

Research Note :**ROLE OF CALCIUM COMPOUNDS AND ETHYLENE ABSORBANTS IN POST HARVEST LOSSES****Ravishankar M. Patil., Prashant Paramagoudar*, Abhishek Katagi* and K.S. Thippanna¹***University of Horticultural Sciences, Bagalkot, Karnataka, India*¹*College of Horticulture, Bidar***E-mail: payaprashant@gmail.com; abhishekkat121@gmail.com*

ABSTRACT : Since post harvest loss of fruits is one of the major problems in less availability of fruits, hence several methods are adopted to avoid that, from among them post harvest application of calcium compounds and ethylene absorbents are found to be the most effective, cheaply available and easily applicable methods for delaying fruit ripening & senescence and are also found to be effective in control of decay loss.

Keywords : Fruits, post harvest losses, calcium, ethylene, Fruits.

India is blessed with variety of agro climatic condition favouring the production of varied fruits. India has become to be the largest producer of fruits in the world but the recent survey shows that in India, about 50% of total fruits produced annually are being lost due to poor post harvest practices, which cause reduction in net per capita availability of fruits (Saraswathy *et al.*, 6). Hence it may not be necessary to step up production of fruits with growing demand if post harvest loss is reduced to a great extent. To reduce post harvest losses different methods have been tried out, among them use of calcium compound and ethylene absorbents is described here.

Post harvest loss

Loss of weight of wholesome edible product that is normally consumed by human.

Post harvest loss occurs in terms of :

- (i) **Economical loss** which refers to reduction in monetary value as a result of physical loss.
- (ii) **Quantitative loss** which includes reduction in weight by moisture loss and loss of dry matter by respiration.
- (iii) **Incidental loss** in terms of quality of food.
- (iv) **Qualitative loss** which refers to loss of consumer appeal.
- (v) **Nutritive loss** which includes loss in vitamins, minerals, sugars, etc.

Role of calcium in control of post harvest loss

The storage potential of fruits is largely dependent on the level of calcium. Any other nutrients, which disturb the calcium content also adversely affects the shelf life of fruits. The higher levels of N, P, and Mg and

low level of K and B leads to the calcium deficiency in fruits and reduce its storage life. Zn is known to act as a vehicle for carrying ion across the tissue and increases the calcium content of the fruit. Boron improves the mobility of Ca. Calcium treatment delays ripening and senescence (Arteca *et al.*, 1). Many physiological disorders of storage organs such as bitter pit in apple and cork rot in pear are related to low calcium content of the tissue.

Exogenous application calcium was found to be incorporated into protopectin molecules in the middle membrane and retards hydrolysis during post harvest ripening, inhibits fruits softening and extends storability of fruits (Bantash and Arasimovich, 3).

Since calcium is a constituent of cell wall and middle lamella, this association of calcium imparts a degree of resistance to decay by certain pathogens. The increased amount of calcium exogenously applied becoming localized in the cell wall, thus increasing the number of salt bridges, could account for the resistance of this tissue to maceration by fungal polygalacturonase and for resistance to pathogen like *Penicillium expansum* and *Botrytis cinerea* (Conway *et al.*, 4).

Ethylene

Ethylene is a colourless hydrocarbon with a sweetish odour that is easily detected in parts per million concentrations. It is widely used for ripening of fruits and destruction of chlorophyll.

Role of ethylene in control of post harvest loss

Ethylene is known as plant growth regulator in last 100 years but its effect have been known for centuries. The use of ethylene to hasten the ripening of fruits, for

example the ripening of mango in India in an atmosphere created by burning straw or in biblical times farmers scarified the skin of young sycamore figs to induce rapid growth and ripening of fruits.

Remarkable effect of ethylene was first noted when flammable gas was piped through out the streets of Europe. This gas contained added ethylene to ensure that lamps burnt with a yellowish flame. It was soon noticed that plants growing in the vicinity of Leaky pipes showed various abnormalities in growth and development such as premature leaf fall and death of the flowers. A Russian graduate student Neljubow (5), showed that the abnormal growth was due to ethylene.

Ethylene synthesis

The unraveling of the biochemical pathway of ethylene biosynthesis (Fig. 1) in plants has been one of the most interesting biochemical stories of recent years. Research in Europe and North America competed to find each step in the pathway.

Mechanism of action of ethylene

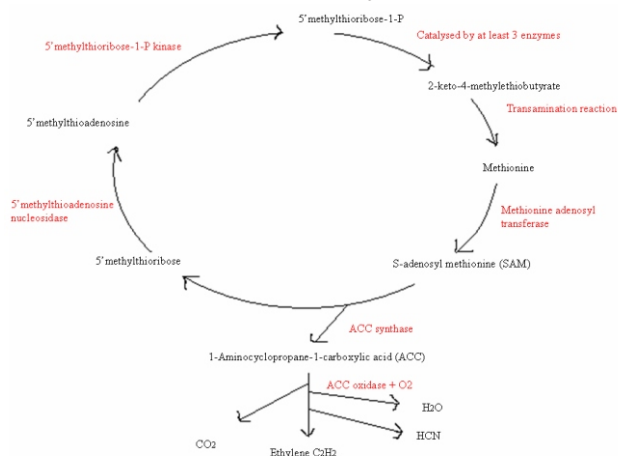


Fig. 1. Biosynthetic pathway of ethylene.

The favoured model is that ethylene binds to a protein, called a binding site, thus stimulating release of a so-called secondary message instructing the DNA to form mRNA molecule specific for the effect of ethylene (Fig. 2). The molecules are translated into protein by polyribosomes and the proteins so formed are the enzyme that cause the actual ethylene response.

Measurement of ethylene

Since available at minute concentrations (1ppm for fruit ripening) its measurement is an expensive process gas chromatography (\$7000-20000), flame ionization detector, laser-acoustic device and gas sampling tubes are used to measure the available ethylene in the atmosphere.

Source of ethylene in the environment

Burning agricultural waste, diesel and propane, truck and auto exhaust, cigarette smoke etc., could be named as the main sources of ethylene in the environment. Growing plant produce a small quantity of ethylene which is not enough to alter the environment.

Ambient atmosphere levels of ethylene are normally 0.001-0.005 ppm while in some urban areas up to 0.5 ppm has also been recorded.

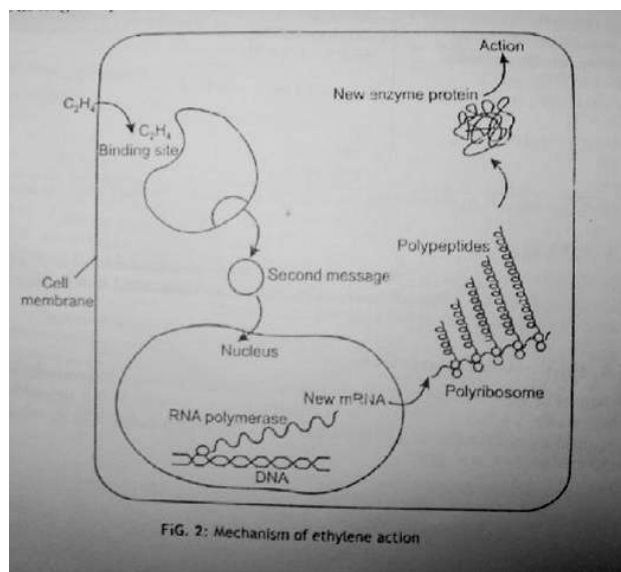


FIG. 2: Mechanism of ethylene action

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Undesirable effect of ethylene

- Accelerates senescence:** In green tissues, ethylene commonly stimulates senescence, as indicated by loss of chlorophyll and susceptibility to decay.
- Accelerates ripening:** Presence of ethylene in storage area reduces storage life.
- Induction of leaf disorders:** Ethylene causes many disorders in leafy vegetables, such as russet spotting in lettuce.
- Isocoumarin formation:** In carrots, ethylene exposure causes the biosynthesis of isocoumarin which makes the carrot bitter.
- Sprouting:** Ethylene stimulates sprouting of potatoes which leads to increase water loss and early shriveling.
- Abscission of leaves, flowers and fruits:** Abscission is most often a problem in ornamentals.
- Susceptibility to pathogen:** Ethylene accelerates senescence and enhances the opportunities for pathogen.

Overcoming undesirable effect of ethylene

Among the different methods tried, the removal of ethylene from the atmosphere around the commodity is the cheapest and most effective method.

1. Elimination source of ethylene : Such as avoiding loading and unloading operations of vehicles and engines in enclosed space.

2. Ventilation : where the out side storage area is not polluted one air change per hour is sufficient and could be provided by installing an intake fan and a passive exhaust.

3. Chemical removal :

- a. **Potassium permanganate:** It oxidizes ethylene to CO₂ and H₂O. Vermiculite, pumice and bricks are used to manufacture permanganate absorbers.
- b. **Brominated charcoal :** It could absorb ethylene from the air, it is mostly used in laboratories, as potassium permanganate absorbers are cheap and widely available.

Inhibiting the effects of ethylene

- a. **Modifying atmosphere :** Low oxygen and high carbon dioxide reduces ethylene production.
- b. **Use of anti ethylene compounds :** Anti-ethylene compounds such as silver thiosulfate (STS) and 1-methylcyclopropane (1-MCP) inhibits ethylene action (Asrey et al., 2)
- c. **Use of ethylene synthesis inhibitors :** Ethylene synthesis inhibitors such as aminoethoxy vinyl glycine (AVG) and aminoxyacetic acid (AOA), these inhibitors do not prevent the action of ethylene.

Commercial application in packaging

Most substances designed to remove ethylene from packages are delivered either as sachets that go inside the package or are integrated to the packaging material, usually a plastic film or the ink used to print on the package.

1. **Potassium permanganate based scavengers:** Potassium permanganate is not integrated into food contact packaging because of its toxicity; however sachets could be used inside produce packages and have been shown to effectively scavenge ethylene from the packages. Typically such sachets contain 4-6 % KMnO₄ on an inert substrate such as perlite, vermiculite and silica gel (Sihag et al., 7).

2. **Activated carbon based scavengers:** The Japanese company Sekisui Jushi has developed a product, Neupalon that is a sachet containing activated carbon and water absorbant capable of absorbing up to 500-1000 times its weight of water and 40 ml of ethylene per m².
3. **Evert-fresh** Corporation markets evert-fresh bags in the USA which is having ethylene absorbing capacity.
4. A new product called **frisspack** has been developed in Hungary for use in storage of fresh fruits and vegetables which is having the capacity of ethylene absorbing.

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