Atmosphere Modification on Types of Packaging to Extend the Shelf life of Cabbage (*Brassica oleracea*)

A. Alamsyah and E. Basuki*

Faculty of Food Technology and Agroindustry University of Mataram,Indonesia 83125

***Corresponding Author**

DOI: https://doi.org/10.51244/IJRSI.2024.1108121

Received: 11 August 2024; Revised: 26 August 2024; Accepted: 29 August 2024; Published: 21 September 2024

ABSTRACT

Modification of types packaging of cabbage by using paper board, plastics bags of Polyethylene (PE) and Polypropylene (PP) with thickness of 0.08 mm and its combination with paper board were examined in order to determine the shelf life of cabbage. The experiment was carried out at Agricultural Product Technology Laboratory, Agricultural Faculty University of Mataram. Completely Randomized Design was applied and analyzed with Analysis of variance with Honestly Significantly Different at five per cent significant level. Cabbage was enclosed inside Paper board (19 x 18 x 16 cm), Polyethylene (PE), Polypropylene (PP) (20 x 30 cm), PE + paper board, and PP+ paperboard then stored for 0, 2, 4, 6 and 8 days at ambient temperature. Based on weight loss, decays percentage and organoleptic properties (texture and freshness level), PP and PE bags gave the best protection up to 8 days.

Keywords: Cabbage, Packaging, Polyethylene, Polypropylene.

INTRODUCTION

Cabbage (*Brassica oleracea*) is one type of vegetable that is well known and loved by the people, because it contains many vitamins and minerals [4]. Cabbage market opportunities are not only limited in the country, but also has been reaching out to many foreign countries such as Taiwan, Malaysia, Hong Kong, Singapore, Japan, Germany, and others [8].

Harvested cabbage is perishable and easily damaged because it is a leafy vegetable that have high respiration rate when compared to other types of cereals or legumes [16]. Based on preliminary experiments cabbage after harvesting can only survive for 4 days at room temperature storage, after which it begins to look their destruction. Damage caused by respiration processes which continue in cabbage after harvesting can lead to nutritional impairment, severe shrinkage, discoloration and decay, so it can reduce its appeal. This condition will cause losses, therefore, to overcome this problem needs to be done post-harvest handling can inhibit respiration, such as packaging [16].

Packaging is a way to delay the damage caused by mechanical factors, microbiological, water, oxygen, and light in a certain period of time during storage. Type of packaging commonly used for packing vegetables are plastic PE, PP and paper as folding cartons [7, 15,21,22]. Packaging capabilities in inhibiting the damage varies depending on the nature of each packaging material. Besides polyethylene resistant to chemicals, water-resistant it is able to prevent excessive water loss so the vegetables stay fresh. Polypropylene is a plastic that is strong and lightweight, and has a permeability to gas and water are low, so the possibility

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XI Issue VIII August 2024

penetrated by gases, liquids, ions, and molecules dissolved to cause damage can be avoided, thereby extending the shelf life of packaged products [14,22]. Meanwhile folding cartons are generally made of folding box board; produce a semi rigid shape is not influenced by the shape of the packaged products, so as to avoid damage due to impact [16]… According Pantastico [14] that the packaging for agricultural products needs to be drilled to prevent condensation of air. Perforation of plastic packaging (20 x 30 cm) with two to four holes sized 1/4 to 1/8 inch will allow the entry of O2 sufficient and avoid the damaging effects of high CO2 concentrations during storage [10]. Packaging with plastic and cardboard have been performed on several kinds of fruits and vegetables such as rambutan, tomatoes, cauliflowers, beans, carrots, and others, but this has not been done on vegetables cabbage. This study aims to obtain appropriate packaging to extend the shelf life of cabbage at room temperature.

MATERIALS AND METHODS

Cabbage were picked from the fields in Kembang Kuning District of West Lombok, NTB Indonesia which has a weight of approximately 1.6 kg. Sorting is done by sorting good cabbage. After cabbage is cleaned, covered the pores of cabbage stem with lime solution trunk to prevent the growth of aerobic bacteria that attached to or entered into heads of cabbage. Draining done to remove the used washing water, so that the pathogen is not easy to grow and spoil the cabbage crop has been harvested. Plastic packaging polyethylene, polypropylene plastic that is used has a thickness of 0.08 mm with a size of 20 x 30 cm. Paper folding cartons with a thickness of 0.8 mm made with a size of 19 x 18 x 16 cm. Packaged Cabbage stored at room temperature and observed on days 0, 2, 4, 6, and 8 respectively.

Experiments conducted in the Laboratory of Food Technology, Faculty of Food Technology and Agroindustry, University of Mataram that laid out with completely randomized design (CRD) with five treatments namely: KL = folding carton packaging; PE = polyethylene plastic packaging; PP = poly-propylene plastic packaging; PE + KL = Plastic packaging polyethylene coated with folding cartons and PP + KL = Plastic packaging poly-propylene coated with a folding carton. Packaging KL perforated four holes with a diameter of 6 mm respectively. All treatments were made in four series with triplicate in order to obtain 60 units of analysis. Data were analyzed by using ANOVA and continued by Honestly Significant Difference test at five per cent significance level [17

Determination of vitamin C is done with iodine titration method, Moisture carried by the oven method [19], weight loss [21]. The percentage damage is calculated by comparing the weight of defective parts with the weight of fresh [3,18]. Determination of texture and freshness conducted using Scoring Test [11]. Texture level of freshness: Very hard = 6; Hard = 5; Rather loud = 4; Rather soft = 3; Soft = 2; Fresh very soft = 1 Level of freshness ; Fresh = 4,Rather fresh = 3; Slightly wilted = 2 and Withered = 1

RESULTS AND DISCUSSION

The influence of the type of packaging of the chemical components of cabbage.-Levels of vitamin C cabbage on the packaging of polypropylene (PP) on the storage of 8 days was significantly different from the four other treatments, but the storage 2, 4, and 6 days showed results that were not significantly different among all treatments on the real level of 5 percent (Figure 1), Significant difference to the levels of vitamin C white cabbage in 8 days storage time was likely caused by the differences in packaging permeability to gases (oxygen). Levels of vitamin C of cabbage packed with PP (0.08 mm) were (14.55 mg / 100 g material) is higher than the levels of vitamin C cabbage are packed Polyethylene (PE) with the same thickness, namely (8.45 mg / 100 g ingredients). This is because the packaging PE has greater permeability to oxygen [6].

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XI Issue VIII August 2024

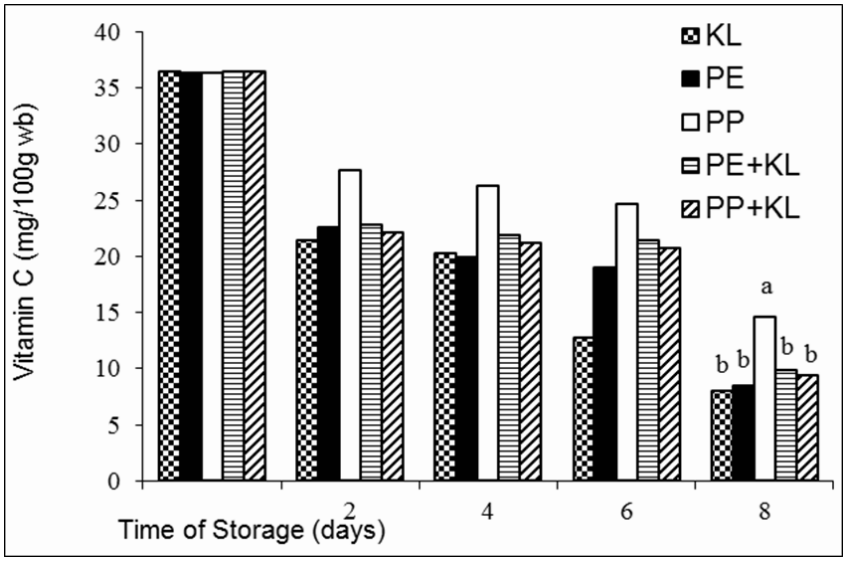

Figure 1. Changes in the levels of vitamin C cabbage during storage (KL = folding carton, PE = Polyethylene, PP = Polypropylene, Polyethylene PE + KL = + folding carton, PP + KL = Polypropylene + Cardboard folding).

The higher the permeability, the more oxygen diffuses into the PE packaging that causes the higher the oxidation of vitamin C. According Winarno statement [25] that the presence of oxygen will cause vitamin C reversibly oxidized into dehydroascorbic acid L highly unstable and can undergo more changes further into acid L-diketogulonat who do not have the liveliness as vitamin C. this statement is supported by Pantastico [13,20] that the heat generated from respiration will be buried in a storage room that led to the respiration rate of the packaged material increases, with increased respiration rate may accelerate the destruction of vitamin C. Basuki et al., [5,6] stated that the tomatoes are packed with PE and PP at room temperature storage for 20 days, decreased levels of vitamin C.The water content of cabbage is packed KL at 8 days storage time significantly different from the Figure 2. Changes in the levels of moisture of cabbage during storage (KL = folding carton, PE = Polyethylene, PP = Polypropylene, Polyethylene PE + KL = + folding carton, PP + KL = Polypropylene + Cardboard folding)

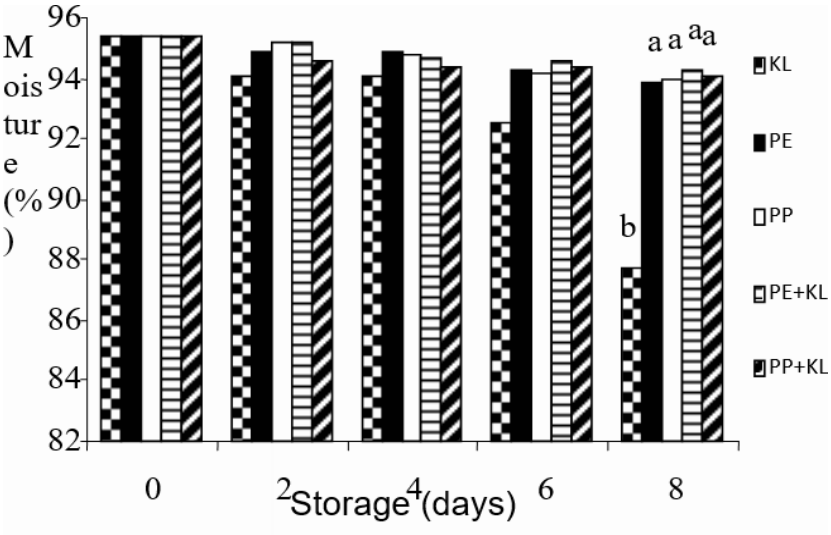

Figure 2. Changes in the levels of moisture of cabbage during storage (KL = folding carton, PE = Polyethylene, PP = Polypropylene, Polyethylene PE + KL = + folding carton, PP + KL = Polypropylene + Cardboard folding)

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XI Issue VIII August 2024

other four treatments (Figure 2). This is due to KL has properties that absorb water vapor transpiration rate on cabbage are packed higher than other treatments, where the loss of water from the cabbage highest. This statement is supported by Winarno [23,25,] that the loss of water from the fresh material by transpiration could reach 50%, whereas the loss of water due to respiration 0.5%. The higher the vapor pressure of water in the material than the vapor pressure of water outside material causes white cabbage tends to remove the water in it through transpiration [21].

Cabbage is packed KL obtained the lowest water content in packaging KL compared to other packaging. This is probably due to oxygen permeability KL is greater than the other packaging, so that more oxygen which accelerates respiration in packaging KL compared to other packaging…

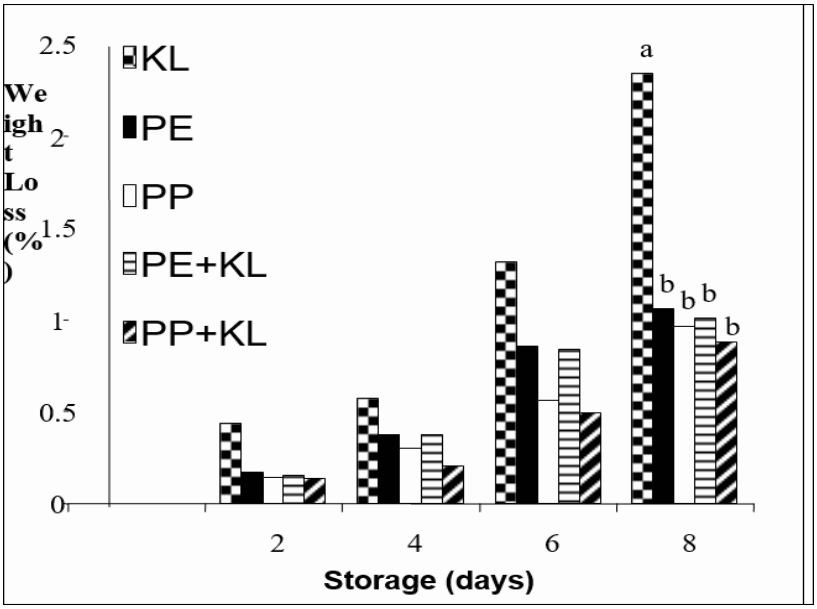

Figure 3. Changes in weight losses during storage of white cabbage (KL = Cardboard folding, PE = Polyethylene, PP = polypropylene, PE + KL = Polyethylene + Carton folding, PP + KL = Polypropylene + Cardboard folding)

The influence of the type of packaging to the physical components of cabbage.-Losses weight of white cabbage are packed KL on storage time of 8 days was significantly different from the four other treatments, while the storage duration of 2, 4, and 6 days showed results that were not significantly different among all treatments on the real level of the same (Figure 3).

This difference is due to the packaging KL will accelerate the process of transpiration and respiration so that shrinkage of the higher severity. Changes severe shrinkage of white cabbage on the packaging KL mostly caused due to water loss during storage, where water loss is closely related to the process of respiration and transpiration material. Cabbage is packed with KL has the highest weight losses and the lowest water levels (Figure 2), while the other has a shrinkage packaging weight is low (below 1%) and moisture content above 95%. The occurrence of transpiration (evaporation) due to the difference in water vapor pressure inside and outside the material causing heavy losses on the materials. From the analysis of the mean percentage of damage indicate that treatment of various types of packaging give real effect to the damage percentage of white cabbage (Figure 4). The damage that occurs in the form of packed cabbage was color change from greenish white to yellow and even brown. The percentage breakdown of white cabbage are packed PE and PP in the storage for 4 days yet to show damage (zero percent), visible on the color of outer leaves are greenish-white, even until the eighth day the damage percentage of white cabbage in both types of packaging is still below 1 percent when compared with other types of packaging. The percentage of white

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XI Issue VIII August 2024

cabbage is packed damage during storage KL 4, 6 and 8 days was significantly different from other types of packaging. In the storage time of 8 days treatment was not significantly different PE packaging with PP packaging, but significantly different from the packaging KL, KL + PE, and PP + KL. After the 6th day of treatment packing PP showed no significantly different from the packaging of PE, but both treatments showed significant differences with packaging KL, PE + KL, PP + KL, which is not seen the real difference between the three treatments are the real level 5 %. Meanwhile, after the 8th day packing KL showed significant differences in all treatments (PE, PP, PE + KL, PP + KL), where packaging PE was not significantly different from the packaging PP but significantly different with packaging PE + KL and PP + KL.

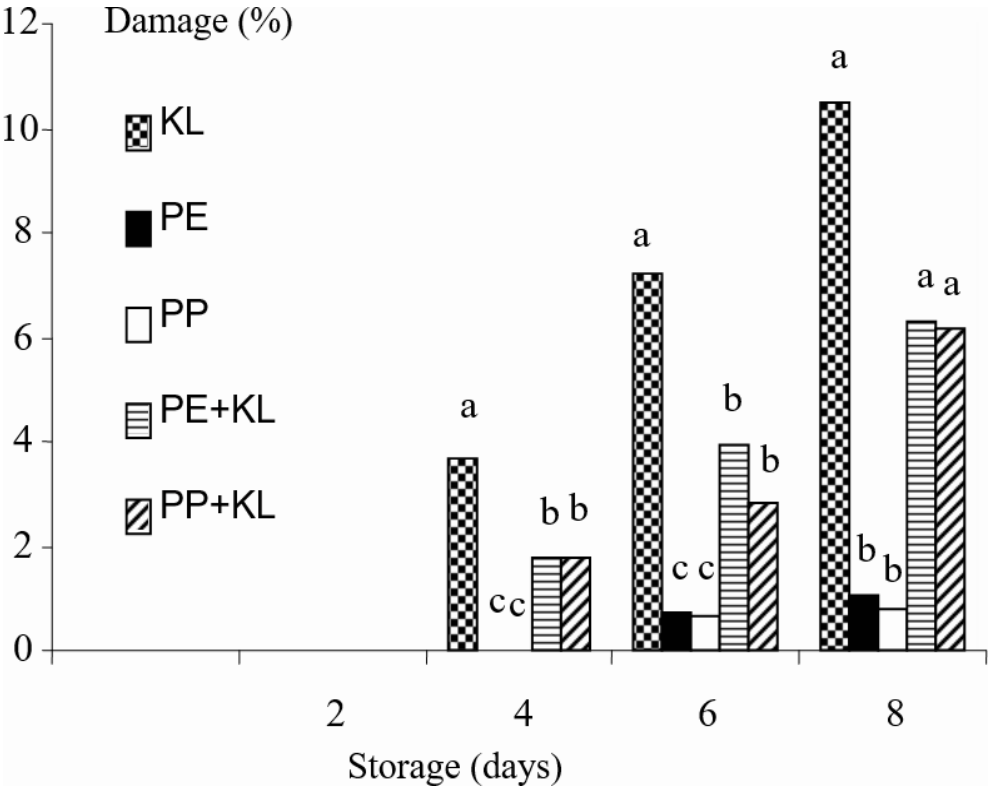

Figure 4. Percentage of cabbage damage during storage (KL = folding carton, PE = Polyethylene, PP = Polypropylene, Polyethylene PE + KL = + folding carton, PP + KL = Polypropylene + Cardboard folding)

Significant difference to the color of the outer leaves of cabbage is packed in 8 days storage time suspected because of the differences in the nature and packaging for oxygen permeability. White cabbage packing with PP and PE looks more capable of maintaining color than the outer leaves of white cabbage packaging KL, KL + PE, and PP + KL. According to the results of research Jakaria [9] stated that the loss of green color in tomatoes are packed PE thick 0, 03 mm larger than PP packaging at the same thickness, which is stored at room temperature for 20 days. Provision of packaging KL on PE and PP packaging resulted in the packaging condition becomes darker, where it caused chlorophyll more easily degraded. As seen in cabbage are packed PE and PP + KL + Cf discoloration of whitish green to yellow. While the packaging using KL color changes to brown due to of the high respiration processes that stimulate the degradation of chlorophyll in cabbage packaged, in addition to the conditions in the packaging darker.

In accordance with Purwadi study [14] that the tomatoes are packed PE better able to sustain a loss of green color in tomatoes than packaging KL at room temperature storage. Able et al., [1] found that the loss of green color is associated with modified atmosphere packaging and storage temperature.Changes in the level of freshness of white cabbage are packed because of a change in color during storage, which is the color of freshness assessment index of agricultural commodities. (Figure 5).

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XI Issue VIII August 2024

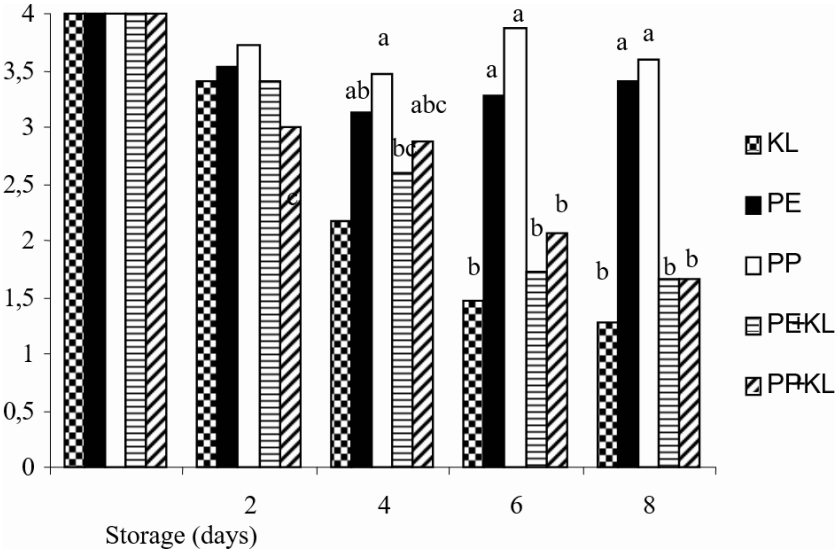

Figure 5. Score freshness of white cabbage during storage (KL = folding carton, PE = Polyethylene, PP = polypropylene, PE + KL = Polyethylene, Polypropylene PP + KL = + Cardboard folding)

As shown in the color parameters outer leaves of cabbage white, where on the packaging PP and PE are better able to maintain the freshness of white cabbage during storage than other packaging (KL, KL + PE, PP + KL). But from the observation visible on the packaging PP tend to be more able to maintain the freshness of the cabbage with the criteria of fresh (4) than packaging PE that has the following criteria rather fresh (3), due to a smaller permeability PP for oxygen than bottled PE that affect the rate of respiration and degradation of chlorophyll from the cabbage but have not showed significant differences at the 5% significance level. While packing PE + PP + KL and KL are not able to maintain the color of white cabbage, where the second package obtained color with slightly wilted criteria, this is due to the conditions in, in addition to the oxygen that stimulate respiration and degradation of chlorophyll. Similarly, the white cabbage are packed KL obtained wilt criteria (1) as a result of the high respiration and degradation of chlorophyll in the package (Figure 5). Wong *et al* [26] suggest that storage of fresh vegetables at low oxygen concentrations (5% CO2 + 0.5% O2) extend the shelf life by maintaining color and texture. Supported by Niyamlao [12] that the use of plastic packaging retains the content of chlorophyll and appearance as well as Chinese kale shelf life to 16 days at a temperature of 10^{o}C.[1]. Texture changes that occur in the white cabbage packed form of changes of texture rather hard to be rather soft and malleable. After 6 and 8 days storage KL packaging showed significant differences with all the packaging, while in the old storage 2 and 4 days not seen a noticeable difference among all treatments at the 5% significance level.

White cabbage texture changes during storage allegedly due to changes in the substance of pectin and cell wall composition changes. Decrease in protopectin due to their enzyme activity of pectin metilesterase, polygalacturonase into other compounds such as pectinic acids, pectic acid, and galacturonic acid that soluble in water causes the texture becomes soft [24,25,2,20]. The cell walls are rigid structures that surround the cell membrane, the main constituent of the cell wall is cellulose is a polysaccharide such as fibers which are hard and insoluble in water [2]).

CONCLUSION

Cabbage, can be successfully extended storage at various types of packaging using polyethylene and polypropylene plastic bags. The packages provides real influence on vitamin C content, water content and weight losses on the eight days, the texture on the sixth day, the percentage of damage, the color of outer leaves and the level of freshness on the fourth day. Based on the weight losses, the percentage of damage

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XI Issue VIII August 2024

and the organoleptic properties of packaging PP and PE provide the best effect on the shelf life of cabbage until day eight.

REFERENCES

1. Able, A.J.L.;S. Wong; A. Prasad and T.J. O'Hare.1999. Postharvest Physiology of Pak Choy Proceeding of Australasian Postharvest Conference, 3-4 October, Waitangi, NZ.
2. Apandi, M, 1984. Fuit and Vegetable Technology, Alumni, Bandung.
3. Aprianto A., D. Fardiaz, N. Puspitasari, S. Budiyanto, dan Sedarnawati, 1989. Procedure of Food Analitycal Laboratory. PAU PG-IPB, Bogor.
4. Arsyad. H dan T.J. Vivian K., 1992. Procedure of Various Vegetables Production. PD Mahkota, Jakarta.
5. Basuki, E., Nazaruddin, Zainuri, 1992.Study of Quality of Tomato at two type packaging and Storage Temperature. Penelitian Fakultas Pertanian Unram, Mataram.
6. Basuki, E., A. Prarudiyanto dan Zainuri, 2012. Postharvest Technology and Physiology. Prima Print, Yogyakarta.
7. Buckle, K.A; R.A. Edwards; G.H. Fleet and M. Wottoon. 1987. Food Science. UI Press. Jakarta.
8. Cahyono, B., 1995. Cara Meningkatkan Budidaya Kubis. Kelayakan Secara Intensif Jenis Kubis Putih. Yayasan Pustaka Nusantara, Yogyakarta.
9. Jakaria, 1991. Effect of Plastic Packaging and Time of Storage to the Component Quality of Tomato (*Lycopersicum escullentum. Mill*). Skripsi Fakultas Pertanian Unram, Mataram.
10. Kader, A.A. 2002. Modified Atmosphere during Transport and Storage. In A A. Kader Postharvest Technology of horticultural Crops Third Ed. University of California Agricultural and Natural resources Pub. No 3311.
11. Meilgaard, M; G.V. Civille and B.T. Carr. 1991. Sensory Evaluation Techniques. CRC Press. Boca Raton.
12. Niyamlao, W;S. Kanlayanarat; C. Maneerat. 1999. The effect of Hydrocooling and Plastic Bag Packaging in Shelf life of Chinesse Kale (Brassica albograba L). Procceding of ASIAN Seminar on Postharvest Technology, Ho Chi Minh City, Vietnam 9 – 12 November.
13. Pantastico, ER.B., 1989. Postharvest Physiology, Gadjah Mada University Press, Yogyakarta
14. Purwadi, J., 1992. Effect of types packaging and Maturity of Tomato to the Vitamin C Content. Skripsi Fakultas Pertanian Universitas Mataram.
15. Robertson, G.L. 1993. Food Packaging. Marcel Dekker, New York.
16. Setyowati R. Niwan dan A. Budiarti, 1992. Postharvest of Vegetables. Penebar Swadaya, Jakarta.
17. Soemartono, 1997. Experimental Design.UGM Press
18. Standar Nasional Indonesia, 2000. Vegetable Product. Ministry of Trading and Industry R I. Jakarta
19. Sudarmadji, S., B. Haryono dan Suhardi, 2010. Procedure of Food Analitycal Laboratory. Liberty, Yogyakarta.
20. Susanto, T. 1994. Postharvest Physiology and Technology. Akademika, Yogyakarta.
21. Syarief, R. dan A. Irawati, 1988. Plant Food Product for Industry. Medyatama Sarana Perkasa, Jakarta.
22. Thompson, J.E and E.G. Mitchel. 2002. Packaging for Horticultural Crops. In A A. Kader Postharvest Technology of horticultural Crops Third Ed. University of California Agricultural and Natural resources Pub. No 3311.
23. Wills, RBH; B. McGlasson; D. Graham and D. Joice, l998. Postharhest, An introduction to the Physiology & Handling of Fruit, Vegetables & Ornamentals, UNSW Press, Sydney.
24. Winarno, F.G dan M. Aman. 1981. Postharvest Physiology. Sastra Hudaya. Jakarta.
25. Winarno, F.G, 1992. Food Chemistry and Nutrient. PT Gramedia Pustaka Utama, Jakarta.
26. Wong, L.S; A. Parasad and T.J. O'Hare. 1997. Shelf-life Extention of Minimally processed Asian Vegetables using CAS. Proceeding of Australasian Postharvest Horticulture Conference. 28 Sept. -3 October, Richmond, Australia.