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# Artificial Ripening in Fruit Crops – A Boon or Bane

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## INTRODUCTION

Ripening is physiological maturity of an inedible plant organ into a visually attractive olfactory and taste sensation. Ripening makes the completion of development of a fruit and the commencement of senescence. It is normally an invisible event. Ripening is a result of complex changes, many of them probably occurring independently of one another. Ripening is associated with both the anabolic and catabolic processes. During ripening processes complex, multi structured compounds are broken into simple compounds.

Fruit ripening is a natural phenomenon that makes the fruit soft and sweeter. During ripening the fruits achieve desirable quality, flavour, colour, palatable nature and improvement in overall textural properties. Usually there is a decline in acid content and an increase in soluble sugar content with ripening. During the process of ripening starch is converted to simple sugars.

Artificial ripening would ensure a uniformly ripened fruit with excellent cosmetic/visual characteristics but there is compromise with nutrition value, organoleptic qualities and shelf life when compared with the naturally ripened ones.

### Understanding the need for artificial ripening

Artificial ripening is the process of

triggering the ripening process of an almost matured or fully matured fruit. Artificial ripening agents is known to hasten the ripening process. Artificial ripening concept emerged when man understood the need of transporting firm matured fruit at some distant place and initiate the ripening process after it has reached the destination. This is because transportation of firm fruits is not only economically beneficial but also renders minimum damage to the fruits. Another need for artificial ripening is to accelerate the ripening process during any particular event when the market price or requirement is high. For example, during Ganesh Utsav in Maharashtra or Durga Puja in West Bengal the demand for fresh ripened bananas is at its peak. The demand is such enormous that even supplies from adjacent districts and states are not enough. Then there comes the need for artificial ripening agents which can ripen the fruit during the peak requirement time. Hence, we can conclude from the above paragraph that artificial ripening is not the need of nature but the need for commercial horticulture where the seller usually applies ripening agent to trigger the ripening process. It also helps in synchronized harvesting of the fruits.

Parameters	Value
Temperature	18 - 25 OC
RH	90-95 %
Duration of treatment	24-72 hrs
Ethylene concentration	10 to 100 ppm
Carbon dioxide	< 1%
Air circulation	Sufficient enough for aeration but not too much to cause anaerobic damage to fruits

### Optimum condition for artificial ripening.

#### Some common artificial ripening agents

For artificial ripening of fruits, the application of ripening agents and chemicals are usually applied during pre-harvest stage, just after harvesting, transportation and storage. The stage of application ripening agents depends on the need of the seller. Discussed below are some artificial ripening agents seldom employed in artificial ripening.

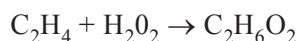
#### A. Ethephon/Ethrel

Ethephon is one of the most commonly used ripening hormones in India. It is a very common ethylene-generating chemical that is used in post-harvest treatments. Ethephon is chemically known as 2 - chloroethyl phosphonic acid with chemical formula  $C_2H_6ClO_3P$ . In India it is known by the trade names Floral and Cepa. The resultant ethylene produced is similar to that produced during ripening process. Ethephon is known to penetrate into the fruit tissues and decomposes to liberate ethylene gas. Government of India has allowed the use of ethephon for ripening of fruits as it is less harmful as compared to the other commonly used ripening agents. Ethephon is widely used for ripening banana, mango and other berries. Ethrel is the liquid form of ethephon where the fruits are needed to be dipped in ethylene solution.

Even though ethrel/ethephon application is safer as compared to other ripening processes but is known to produce organophosphate signs of toxicity. This includes lacrimation, muscle twitching, salivation and incoordination. Inhibition of red blood cells and cholinesterase are also observed in case of excess application. Excess exposure might lead to chest tightness, respiratory troubles, lung disorders and even loss of consciousness.

#### B. Ethylene glycol

Ethylene glycol is another low-cost ripening agent with chemical formula  $C_2H_6O_2$ . It is widely used as an artificial ripening agent. Ethylene glycol is cheaper as compared to gaseous ethylene. Ethylene reacts with hydrogen peroxide to form ethylene glycol



Ethylene glycol is not only cheap but it can be diluted with water and it can be used as a dipping treatment for fruit ripening. It shows efficacy of ripening even where temperature is low. The major drawback of Ethylene glycol is that it should be kept away from children as it is poisonous and might lead to kidney failure.

#### C. Ethylene ( $C_2H_4$ )

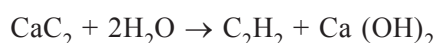
Ethylene is a gaseous ripening hormone of chemical formula  $C_2H_4$ . It is applied in fruits to trigger the ripening process. The gaseous hormone is very expensive is not commercially feasible for sellers. Ethylene in the range 0.1

to 1 ppm can trigger the ripening process. It is a safe ripening agent according to FDA and government of India as well. For artificial ripening, ethylene is blowout using catalytic generators in a closed chamber under controlled temperature and relative humidity. Ethylene generators can also be used. Ethylene is known to trigger rate of respiration thus causing denaturation of chlorophyll, synthesis of anthocyanin and carotene, increase in sugar content, decline in titratable acidity and cell wall softening. Ministry of Agriculture, GOI have suggested an application of 10-100 ppm exogenous application of ethylene to be sufficient to trigger the ripening process.

#### D. Calcium carbide (CaC<sub>2</sub>)

Calcium carbide is a chemical compound of chemical formula CaC<sub>2</sub> which is known to produce acetylene and calcium cyanamide at controlled conditions. In particular temperature and in presence of sufficient moisture produces acetylene gas which acts as a ripening agent.

Acetylene is another ripening gas which (that) is produced during the process. The intensity of colour development in CaC<sub>2</sub> ripened fruits depends on concentration of CaC<sub>2</sub> used. The fruits ripened using calcium carbide is of good colour but is poor in terms of flavour, taste and palatability.



10 tonnes of fruit can be ripened using 1 kg of Calcium carbide which costs near about Rs. 25-30. The use of Calcium carbide (CaC<sub>2</sub>) as a ripening agent is banned in many countries including India. Till then it is used extensively by local sellers. Fruits ripened by Calcium carbide (CaC<sub>2</sub>) can be extremely hazardous as it is known to have traces of phosphorous and arsenic. Acetylene gas is also known to affect the neurological system due to prolonged hypoxia. Excess exposure might cause immediate adverse effects like diarrhea, vomiting, burning sensation of chest, weakness, trouble in swallowing, irritation in eyes, shortness of breath. This is the

#### Quality comparison between naturally ripened and calcium carbide ripened fruits

Parameters	Naturally ripened fruit	Using Calcium carbide
Weight per fruit	Good	Fair
Aroma Excellent	Good	
Taste Sweet	Slightly less sweet Usually starchy	
Firmness	Optimum	Fair
Texture	Less attractive but somewhat uniformly coloured	Uniformly coloured
Shelf-Life	Longer	Short – Initiation of blackening in 2-3 days

reason why it is banned according to the rule 44AA of the Prevention of Food Adulteration Rules 1955.

#### Regulations to prevent hazardous artificial ripening

Not all artificially ripened fruits are not hazardous. But the consumption of fruits

ripened by using artificial ripening agents like Calcium carbide can be catastrophic. Government has banned the use of Calcium carbide as a ripening agent. But till then at local level the user is not yet stopped. Most of the sellers are using the harmful chemical due to lack of awareness but some of the sellers

### Comparison between ethylene and calcium carbide based artificial ripening

Aspects	Ethylene-based	Calcium carbide
Legal	It is approved by WHO and FDA and is unanimously accepted	Totally illegal and banned in many countries. In India its application is punishable under law
Quality of produce	Excellent taste and aroma	Dry texture, poor aroma and poor taste
Health	Safe and Natural	Highly carcinogenic and can cause multiple organ failure
Shelf-Life	More	Less
Market demand	Increasing due to public awareness	Low (with increasing awareness)
Weight Loss	Low (<7%)	High (>13%)
Transport losses	Takes longer period to soften	Softens in 2-3 days
Ripening costs	Rs.5 per 10 Kg (approx)	Very cheap

are applying Calcium carbide quite intentionally due to its cheap price. There should be restriction in selling and buying of Calcium carbide at grass root level can stop the use of Calcium carbide. Awareness and training at wholesaler, retailer and local shopkeeper level should also be organized. The use of Calcium carbide is banned in our nation but awareness at consumer level is also important. Consumers should avert buying homogeneously ripened glossy attractive fruits as they might be ripened by Calcium carbide. Naturally ripened fruit have patches, spots and green spots as well. For second time precautions consumers should wash the fruits with cold water or baking soda solution before the consumption of any fruits purchased from

the market.

#### Conclusion

Artificial ripening technology of fruits is a boom for our society as it has several positive aspects. But along with numerous positive aspects there are also some dark sides of artificial fruit ripening. The use of hazardous chemicals like Calcium carbide can be dangerous for our society. Hence it can be concluded that ripening of fruits using safe chemicals that are non-hazardous to human health can boost commercial horticulture. But the use of carcinogenic chemicals should be totally avoided for safety of future generations.

