International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 12 Issue 2 ǁ February 2024 ǁ PP. 09-15

Effect of Fruit Quantity and Packaging Type on Physico-Chemical Properties and Shelf Life of Fresh Bell Peppers (*Capsicum annuum var. grossum*)

Dewa Putu Jnana Puja Yudistira, Made Sudiana Mahendra[*)],
Anak Agung Gede Sugiarta
Agroecotechnology Study Program, Faculty of Agriculture, UdayanaUniversity
JL. PB. Sudirman Denpasar Bali 80231, Indonesia

Abstract
The demand for bell pepper is increasing along with the growth of the economy and population. This study aims to investigate the effect of the appropriate quantity of fruit in the packaging and determine the suitable packaging type for preserving the physicochemical properties and shelf life of bell pepper. The research is being conducted from February to March 2023 at the Eco-physiology Laboratory, Faculty of Agriculture, Udayana University The experimental design used is a completely randomized design (CRD) with a factorial pattern consisting of 2 factors. The first factor is the packaging treatment (K), which includes three treatments: K0 = Control (without packaging), K1 = Polypropylene (PP) packaging, and K2 = Polyethylene (PE) packaging. The second factor is the quantity of fruit (T), consisting of two treatments: T1 = 2 fruits in one package and T2
= 3 fruits in one package. Each treatment was replicated 4 times, resulting in a total of 24 experimental units. The research findings indicate an interaction between the packaging type and the quantity of fruit for the variable of shelf life. The quantity of fruit has a highly significant effect on weight loss on the 4th and 8th day and a significant effect on the shelf life, whereas the packaging type has a highly significant effect on the shelf life, the total soluble solids (TSS) content on the 8th day, and a significant effect on weight loss on the 4th and 8th day. Furthermore, the highest increase in vitamin C is
observed in K0T1, which records a 198.47% increase

Keywords: *Bell Pepper, polypropylene packaging (PP), polyethylene packaging (PE), bell pepper shelf life*

Date of Submission: 26-01-2024 Date of acceptance: 08-02-2024

I. Introduction

Indonesia is a potential producer of horticultural commodities. One of the growing horticultural products is bell pepper (*Capsicum annuum var. grossum*). Green bell peppers are plants that are easily damaged after harvesting (Poverenov *et al*.2014), this is due to the nature of bell pepper fruit which is classified as climatic so that it is easily damaged (*perishable*). Decrease in fruit quality

Peppers that occur during harvesting, handling and storage, will affect the level of marketing and consumer acceptance. According to Utama *et al.* (2006), to slow down the postharvest deterioration of fruit commodities, a method of handling and treatment is needed that can reduce respiration and transpiration to a minimum limit where the productis still able to carry out its life activities.

To reduce the respiration rate, packaging technology has now developed. The type of packaging that has now been widely introduced and used to protect products and add attractiveness to consumers at a relatively affordable price and easily obtained. There are several types of plastic packaging that can be used in packaging and are easily available, namely *polypropylene* (PP) and *polyethylene* (PE).

Based on this background, the researcher intends to conduct research on postharvest handling with the use of the number of fruits and types of packaging to overcome postharvest handling of peppers that are less appropriate in the field so that it is hoped that the results of this study can be used as a medium of information on how to properly handlepostharvest on peppers.

II. Materials andMethods

This research was conducted from February 2023 to March 2023. The research was conducted at the Ecophysiology Laboratory, Faculty of Agriculture, Udayana University. The tools used in the implementation of this research are digital scales, penetrometer, *hand refractomete*, scissors, stationery, erlenmeyer, filter paper,

plastic hose, air pump, measuring cup, pipette, jar and camera. The materials used in this study were bell peppers obtained from the plantations of bell pepper farmers in Dasong Village, Sukasada District, Buleleng Regency. The peppers used were green in color with a harvest age of 75-80 days, approximately uniform in size and without any physical damage. In addition to peppers, the materials used were *polypropylene* (PP) and *polyethylene* (PE) packaging, amylum solution, distilled water, and 0.01 N Iodine. This study used a factorial complete randomized design (CRD) with two treatment factors. The first factor was the type of packaging which consisted of three levels: no packaging, packaging with polypropylene (PP) packaging, and packaging with polyethylene (PE) packaging. The second factor is the number of fruits consisting of two levels, namely two fruits in the package and three fruits in the package.

The variables observed were fruit weight loss, fruit hardness, total soluble solids (TPT), vitamin C content and shelf life of bell peppers.

III. Results and Discussion

3.1 Results

The results of physical and chemical analysis of bell peppers with the treatment of packaging type and number of fruits include fruit weight loss, fruit hardness, total soluble solids, and shelf life. Analysis of variance on bell peppers showed that the packaging (K) had a very significant effect on the shelf life of days, as well as the total soluble solids onday 1.

The treatment of the number of fruits (T) had a very significant effect on the weight loss of days 4 and 8 and a significant effect on the shelf life of the fruit. The interaction between packaging treatment and number of fruits was observed on fruit shelf life (Table 1).

Table 1
Significance of the Effect of Packaging Type and Number of Fruits on Physico-Chemical PropertiesBell Peppers

No.	Variables	Day	Treatment		
			K	T	K x T
1.	FruitWeight Loss	4	*	**	ns
		8	*	**	ns
2.	FruitHardness	4	ns	ns	ns
		8	ns	ns	ns
3.	TotalDissolved Solids	4	ns	ns	ns
		8	**	ns	ns
4.	ShelfLife		**	**	**

Description: K: packaging
T : number of fruits
Ns : Not significantly different (P>0.05)
* : Significantly different (P<0.05)
** : Significantly different (P<0.01)

3.1 Weight Loss (g)

Based on the results of observations, the differences in packaging treatments showed significant differences in weight loss and fruit hardness on day 8, while the number of fruits showed significant differences in weight loss on day 4 and 8 hsp (Table 2). The occurrence of considerable weight loss in the treatment without packaging is caused by the high activity of respiration and transpiration and the release of water content due to storage in the open space, the type of packaging affects the weight loss of bell peppers. Storage with plastic materials and the properties of the plastic used are also different, especially the permeability that allows substances to enter and exit the plastic packaging (Batu & Thomson, 1998).

3.2 Fruit Hardness (kg)

The lowest decrease in the level of fruit hardness on day 4 on the single factor of packaging was shown by treatment K2 at 210.60 kg, showing no significant difference from treatment K0 at 244.76 kg and K1 at 247.48 kg (Table 3). Water loss during storage not only reduces weight loss but also reduces quality.
and cause damage. Heavy water loss will cause withering and wrinkling (Muchtadi *etal.*, 1993).

Table 2.
Single Factor of Packaging Type (K) and Number of Fruits (T) on Shrinkage Variables Fruit Weight (g)

Weight Loss observation variable		4 hsp	8 hsp
Packagin			
g	K0	399.40 a	377.23 b
	K1	422.18 a	421.55 a
	K2	405.02 a	404.13 a
	BNT 5% 35.13 33.73		
Number of			
	T1	351,59 a	344,52 b
	T2	466,14 b	457,41 a
	BNT 5%	28,68	27,54

Notes: Numbers followed by the same letter in treatments and columns indicates not significantly different in the BNT least significant difference test at the 5% level hsp: days after treatment

Table 3.
Single Factors of Packaging Type (K) and Number of Fruits (T) on Variables Fruit Hardness (kg)

Observation variable Fruit Hardness (Kg)			
		4 hsp	8 hsp
Packaging			
	K0	244.76 a	82.04 a
	K1	247.48 a	173.80 a
	K2210.60 a		
	158.36 a		
	BNT 5% - -		
Number of Fruits			
	T1	244.88 a	134.66 a
	T2		
	243.68 a 141.47 a BNT 5% -		
	- -		

Description: Numbers followed by the same letter in the treatment and column show no significant difference in the BNT least significant difference test at the 5% level hsp: days after treatment.

3.4 Total Dissolved Solids (◦brix)

The results of the analysis of the content of Total Dissolved Solids of bell peppers with packaging treatment and the number of different fruits had a very significant effect on the single factor of packaging ($P < 0.01$) shown in the observation data on day 8. According to Ilfah *et al* (2012), the increase in the value of total soluble solids is due to the effect of respiration which degrades the complex components contained in the stored product into simple components.The results of the analysis of the content of Total Dissolved Solids of bell peppers with the treatment of packaging type and number of fruits(Table 4).

Table 4.
Single Factors of Packaging Type (K) and Number of Fruits (T) on Total Content Variables Dissolved Solids (◦Brix)

Observation variable Total Dissolved Solids			
		4 hsp	8 hsp
Packaging			
	K0	3.625 a	3.9 a
	K1	3.4 a	3.6 b
	K2	3.5 a	3.725 b
	BNT 5% - 0.180		
Number of Fruits			
	T1	3.491 a	3.683 a
	T2	3.525 a	3.8 a
	BNT 5% - - -		

Description: Numbers followed by the same letter in treatments and columns indicate bed not significant at the 5% BNT least significant difference test hsp: days after treatment a

3.5 Vitamin C Content (ml/100g)

The results of the analysis of vitamin C content of bell peppers with the treatment of packaging type and number of fruits were the percentage increase in vitamin C content in the fruit was quite high found in treatment K0T1 (no packaging, number of fruits 2) which was 198.47% and K2T2 (polyethylene packaging, number of fruits 3) which was 195.07% (Table 5).

Table 5.
Percentage Increase in Vitamin C Level in Combination Factor of Packaging Type (K) and Number of Fruits (T)

No.	Treatment	Percentage Increase in Vitamin C
1.	K0T1	198,47 %
2.	K0T2	175,96 %
3.	K1T1	87,40 %
4.	K1T2	37,66 %
5.	K2T1	154,61 %
6.	K2T2	195,07 %

Description: Measurement of vitamin C levels was carried out on days 4 and 8.

3.6 Shelf Life (days)

The results of statistical analysis showed a very significant interaction between the treatment without packaging (K0), the type of packaging *polyprophylene* (PP) (K1) and *polyethylene* (PE) ($_{K2}$) with the number of fruit $_{T1}$ (2 pieces) and $_{T2}$ (3 pieces) had a very significant effect on fruit shelf life (Table 6).

Table 6.
Interaction of Packaging Treatment and Number of Fruits on Fruit Shelf Life Paprika

	Treatment		
	K0	K1	K2
T1	6,5 c a	18,5 a a	14,5 b a
T2	6,5 c a b b	14,5 a	10,5 b
BNT	1.917		

Description: Numbers followed by the same letter in the treatment and column show no significant difference in the BNT least significant difference test at the 5% level.

Table 7.
Visual Appearance of Paprika Fruit Breakage HSP

Perla-kuan	1	4	8	12	16	20
K0T1						
K0T2						
K1T1	1 2  1	 1	 1	 1	 2	 3
K1T2	 1	 1	 1	 2	 3	
K2T1	 1	 1	 2	 2	 C	
K2T2	 1	 1	 2	 3		

3.7 Results of Fruit Shelf Life Analysis based on Visual Appearance

Based on the results of observations, it shows that the peppers experienced the fastest decay in the K0T1 and K0T2 treatments on the 8th day of observation. Indicated by a scoring value of "3" which is a state of reaching 60% damage and treatment K1T1 has the longest freshness resistance of bell peppers on the 20th day of observation (Table 7).

3.2 Discussion

The results of statistical analysis showed that there was an interaction between packaging factors and the number of fruits on the shelf life of bell peppers. Observation data on the shelf life of bell peppers, the combination treatment K1T1 (*Polypropylene* Packaging, Number of Fruits 2) showed the highest value, which indicated the longest shelf life compared to other treatments in this study. This highest number indicates that the level of damage to the bell pepper fruit that appears visually appears the longest compared to other treatments. In line with this, this study also found that the lowest weight loss was shown by peppers with *polypropylene* packaging treatment (K1).

The analysis of the shelf life of peppers with packaging treatment and the number of fruits caused

visible differences based on the results of this study. According to (Matto *et al*., 1989) color change can be caused by 2 factors, namely the degradation process and the synthesis process of the pigments contained in the fruit. This study shows that both *polyethylene* and *polypropylene* packaging treatments can keep the fruit from contact with oxygen at room temperature so as to slow down the respiration process which reduces the shelf life of the fruit. However, when compared, *polypropylene* packaging (K1) was the best and could maintain the longest fruit shelf life of up to 18.5 days (+20) compared to *polyethylene* packaging and no packaging at all.

Fruits and vegetables store carbohydrates for material and energy. These supplies are used to carry out activities for the rest of their lives. Therefore, in the process of ripening, the sugar and carbohydrate content always changes (Iflah *et al*, 2012). Paprika, which is a climatic fruit, certainly undergoes a breakdown such as carbohydrates into simple sugars and several other large molecules. Based on the results of the study, the highest TPT levels were shown in the single factor without packaging (K0) and the number of fruits 3 (T2) while the lowest values were shown in the *polypropylene* packaging treatment (K1) and the number of fruits 2 (T1) on each observation day.

Vitamin C is a micro-nutrient needed by humans to run the body's metabolism, with its water-soluble nature making it easy to find in almost all vegetables and fruits. Paprika is one of the fruits with high vitamin C content. Based on the observation results, the highest percentage increase in vitamin C levels occurred in the K0T1 treatment (without packaging with the number of fruits).

2 in the package) which is 198.47%. Some factors that can affect vitamin C levels in plants include conditions before and after harvest, temperature, storage techniques, length of storage, moisture content, and the level of fruit maturity (Ernest *et al*. 2017). Treatment without packaging certainly accelerates the process ripening because the fruit experiences direct contact with the temperature and oxygen around it. The room temperature (26-27^{o} C) and the oxygen present accelerate the respiration process of the fruit so that ripening becomes faster.

The weight of bell peppers during storage decreased and the percentage of weight loss increased proportional to the length of storage. Weight loss occurs because in the process of respiration there is a chemical process between O_2 and carbohydrates to produce CO_2 and H_2O which are released into the air. The type of packaging affects the weight loss of bell peppers. Storage with plastic materials and the properties of the plastic used are also different, especially the permeability that allows substances to get in and out of this plastic packaging (Batu and Thomson, 1998).

Fruit hardness after packaging treatment showed the most decrease reaching 162.72kg (4 hsp minus 8 hsp) in the K0 treatment while in the number of fruit treatment, it was shown by T2 which was 102.20kg (4 hsp minus 8 hsp) on day 8.

. Water loss during storage not only decreases weight loss but also reduce quality and cause damage. Heavy water loss will cause withering and wrinkling (Muchtadi *et al*., 1993). In addition to weight loss, the treatment without packaging caused a decrease in the level offruit hardness the most among other treatments.

The decrease in the level of hardness reached half the level of hardness with packaging treatment. This is due to the process of breaking down substances in the fruit (Kusumiyati *et al*, 2019), namely insoluble protopectin which is broken down into pectic and pectic acid which can dissolve in water (Fransiska *et al*, 2013). Bell peppers fall into the climatic category because they experience the ripening process after harvest. The climatic process itself is a phenomenon of increased ethylene gas production and physical and chemical changes in the fruit (Fonseca *et al*, 2002).

IV. Conclusion

Based on the results of this study, it can be concluded as follows. The number of fruits has a very significant effect on the variable weight loss of bell peppers on days 4 and 8 and has a very significant effect on shelf life. The treatment of packaging type had a very significant effect on the variable of day shelf life, and TPT day 8, while the weight loss of bell peppers had a significant effect on days 4 and 8. In this study, the best type of packaging was PP plastic packaging type (K1) compared to PE plastic packaging type (K2). There was an interaction between the packaging type factor and the number of fruits on the shelf life variable. In this study, the interaction of PP plastic packaging type (K1) with the number of fruits (T1) had the best shelf life, namely 18.5 days compared to PE plastic packaging.

Bibliography

[1]. Stone, A and AK. Thompson. (1998). Effect of Modified Atmsphere Packaging on Post Harvest Qualities of Pink Tomatoes. Journal of Agriculture and Forestry p 22

[2]. Ernest, E., Onyeka, O., A.C., O., & R.O., O. (2017). Comparative Assessment of the Effect of Ripening Stage on the Vitamin C Contents of Selected Fruits Grown within Nsukka Axis of Enugu State. International Journal of Environment, Agriculture and Biotechnology; 2; 712-714.

[3]. Fonseca, S. C., Oliveira, F. A. R., and Brecht, J. K. (2002). Modeling respiration rate of fresh fruits and vegetables for modified

atmosphere packages: a review. Journal of Food Eng. 52: 99-119.
[4]. Fransiska, A., Hartanto, R., Lanya, B., & Tamrin. (2013). Physiological Characteristics of Mangosteen (Garcinia mangostana L.) in Modified Atmosphere Storage. Journal of Agricultural Engineering, 2(1), 1-6.
[5]. Iflah, T. 2012. Effect of Starch-Based Plastics (Bioplastics) Packaging on the Quality of Tomatoes and Peppers during Cold Storage. Journal of Agricultural Industry Technology, 22(3).
[6]. Ismawati, N., Nurwantoro, N., and Pramono, Y. B. (2017). pH value, total solids soluble, and sensory properties of yogurt with the addition of beet extract (Betavulgaris
[7]. L.). Journal of Food TechnologyApplications, 5(3).
[8]. Kusumiyati, Ine E. Putri, Y. Hadiwijaya, S. Mubarok. (2019). Response of Hardness Value, Moisture Content and Total Dissolved Solids of Crystal Guava Fruit on Various Packaging and Storage Period. 6(1):49-56. Agro Journal. URL: https://journal.uinsgd.ac.id/index.php/ja/article/download/4142/pdf
[9]. Matto, A. K., T. Murata, Er. B. Pantastico, K. Chachin, K. Ogata and C. T Phan. (1989).
[10]. Chemical changes during maturation and aging, p. 160-197. In Er. B. Pantastico (Ed.). Postharvest Physiology Handling and Utilization of Tropical and Subtropical Fruits and Vegetables. Translation of Postharvest Physiology, Handling and Utilization of Tropical and Subtropical Fruits and Vegetables. Translated by Kamariyani. Gajah Mada University Press. Yogyakarta.
[11]. Muchtadi. D., Sri Palupi N., Astawan M. (1993).Metabolism of Nutrients. Sources Functions and Needs for the Human Body. Volume II. Sinar Harapan Library Jakarta. 44-
[12]. 48.
[13]. Poverenov, E., Zaitsev, Y., Arnon, H., Granit, R., Alkalai-Tuvia, S., Perzelan, Y., ... & Fallik, E. (2014). Effects of a composite chitosan-gelatin edible coating on postharvest quality and storability of red bell peppers. Postharvest Biology and Technology, 96, 106-109.
[14]. Utama, M.S., Komang A. Nocianitri and Fitri W. Tunggadewi. (2006). Studying the Effectof Thickness of Low Density Polyethylene Plastic Film as Mangosteen Fruit Packaging Material on Oxygen and Carbon Dioxide Gas Modification. Udayana University. Bali.