

# ETHYLENE (C<sub>2</sub>H<sub>4</sub>)

**ETHYLENE IS A NATURAL PLANT HORMONE** It affects the growth, development, ripening, and senescence (aging) of all plants. It is normally produced in small quantities by most fruits and vegetables. Many fruits produce larger quantities of ethylene and respond with uniform ripening when exposed to an external source of ethylene.

**ETHYLENE HAS BEEN FOUND NOT HARMFUL OR TOXIC TO HUMANS IN THE CONCENTRATIONS FOUND IN RIPENING ROOMS** In fact, ethylene was used medically as an anesthetic in concentrations significantly greater than that found in a ripening room. However, ethylene is often targeted as the reason for difficulty in breathing in ripening rooms; what can affect some people is usually either:

- a) Carbon Dioxide (CO<sub>2</sub>) levels: CO<sub>2</sub> is produced by the ripening fruit in the room and levels increase over time, or
- b) Oxygen levels: The oxygen in the room when loaded is taken in by the ripening fruit. This sometimes will make breathing in a ripening room difficult. The increased CO<sub>2</sub> and decreased oxygen levels are the main reasons for venting the ripening room.

**ETHYLENE ACTION SLOWS AT LOWER TEMPERATURES** At their minimum temperature levels, fruit is basically inactive and does not respond well to externally supplied ethylene.

**ETHYLENE WILL PENETRATE MOST SUBSTANCES** In fact, it will permeate through produce cardboard shipping boxes, wood and even concrete walls.

**ETHYLENE IS HARMFUL TO MANY FRUITS, VEGETABLES AND FLORAL ITEMS** While ethylene is invaluable due to its ability to initiate the ripening process in several fruits, it can also be very harmful to many fruits, vegetables, flowers, and plants by accelerating the aging process and decreasing the product quality and shelf life. The degree of damage depends upon the concentration of ethylene, length of exposure time, and product temperature. One of the following methods should be used to ensure that ethylene-sensitive produce is not exposed: a) Ethylene producing items (such as apples, avocados, bananas, melons, peaches, pears, and tomatoes) should be stored separately from ethylene-sensitive ones (broccoli, cabbage, cauliflower, leafy greens, lettuce, etc.). Also, ethylene is emitted by engines. Propane, diesel, and gasoline powered engines all produce ethylene in amounts large enough to cause damage to the ethylene-sensitive produce items mentioned; b) Ventilate the storage area, preferably to the outside of the warehouse, on a continuous or regular basis to purge the air of any ethylene; c) Remove ethylene with ethylene absorbing filters. These have been proven in reducing and maintaining low ethylene levels. If ethylene damage is suspected, a quick and easy way to detect ethylene levels is with hand held sensor tubes. This will indicate if the above steps should be followed.

**ETHYLENE IS EXPLOSIVE AT HIGH CONCENTRATIONS** However, when using as directed the products of Catalytic Generators, reaching the explosive level is not possible. The explosive level is about 200 times greater than that found in ripening rooms. As a matter of fact, it would take 20 - 30 of the Easy-Ripe Generators on the highest setting in a one-load room to reach this level.

**ETHYLENE IS USED TO "DE-GREEN" CITRUS** This is a natural process that triggers pigment changes: the loss of green peel color by removing the chlorophyll, which allows the orange or yellow to fully cover the entire peel. No loss of flavor is caused; this is merely a continuation of the natural plant process.

## FAQs

**WHAT IS THE EFFECT OF ETHYLENE ON FRUIT RIPENING?** Ethylene can promote ripening in tomatoes, bananas, citrus, pineapples, dates, persimmons, pears, apples, melons, mangoes, avocados, papayas and jujubes - a clear indication that the action of ethylene is general and widespread amongst a number of fruits. It is clear that ethylene is a ripening hormone - a chemical substance produced by fruits with the specific biological phenomenon of accelerating the normal process of fruit maturation and senescence.

**IS ETHYLENE A HARMFUL COMPOUND OR TOXIC TO HUMAN HEALTH IN ANY WAY?** No! In fact, ethylene was used historically as an important anesthetic until less flammable compounds were developed. It is a colorless gas with a sweet ether-like odor. As an anesthetic, it was used as a concentration of 85% with 15% oxygen. Ethylene is a hydrocarbon gas and quite flammable and explosive at concentrations above about 3%. Remember, a non-toxic anesthetic for humans at a concentration of 85% or higher, yet as a fruit ripening hormone, ethylene gas is effective at 0.1 to 1 ppm. One part of ethylene per million parts of air that's one cupful of ethylene gas in 62,000 gallons of air - is enough to promote the ripening process in fruits.

**WHAT DO YOU MEAN "PROMOTE" THE RIPENING PROCESS?** Using tomatoes as an example, the life of a tomato fruit begins with fertilization of the flower ovules. After fertilization, the young fruit goes through a short period of cell division which is then followed by a rapid period of growth as these cells enlarge. During the final stages of growth and development, the tomato fruit reaches its full size and is now mature. This period of growth and development, from fertilization to development of the mature fruit, requires about 45-55 days, depending on the cultivar and the season. During the growth and development period, there are many chemical and physical changes occurring that have an impact on fruit quality and ripening behavior after harvest. Ripening is the final stage of the maturation process when the fruit changes color, and develops the flavor, texture and aroma that makes up what we define as optimum eating quality. The biological agent that initiates this ripening process after the fruit is mature is naturally produced ethylene - this simple plant hormone described and understood over 40 years ago. While there are other factors involved in this "triggering" of the ripening process by ethylene, it is essentially a universal ripening hormone. When this internal concentration of naturally produced ethylene increases to about 0.1 - 1.0 ppm, the ripening process is irreversibly initiated. The process may be slowed, but it cannot be reversed once it is truly under way. So, here is the key point: additional and externally applied ethylene, provided prior to the time that the naturally produced internal concentration reaches the required 0.1 - 1.0 ppm level, will trigger or initiate - "promote" if you will - this natural ripening process at an earlier time.

**DOESN'T THIS AMOUNT TO AN ARTIFICIAL PROCESS?** No! The additional externally applied ethylene (the "gassing" so frequently referred to in the popular press) merely accelerates the normal ripening process. Numerous studies have shown that there are no important biochemical, chemical, or physiological differences between fruit ripened where the naturally produced ethylene has been the triggering mechanism or where additionally externally applied ethylene has triggered the process in the mature but unripe fruit.

**NEVERTHELESS, DOESN'T THE USE OF ETHYLENE STILL ALLOW THE TRADE TO 'CHEAT' THE CONSUMER WITH AN INFERIOR PRODUCT?**

For example, tomato fruit are not and cannot be "artificially reddened" by ethylene. The normal tomato ripening process, which includes pigment changes - the loss of green chlorophyll and conversion of carotenoids into red lycopene pigments - can be accelerated and brought about earlier by externally applied ethylene, but this is a normal process. In fact, some of the components of nutritional quality, such as Vitamin C content, benefit because of the fact that the fruits will be consumed after a shorter time interval from harvest as a result of ethylene treatments and hence, the initial level will not have degraded as far as the longer, unaccelerated process. Ethylene is actually used commercially on only a few crops, including: (a) bananas, (b) for removing the green color from citrus fruits, (c) almost all honeydew melons, and (d) to a limited extent, with tomatoes.

**WHAT ARE THE FACTORS THAT RESULT IN THE POOR QUALITY TOMATOES WE OFTEN SEE ON THE MARKET?** Although many factors could be listed, there are four which play the dominant role in determining the quality of tomato fruits presented to the customer in the retail store: (1) variety; (2) maturity at time of harvest; (3) storage temperature during shipping and handling, and (4) physical damage.

Source: California Fresh Market Advisory Board, Informational Bulletin No. 12, June 1, 1976.