

Full Length Article

Comparison on physical alteration of the peeled durian stored in “OZONE BOX” odor lock and commercial packaging

Siriwan Tungsangprateep ^{1*}, Waree Jaruwattanayon ¹, Kasinee Saowakon ²,
Papitchaya Kongchinda ² and Rujira Deewatthanawong ²

¹ *Thailand Institute of Scientific and Technological Research 196 Phahonyothin Rd., Ladyao, Chatuchak, Bangkok 10900*

² *Thailand Institute of Scientific and Technological Research 35 Mu 3, Khlong Luang, Pathum Thani 12120, Thailand*

**Corresponding author's email: siriwan_t@tistr.or.th*

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Abstract

This study investigated the physical changes including oxygen (O₂) and carbon dioxide (CO₂) gas content, weight loss, color change and firmness of peeled durian stored at 4 °C for 15 days in “Ozone Box” odor locking package compared to commercial package. Testing plan was a Complete Randomized Design (CRD) experiment. Statistical analysis was conducted by comparison of the mean t-test at 95% confidence level. It showed that the oxygen gas in Ozone Box decreased significantly when compared to commercial package. On the other hand, carbon dioxide increased dramatically in the first 5 days of storage. It has been indicated that Ozone Box has complete barrier properties against ingress of oxygen and carbon dioxide through the development of the air tight seal structure. The durian in Ozone Box has less weight loss than commercial package in 5-7 days of storage. The Ozone Box absolutely retained moisture inside the air tight seal structure comparing to the commercial package which had a seal opening. There was no significant difference of the color and firmness of the durian in both packages throughout the storage period.

Keywords: odor lock packaging, durian, OZONE BOX, stored or peeled

Introduction

Durian (*Durio zibethinus* Murr.) is considered an economic fruit with high value and high potential for export. Thailand is the number one producer and exporter of durian and durian-based products in the world. For domestic distribution, there are both whole durian and peeled durian available. Because the durian is a fruit that has a peel or parts that are not eaten up to 70% on average, the production of fresh peeled durian, which is ready to eat, is a good choice to expand the fresh durian market. It also saves space and transportation costs compared to selling whole durian, however, durian is a family of Bombacaceae and responds well to ethylene gas (Tropical Climacteric Fruit).

When the durian is ripe, it produces a sulfur compound with a unique strong odor and can cause allergic reactions (Belgis et al., 2017 and Cannon and Ho, 2018). Therefore, the “Ozone Box” durian odor locking package, which can contain the durian odor 100%, was developed by Thai Packaging Center, the Thailand Institute of Scientific and Technological Research (TISTR) with Safer Pack Thailand Co., Ltd. It is well received in commercial use as well as being strong enough for real application. However, information on the changes in properties of peeled durian stored in the package was still needed for determining the release date and helping to ensure the use and sale. The objective of this research study was to study changes in physical properties during storage including weight loss color change and firmness in durian odor locking package, "Ozone Box" compared to the commercial packaging.

Materials and Methods

Peeled durian meat preparation

The durian was selected from Monthong variety with similar maturity. The durian skin was washed and sterilized before peeling at 25 ° C, then lowered to -20 ° C for 20 minutes, then the peeled durian was packed in a package. The study plan consisted of 2 treatments, 3 repetitions per treatment, 3 packages per repetition. Box including

The first treatment: commercial boxes were not completely sealed. Therefore, no complete gas retention condition occurs, resulting in a slight durian odor after closing the package. Place about 500 grams of durian in the package as shown in Figure 1.



Figure 1. Dimensions of commercial box package and peeled durian in commercial box package



Figure 2. Dimensions of commercial box package and peeled durian in commercial box package

The second treatment, Ozone box package, which has been developed to have a tight sealing structure like an air tight seal to keep the durian odor inside so that it does not escape into the environment outside. Therefore, there was no odor after closing the package. Place about 500 grams of durian in the package as shown in Figure 2. Store at 4 ° C for 15 days. Sampling for recording before storage and after storage on day 5, 7, 9, 12 and 15.

Data recording

The amounts of gases in the package were evaluated. These were reported in percentage (%) by measuring the amount of oxygen (O₂) and carbon dioxide (CO₂) in the package with a gas meter.

The Weight loss was recorded. The recorded weights of the durian before storage and after storage were calculated according to the following formula:

$$\text{Percentage of weight loss} = \frac{(\text{Weight before storage} - \text{weight after storage})}{\text{Weight before storage}} \times 100$$

The color change was determined. The durian color was measured at 3 points (head, middle, tail) with a color meter and reported in the CIE system L * a * b *

where L * is used to set the brightness (Lightness).

L = 0, the resulting color is darkened to black.

L = 100, the resulting color will light up in white.

a * determines red or green color.

a is +, a reddish-colored object

a is -, a greenish-colored object

b * determines the yellow color or blue

b is +, yellowish object

b is -, a bluish color object

The hardness was measured. Peeled durian was measured at 3 points (head, middle, tail) with a food texture analyzer and reported the values in Newton (N).

Statistical analysis of data

Testing plan was a Complete Randomized Design (CRD) experiment. Statistical analysis was conducted by comparison of the mean t-test at 95% confidence level.

Results and Discussion

The amount of gas inside the package

Ozone packaging offers complete barrier properties against ingress of oxygen and carbon dioxide through the development of an air tight seal, as evidenced by the oxygen content of the package (Figure 3 and Table 1 and 2) which fell sharply to 0.25% for the first five days and to the highest of only 1.06% later throughout the storage period. This is because peeled durian uses oxygen that exists only in the head space for breathing and oxygen from the outside cannot penetrate into the package. This corresponds to a rapid increase of carbon dioxide to 31.73% in the first five days caused by respiration of the durian and accumulation of carbon dioxide gas inside the package resulting in the high content in the range of 31.73% - 49.62% throughout

the storage period. On the other hand, the peeled durian in the commercial package which still allows oxygen and carbon dioxide through the package has oxygen content in the package similar to that of the outside air. It was in the range of 18.37-18.85 percent throughout the storage period. Comparably, the amount of carbon dioxide is similar to that of the outside air. The range is 0.70-1.16% throughout the storage period.

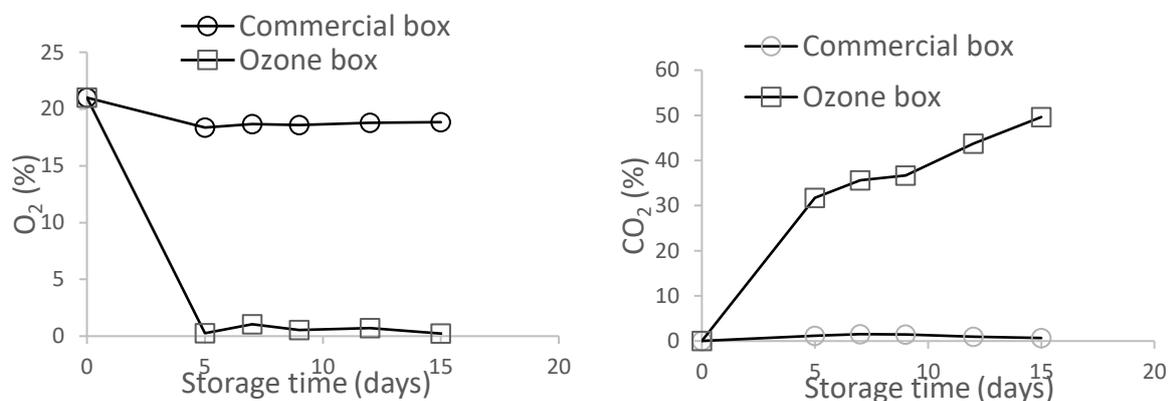


Figure 3. The amount of oxygen (A) and carbon dioxide (B) in the commercial package and Ozone package containing peeled durian.

Table 1. Oxygen gas content (percentage) in commercial package and Ozone package containing peeled durian.

Treatments	Storage time (days)					
	0	5	7	9	12	15
Commercial box	21	18.37±0.33	18.68±0.59	18.59±0.99	18.79±0.01	18.85±0.02
Ozone box	21	0.25±0.17	1.06±0.51	0.55±0.13	0.71±0.16	0.23±0.09
F-test	-	*	*	*	*	*

Note: * means that there was a statistically significant difference at a 95 percent confidence level.

ns means that there was not a statistically significant difference at a 95 percent confidence level.

Table 2. Carbon dioxide gas content (percentage) in commercial package and Ozone package containing peeled durian.

Treatments	Storage time (days)					
	0	5	7	9	12	15
Commercial box	0.03	1.16±0.13	1.53±0.10	1.44±0.28	0.99±0.11	0.70±0.06
Ozone box	0.03	31.73±1.91	35.60±0.73	36.70±1.91	43.72±2.48	49.62±2.54
F-test	-	*	*	*	*	*

Note: * means that there was a statistically significant difference at a 95 percent confidence level.

ns means that there was not a statistically significant difference at a 95 percent confidence level.

Weight loss

Weight loss of peeled durian in ozone package and the commercial package were shown in Figure 4 and Table 3. Both have weight loss increased over the storage period. During days 5-7 of storage, it was found that peeled durian in ozone package had significantly less weight loss than commercial package. This was because ozone package retained all of the moisture inside the air tight seal structure, while the commercial package had a seal opening, so moisture does not accumulate. However, after the seventh day of storage, the weight loss of peeled durian in both packages was not significantly different. This is due to the very high respiration rate of peeled durian in Ozone package, resulting in weight loss that is no different from the peeled durian in commercial package. This was consistent with the results of Kwanhong (2017) and Boonthanakorn (2020).

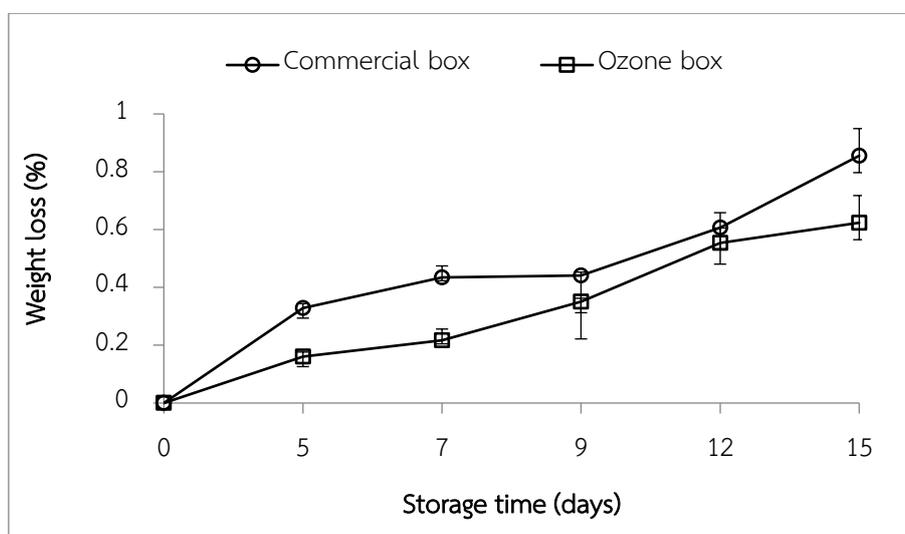


Figure 4. Weight loss of peeled durian in commercial package and Ozone package

Table 3. Weight loss (percentage) of peeled durian in commercial package and Ozone package

Treatments	Storage time (days)					
	0	5	7	9	12	15
Commercial box	0	0.33±0.02	0.44±0.04	0.44±0.01	0.61±0.05	0.86±0.09
Ozone box	0	0.16±0.06	0.21±0.01	0.35±0.13	0.55±0.07	0.62±0.06
F-test	-	*	*	ns	ns	ns

Note: * means that there was a statistically significant difference at a 95 percent confidence level.

ns means that there was not a statistically significant difference at a 95 percent confidence level.

Firmness

The firmness of the peeled durian in the commercial package and Ozone package prior to storage was 7.86 N. After that, the firmness of the peeled durian in both packages decreased similarly and no significant difference was observed over the storage period. At the end of the storage, it was found that the firmness of the peeled durian in commercial package and Ozone package were 5.56 N and 5.08 N, respectively (Figure 5 and Table 4). Obviously, there was only a slight decrease in the firmness due to the low metabolism of peeled durian, especially compared to durian skin (Booncherm and Siriphanich, 1991 and Wongs-Aree, C. and Noichinda, S. 2014).

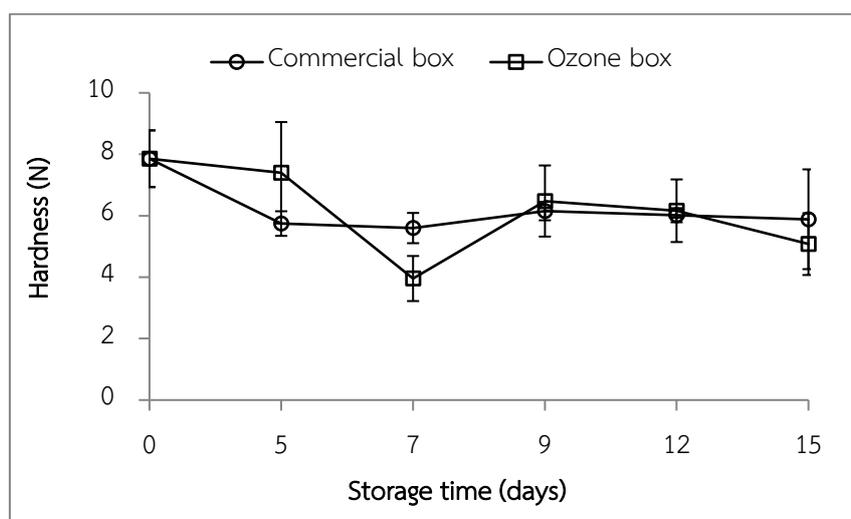


Figure 5. Firmness of peeled durian in commercial package and Ozone package

Table 4. Firmness (Newton) of peeled durian in commercial package and Ozone packaging

Treatments	Storage time (days)					
	0	5	7	9	12	15
Commercial box	7.86±0.92	5.74±0.40	5.60±0.49	6.15±0.30	6.02±0.23	5.56±1.62
Ozone box	7.86±0.92	7.40±1.65	3.95±0.73	6.48±1.16	6.16±1.02	5.08±1.01
F-test	ns	ns	ns	ns	ns	ns

Note: * means that there was a statistically significant difference at a 95 percent confidence level.

ns means that there was not a statistically significant difference at a 95 percent confidence level.

Color change

The changes in L* (brightness) of the peeled durian in commercial package and the Ozone package is relatively constant over the storage period and there was no significant difference in both packages with L* between 87.39-87.90 in commercial package and 87.39-88.52 in Ozone package, respectively (Figure 6 (A), and Table 5).

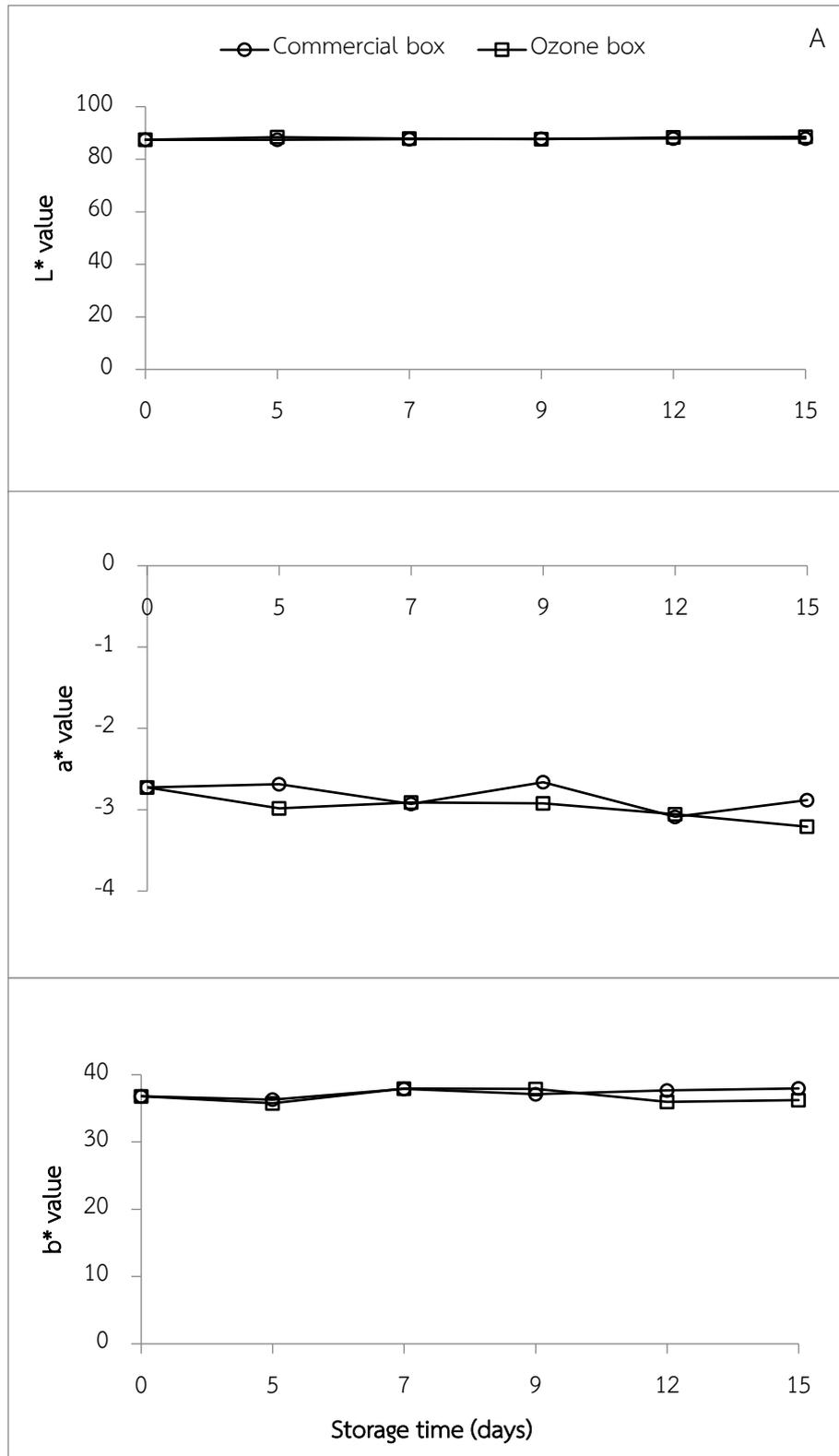


Figure 6. Color change: L* (A), a* (B) and b* (C) values of peeled durian in commercial package and Ozone package

Table 5. Color change, L * value of peeled durian in commercial package and Ozone package

Treatments	Storage time (days)					
	0	5	7	9	12	15
Commercial box	87.39±0.18	87.43±0.22	87.83±0.13	87.80±0.33	87.90±0.10	87.83±0.28
Ozone box	87.39±0.18	88.38±0.22	87.82±0.25	87.86±0.20	88.27±0.30	88.52±0.21
F-test	ns	*	ns	ns	ns	ns

Note: *means that there was a statistically significant difference at a 95 percent confidence level.
ns means that there was not a statistically significant difference at a 95 percent confidence level.

Table 6. Color change, a * value of peeled durian in commercial package and Ozone package

Treatments	Storage time (days)					
	0	5	7	9	12	15
Commercial box	87.39±0.18	87.43±0.22	87.83±0.13	87.80±0.33	87.90±0.10	87.83±0.28
Ozone box	87.39±0.18	88.38±0.22	87.82±0.25	87.86±0.20	88.27±0.30	88.52±0.21
F-test	ns	*	ns	ns	ns	ns

Note: *means that there was a statistically significant difference at a 95 percent confidence level.
ns means that there was not a statistically significant difference at a 95 percent confidence level.

Table 7. Color change, b * value of peeled durian in commercial package and Ozone package

Treatments	Storage time (days)					
	0	5	7	9	12	15
Commercial box	36.81±0.58	36.30±1.06	37.91±0.92	37.10±0.65	37.66±0.47	37.97±0.80
Ozone box	36.81±0.57	35.77±1.43	37.95±0.65	37.92±1.19	35.98±2.34	36.24±1.44
F-test	ns	ns	ns	ns	ns	ns

Note: *means that there was a statistically significant difference at a 95 percent confidence level.
ns means that there was not a statistically significant difference at a 95 percent confidence level.

The change in a * of the peeled durian was negative (- a *) because of the yellowish color of the fresh durian. The a* of the peeled durian in both packages was relatively constant and not significantly different over the storage period with a* between (-) 2.66 - (-) 3.09 in commercial package and (-) 2.73 - (-) 3.21 in Ozone package, respectively (Figure 6 (B), Table 6).

The change in b* of the peeled durian in both packages, like the a*, was somewhat constant and no statistical difference was observed at the 95% confidence level over the retention period. The b* values were between 36.30-37.97 for commercial package and 35.77-37.95 for Ozone package, respectively (Figure 6 (C) and Table 7).

In summary, the color change in peeled durian in commercial packaging and ozone packaging was virtually unchanged over the storage period, and there was no significant difference between the peeled durian in either package. This is due to the same main cause with firmness, which was a low metabolism in the peeled durian, especially when compared to the durian skin (Booncherm and Siriphanich, 1991 and Wongs-Aree, C. and Noichinda, S., 2014)

Conclusion

Ozone packaging has completely barrier properties for oxygen and carbondioxide gases. With the development of a tight structure (Air tight seal), it can be used to preserve peeled durian without sinificantly physical differences i.e weight loss, firmness and color with 95% confidence level.

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