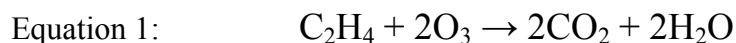


# Ozone experimentation on the shelf life of various fruits

## Abstract

Earth Safe Ozone will investigate the effects of ozone on fruit storage at room temperature. Ozone has been shown to reduce mold and fungus on fruits but to our knowledge no experimentation has been done for practical storage at room temperature. Also it has been hypothesized that ozone will reduce the production of ethylene gas, which can severely damage ripening fruit and causes much of the decay seen in fruit and flowers. Ozone will react with Ethylene gas to produce carbon dioxide and water demonstrated in the chemical equation



By reducing the exposure to Ethylene, ozone may greatly reduce the damage caused by the natural ripening process to keep fruit looking and tasting fresher, longer.

## Procedure

For this experiment, fruit is purchased at a local grocery store at the same time and in similar condition. A control specimen for each variety of fruit is placed in a lighted location at room temperature. The experimental fruit is placed in a 1000 cc container that is quasi-sealed allowing for gaseous release to alleviate pressure build-up. 1.3 to 1.5 mg of ozone gas is pumped into the container for 10 minutes once per day for a total dose of 13 – 15 mg. The variation in dosage is due to differences in day-to-day temperature and atmospheric pressure. Observations are made before ozonation. After 11 days the experiments were concluded and the specimens were examined for color, firmness, rot, and edibility. All specimens can be seen in the Appendix. This includes photos taken at the beginning of the experiment as well as periodic updates.

NOTE: The pears used were of two different varieties. The control pear was a Bartlett Green Pear and the experimental was a Bartlett Red Pear.

## Results

### Pears

All experimental specimens used in the procedure were still saleable after 11 days of room temperature storage. The only specimen that had any significant degradation was the pear. But, compared to the control pear located at the top of Figure 1, the deterioration is minimal. The pear was still firm and has very little noticeable browning on the outside. The only place browning occurred was at the bottom, where the damage can be seen in Figure 1. This started to develop around day 9 and is the result of water contact with the bottom of the pear. The fruit is still edible and firm. The chances of sale for this specimen are good.

The control pear was very mushy and had brown spots on the exterior. The skin pulls easily away from the fruit when cut open. The skin has taken on a brownish tint and would not be edible. It is doubtful that anyone would purchase this fruit. The specimen started to develop noticeable brown spots at day 5. After this point it is unlikely that the fruit would have been purchased.

At this point of comparison the pears differ greatly in appearance and feel. The control developed a soft feel after day 5. The experimental pear still retained its firmness except for the very bottom section until the end of the experiment.

### Apples

These two Gala apples were in similar condition at the start of the experiment. However, Mold developed and continued to grow on the control apple throughout the experiment. At day 4 the control apple started to deepen in color. At day 6, the control apple developed a noticeable brown spot around the area of mold around the top of the apple. On day 11, the control apple's brown spot had developed into a one-inch diameter dead spot. Upon internal examination, it was easily seen that the entire top part of the apple was browned and inedible. This spot was mushy and clearly had mold growing throughout. The damage mentioned can clearly be seen in Figure 2.

Both the control and experimental apples were still firm at the conclusion of the experiment. However, the experimental specimen was in much better shape and still looked as fresh as the day it was purchased. The color was the same as was the firmness and skin condition. The interior of the apple was in excellent condition. There was no browning or discoloration.

### Bananas

The bananas were both part of the same bunch and kept in similar environments. Throughout the experiment the bananas developed brown spots on the peel similarly. These spots were not excessive nor were they telling of overly ripe bananas. On the eleventh day, the bananas appeared similar externally. However, the control banana was noticeably softer than the experimental. Upon internal examination it was easy to see the difference between the two, as is evident in Figure 3.



**Figure 1: Pear comparison after 11 days. Lower pear is the experimental and upper pear is the control**



**Figure 2: Apple Comparison on Day 11. The top apple is the control and the bottom, the experimental**

There were several brown “bruises” on the control banana that are normally associated with an over ripe banana as well as a very developed dark spot at the top of the banana. The control banana broke in two when peeled to further denote a deterioration of the fruit.

The experimental specimen was free of bruising or spots and was firmer than the control banana. The experimental was noticeably whiter than the control with a nice sheen when freshly peeled. Even though they look similar externally, there is a big difference between the quality of these two specimens internally. The experimental banana is still very edible and desirable.

### Conclusions

As the experiment progressed, degradation in control specimens was evident externally. Mold developed on the control apple, the control pear became mushy and brown, and the banana became brown and splotchy. With periodic ozone exposure in low amounts fruit stored at room temperature retained its fresh appearance and qualities.

More experimentation needs to be conducted. This experiment was a small-scale foray and large-scale, directly applicable experimentation needs to be done. However, this experiment demonstrates the ability of ozone to retard the ripening process and prolong certain produce’s saleable shelf life. These experiments were not directly practical. However, the next set of experiments will use a one time large dose.



**Figure 3: Bananas at Day 11. Control specimen located on the left and experiment on the right**

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## Appendix



**Figure 4: Apple Control on the Left and Experimental on the Right at Day 1**



**Figure 5: Control Banana on the left and Experimental on the right at Day 1**



**Figure 6: Control Pear on the Right, and Experimental on the left at Day 1**

**Table 1: Data Collected Throughout the Experimental Process**

Day	Control Apple	Exp. Apple	Control Pear	Exp. Pear	Ctrl Banana	Exp. Banana
11-1-02 Day 1	Has dent on one side, lacks stem	Has dent on one side	Good shape with slight browning around a few damaged areas	Good shape with slight browning on bottom of pear	Still green on the ends but in otherwise good condition	Still green on the ends, but in otherwise good condition-has sticker
2	No Change	No change	No Change	No Change	Yellowing at ends	No Change
3	Slight loss of firmness, developed small amount of blue green mold on the top	No Change	No Change	No Change	Yellowing at ends	Yellowing at ends
4	Small amount of mold growth	No Change	Slight loss of firmness	No Change	Browning at ends, spotting	Yellowing at ends
5	Brown spot has developed on the top of the apple	No Change	No Change	No Change	Browning and spotting	Browning and spotting
6	Brown spot spreading. Loss of firmness around the top	No Change	Loss of firmness	No Change	No change	No Change
7	Brown spot continues to develop	No Change	Continued loss of firmness	No Change	More browning	More browning
8	Brown spot developed on other side of top of apple	No Change	Very mushy, no longer saleable	Still firm and marketable	No change	No change
9	Further loss of firmness on top	No Change	Continues to deteriorate	Brown spot has developed on the bottom	Further browning	Further browning
10	Further spot development	Very Slight loss of firmness	Browning fully developed on the exterior	Small patch of brown on the bottom	Further spotting developed	No change
11	Cut open to examine	Cut open to examine	Cut open to examine	Cut open to examine	Cut open to examine	Cut open to examine