY REDUCTION OF CABBAGE DURING TRANSPORTATION IN PAGAR ALAM CITY, INDONESIA

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ABSTRACT: *Cabbage (Brassica oleracea var. Capitata L) is a kind of leaf vegetable which consists of layers of leaves shaped into a ball (crop). This layer of leaves is used as food. The damage of cabbage during distribution could happen because of bumping or pressure during distribution which results in bruises or torn on the outer layer. This bruise can activate the decaying process and it may spread to other parts of the cabbage. Other damage during the distribution was evaporation, which results in the reduction of cabbage's weight. The ongoing respiration during distribution could also reduce the weight although it was in small number. That was why the character of packaging during the transportation would really influence the level of material's damage. In this research, we would study the influence of some cabbage packagings during the distribution. Three kinds of packaging, which were bamboo basket (K2), plastic sack (K3) and plastic net (K4) were the packagings which were usually used by the farmers and traders in Pagar Alam town. The packaging of wooden box (K1) was tried as treatment K1. After the distribution for about 8 hours from the center of production (Pagar Alam town) to the center of marketing (Palembang city), we did the measurement and analysis to the reduction of weight and the amount of ascorbic acid.The result showed that the weight reduction of cabbage in the packaging after the evaporation were 0.77%, 2.56%, 1.47% and 2.27%, consequently for the packaging of K1, K2, K3, K4. While the weight reduction because of the damage were 1.2%, 8.36%, 14.26% and 15.46%. The evaporation of cabbage was not only reducing the weight but also decreasing the hedonic quality of freshness.*

KEYWORDS: Weight Reduction, Cabbage, Transportation

INTRODUCTION

Pagar Alam is a small town in South Sumatra Province Indonesia which has the altitude of 441 to 3000 m above the sea, with the variation of temperature from 14^{o}C to 34^{o} C. The cool condition of the nature makes Pagar Alam the centre of vegetable production in South Sumatra Province, one of them is cabbage. The marketing area of cabbage from Pagar Alam is almost to the whole towns and cities in South Sumatra, especially Palembang city as the capital city of the province. The distance between Palembang to Pagar Alam is 297 km. Everyday the vegetable crops are distributed to all of destinations. The harvesting process is done in the morning. Then,

the crops are taken to the temporary collector. The crops are sorted and graded before the packaging process. The packagings which were usually used by the farmers and traders for distribution were bamboo basket, plastic sack and plastic net. In Palembang, the cabbages were sorted again from the damage one before it was distributed to retail sellers. The damage of the cabbage in distribution could happened because of bumping, pressure and friction which cause the bruises or tore on the outer layer. This bruise could trigger the decaying process and it could spread to other parts. Other damage during the distribution is the biological process, transpiration and respiration which lose the weight. The ongoing respiration during distribution could also reduce the weight although it was just in small numbers. That's the reason why the character of packaging during transportation would really influence the level of material damage, besides its temperature and moisture. Effective packaging could protect the materials from physical and biological damage. To find out the effectiveness of kinds of packaging to the cabbages during distribution, we need to measure the materials loss after the distribution.

MATERIALS AND METHODS

Tools and Materials

The tools which were used were wooden box packaging, bamboo basket packaging, plastic sack packaging, plastic net packaging, analytic scales, oven brand meemer model 100-800, porcelain cup, eksicator, blender, measurement flask, pipette, Erlenmeyer flask, stove and desiccator. The materials which were used were cabbages, amylum indicator, distilled water (aquades) and iodine standard 0.01 N.

Methods of the Study

The cabbage harvesting was done in the morning and the cabbages were directly taken to the collector trader. There, the cabbages were sorted and packed. The packaging used bamboo basket (K2), plastic sack (K3) and plastic net (K4). Besides those three packaging, we also tried wooden box (K1) as the packaging. The arrangement of materials for each packaging was suited to the packaging itself. For the bamboo basket, the cabbage was arranged in an arranged layer from the bottom to the top. Then it was covered with plastic and it was tied with plastic rope so the cabbages would not move. For plastic sack and plastic net, the cabbages were arranged irregularly to the top then the sack or net was tied tightly with plastic rope. Each packaging consists of 36 cabbages. While for the wooden box the cabbage were wrapped one by one and then it was arranged into four layers regularly. Each layer consists of 9 cabbages. All packagings were 1 kg/cabbage. The packages were stacked in a pick up car then they were covered with plastic canvas and then tied with plastic rope. We tied it tightly so the packages wouldn't fall during distribution.

The distribution was done at night with pick up car to Jakabaring market in Palembang city. In Palembang, the packages were unpacked and distributed to the sellers in Jakabaring market. The observation was done after the unpacking process before the cabbages were distributed to the sellers. The parameters which were measured were the evaporation percentage, weight reduction, hedonic quality of freshness and ascorbic acid (vitamin C).

(2)

(4)

Picture 1. Kinds of packaging which were used for cabbage packaging: (1) wooden box, (2) bamboo basket, (3) plastic sack, (4) plastic net

Evaporation Percentage

Evaporation percentage was counted based on the weight reduction of a whole cabbage. We took a cabbage randomly from each packaging. Then we put it on the scale and wrote down its weight. We did the measurement with scale from different samples three times. We count the average. The average evaporation was counted with this equation:

$$\% \text{ evaporation} = \frac{\text{Beginning weight} - \text{final weight}^*}{\text{Beginning weight}} \times 100$$

*Beginning weight was the weight before distribution and final weight was the weight after distribution.

Weight Reduction

We took random samples from each packaging. Then, we cut out the crops part which were damaged (bruises, tore and peeled). We put it on the scale (damage weight). We did it three times for each packaging. After that, we counted the average weight. The percentage of weight reduction was counted with this equation:

$$\% \text{ weight reduction} = \frac{\text{Damaged weight}}{\text{Beginning weight}} \times 100$$

Hedonic Quality of Freshness

The test for hedonic quality of freshness was done to score the freshness level of cabbage after the distribution compared to the fresh cabbage by 30 semi trained panelists (the students of food and science technology study program) using paired comparison method. The procedures of the test were: (1) cut out the outer layer from the crop. (2) Then, we break the stem of the leave or tore the leave. Do the same things to the compared cabbage, and compared the level of freshness. The fresher the cabbage, the easier it breaks or torn. Give the score based on this table:

Score	Freshness Specification
4	* Was not different from the compared cabbage
3	* A bit unfresh from the compared cabbage
2	* Was not really as fresh as the compared cabbage
1	* Was not fresh

Water Amount

It was measured with AOAC method (1995) using oven brand meemmer model 100 – 800.

Ascorbic Acid

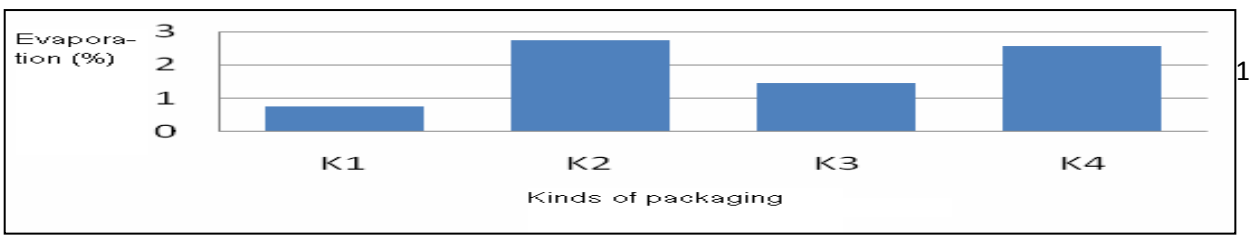
Ascorbic acid was measured with Iodium titration method (AOAC, 1995).

RESULT AND DISCUSSION

Evaporation Percentage

Weight reduction due to biological process was happened for two causes, which were transpiration and respiration. Both of them caused the loss of weight in the materials through transfer of vapor to the air. The difference of temperature and moisture on the material and the environment around the material caused the transfer of vapor to the air (transpiration). If we let this process happen, the material will lose the real weight. It was also happen in respiration process. Respiration will produce heat, vapor and CO2.

Showed in Picture 2, there were varied weight reductions between kinds of packaging because of the evaporation during distribution. The opened packaging like bamboo basket and plastic net had higher weight reduction compared to two other packagings. Wooden box and plastic sack could press down the transpiration and respiration. In bamboo basket and plastic net, the cabbages were bared without any protection. The high temperature and low air moisture, and high air flow during the journey caused the high evaporation. The cabbage evaporation for each packaging was 0.77, 2.56, 1.47 and 2.73.

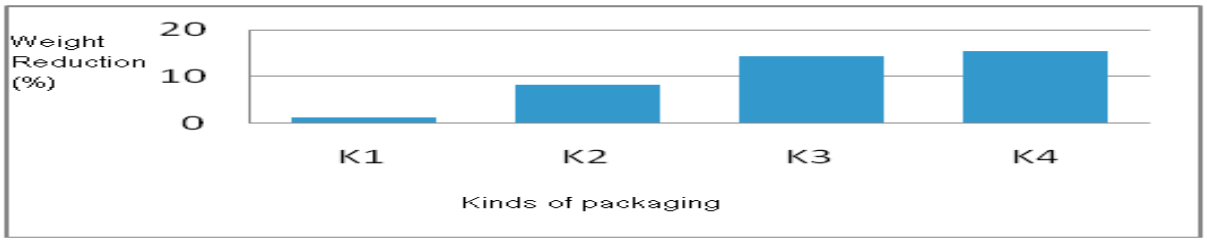


1

Explanation: K1= wooden box, K2=bamboo basket, K3= plastic sack, K4= plastic net
Picture 2. The evaporation of cabbage in the packaging during distribution

Weight Reduction

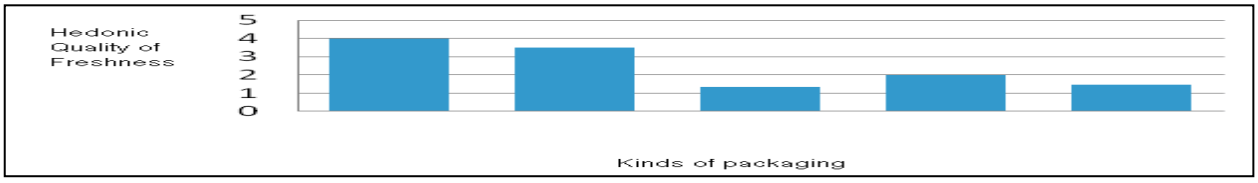
During the distribution, cabbage had many bumps, pressure and friction with some hard objects which results in the damages like bruise, tore and peeled leaves. The weight reductions from these damages were 1.2%, 8.36%, 14.26% and 15.46% t. That was why we needed packaging which was not only function as container but also as the protection of bumps, pressure and friction during distribution. In picture 3, it was proven that wooden box had the ability of protecting the materials so the damage which made from it was lower than other packagings. It was different from the cabbage in other packagings which reached higher level of damage. The cabbage which was stored in the wooden box only had little bruises because of turbulence and there was no layer of leaves which was cut out or torn. Turbulence during distribution was difficult to be avoided because of the bad road condition. On the cabbage of other packagings, we found some torn layer of leaves, peeled leaves and severe bruises. Plastic sack and plastic net had high flexibility. Each turbulence during the distribution and the process of picking out made significant bruises, pressure and friction.



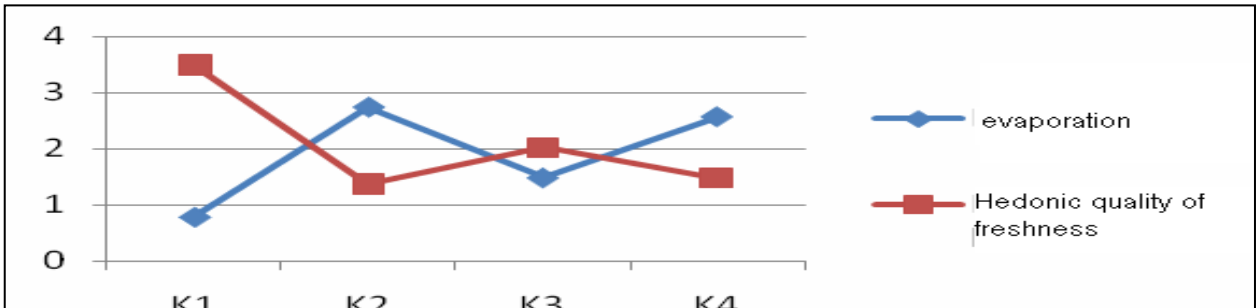
Picture 3. Weight reduction of cabbage due to mechanic in packaging after distribution.

Hedonic Quality of Cabbage Freshness

Freshness becomes important aspect in choosing vegetable for consumption, especially for vegetable side dish (lalap) and salad. The level of cabbage freshness in different packaging after distribution was significantly different at the rate of 1% (ANOVA).



Picture 4. Cabbage's level of freshness in packaging after distribution.

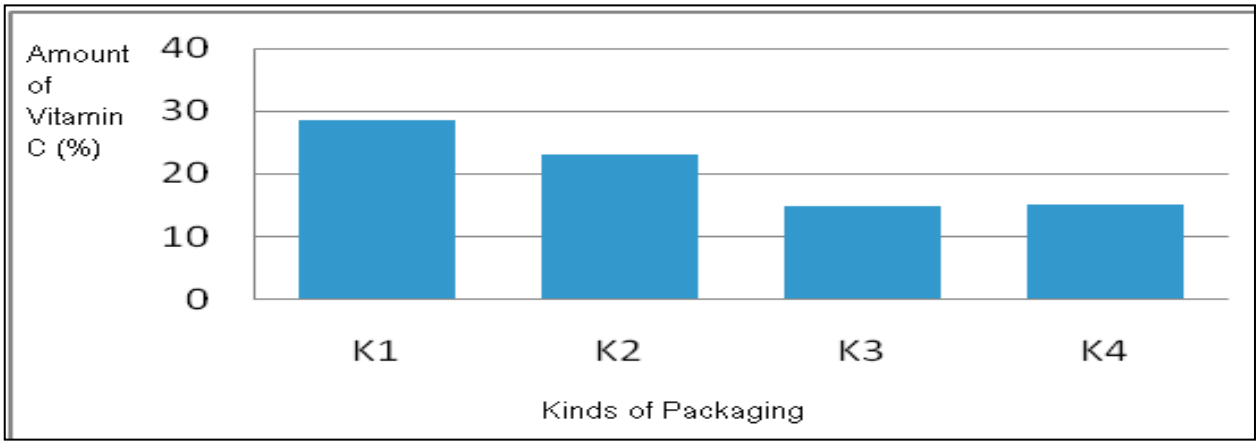


Picture 5. Evaporation Vs Hedonic quality of freshness.

In picture 4, we could see that cabbage in wooden box could maintain its freshness and it was not really different from compared cabbage. While in three other packagings (K2, K3 and K4) was unfresh, a bit of unfresh and unfresh. The Evaporation was inversely proportionate with the material's level of freshness. The higher the evaporation, the faster the materials become withered and vice versa (Picture 5).

Ascorbic Acid

In picture 6, it was significantly seen that kinds of packaging had varied influence to the amount of vitamin C in cabbage after distribution. The heat caused by respiration in cabbage in the packaging and the heat from the weather became the cause of vitamin C damage. Vitamin C was really unstable in hot temperature. The turbulence and friction during distribution also increased the heat in packaging. Strong packaging which protect the materials from turbulence, friction, pressure, bumps, and was able to control heat was not only good to reduce physical damage but also to maintain the amount of vitamin C. Amount of Vitamin C in cabbage for each packaging were 18.60%, 23.00%, 14.87% and 15.03%.



Picture 6. Amount of vitamin C in cabbage in the packaging after distribution.

CONCLUSIONS AND SUGGESTION

1. Weight reduction of cabbage in bamboo basket, plastic sack and plastic net were 8.36, 14.26 and 15.46
2. The main damage was bruises, tore and peeled from its crop
3. The more exposure and the more flexible the packaging, the higher its damage risk during distribution.
4. The damage was caused by pressure, bumps and friction during distribution.
5. The damage because of evaporation were 0.77, 2.56, 1.47 and 2.73
6. Evaporation reduced the hedonic quality of cabbage's freshness.
7. For the sake of distribution, the inelastic packaging was needed to protect the material from bumps, pressure and friction.

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