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## Bitter truth about fruit with reference to artificial ripener

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### ABSTRACT

*In the haste to fruit ripening chemicals and ripening agents are used by retailers and farmers. There are about fifteen (or more) artificial ripener available and practiced on one or other fruits. Natural taste and nutritional value become a casualty of the process but there is no system to check. Artificial fruit ripening is illegal but also practiced regularly and most of them are banned. These agents or chemicals create health problems which are discussed in the article. These chemicals showed several adverse effects on human health hence precaution or control should be needed. The author is not claimed the original work but also collective from refereed resources.*

**Keywords:** Fruits, artificial ripener, chemicals, adverse effect, toxicity.

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### INTRODUCTION

The fruits are sweet or sour and edible in the raw or mature. On the biological sense the fruit includes many structures that are not commonly called fruits, such as bean pods, corn kernels, wheat grains, and tomatoes [1, 2]. Humans and other animals have dependent on fruits as a source of food [3]. The fruits are sweet-tasting plant product, those associated with seeds, plant product and shelled plant product [4]. Fruits are contained fiber, water, vitamin-C and sugars [5]. They also contain minerals, salts, protein, cellulose and various photochemical which protect human body against various disorders. Regular consumption of fruit is associated anti- cancer, reduce risk of cardiovascular disease, stroke, Alzheimer, cataracts and some of the functional declines aging.

Human diet does not need an enzyme contained in fresh foods. Our digestive tract, organs and cells produce enzymes to help for digestion of food and absorb nutrients [6]. The fresh foods can provide us some active enzymes that can function in our digestive tract [7]. They may give digestive benefits but it has not seen research evidence to confirm them. It is indeed to think about enzyme supplement, natural foods and as part of a medical rather than a dietary [8].

Ripening of fruit is a natural process and become sweeter, less green and soft. The acidity of fruit also increases as it ripened. The higher acidity level does not make the fruit taster. It is misunderstanding because it attributed the Brix-Acid Ratio. They allow many fruits to be picked prior to full ripening, which is useful. For example, bananas are picked when green and artificially ripened with specific ripener. The antioxidants found in fruits help eliminate free radicals, carcinogenic by-products from metabolic processes.

With respect to fruits and ripeness, the enzyme of a fruit is constantly changing. Once harvested, a fruit's chemistry will change, including its enzyme chemistry. Some fruits will continue to ripen after harvest and some will not. As a fruit ripens, changes are occurred in enzyme composition and activity. In general, foods are best harvested and consumed fairly close in time to ripening. Consuming raw and cooked fresh foods is a good [6].

Today, it is much concern about artificial ripening of fruits. Fruits naturally ripen in trees. But some chemicals or agents are also used for artificially ripening process by traders, farmers, transporters. Generally 80% fruits are

artificially ripened through ripening agents. Ripped fruits are not suitable to carry and distribute. So traders pick unripe fruits and use certain methods to increase the ripening process. But inappropriate uses of these chemicals are associated with many health hazards.

The fruits and vegetables are the important energy sources to the human body and it is universally recognized. Here are the some fruits used in human diet as Oranges, Raspberries, Plums, Grapes, Apples, Prune, Raisins, Blueberries, Blackberries, Strawberries, Cranberries, Tomatoes, Mangoes, Bananas, Jambu, Figs, Lemons, Pomegranate, Currants, Morello cherries, Citrus, Figs, Sugar beet, Fodder beet, Coffee, Capsicum, Wheat, Coffee, Tobacco, Cotton, Pineapple, Rice Avocados, Bananas, Melons, Peaches, Pears, Broccoli, Cabbage, Cauliflower, Leafy Greens, Lettuce, etc.

#### **Artificial ripeners:**

The chemicals or agents are used to ripe fruits as early as artificially. Nowadays, several artificial ripeners are available and used such as calcium carbide, acetylene gas, carbon monoxide, potassium sulfate, ethephon, potassium dihydrogen orthophosphate, putriscin, oxytocin, photoporphyrinogen, etc. They are used during pre-harvest, postharvest, transportation, capping, storage, etc. However there are about 15 artificial ripeners. They accelerate fruits for ripening and induce color changes [9]. Although the market quality of such artificially ripened fruits are found to improve [10]. But what about ingredient present in fruits and its changes? Artificial ripening processes are used in parts of Asia and all over world.

Artificial ripener reported several effects including memory loss, cerebral edema [11], 2007), colonic, prostates and lung cancer, quick-buck syndrome [10], DNA, RNA and hematological changes [12, 13]. Artificially ripened fruits lead to germinate bacteria, fungus and viruses which can cause diarrhea, peptic ulcer and other diseases. No steps have been taken so far to keep a check on it. However, no inspection or control has been done so far on artificial ripening. Following are the some artificial ripener commonly used and discussed as below.

**Calcium carbide:** It is a chemical compound ( $\text{CaC}_2$ ) used in the production of acetylene and calcium cyanamide [14]. Acetylene is believed to affect the nervous system by reducing oxygen supply to brain. The pure  $\text{CaC}_2$  is colorless but technical-grade  $\text{CaC}_2$  are grey or brown and consist only 80-85% of  $\text{CaC}_2$  (the rest is  $\text{CaO}$  (calcium oxide)). It is used in carbide lamps. However, carbide lamps are still used extensively in slate, copper and tin mines. It is still used for mining in some countries. Carbide lamps were also used as headlights in early automobiles, motorcycles and bicycles [15]. In the ripening process of fruit,  $\text{CaC}_2$  is sometimes used as source of acetylene gas [16]. It is also used in toy cannons and self-igniting naval signal.

$\text{CaC}_2$  is also used for ripening of fruit. It reacts with water to produce acetylene [17], which acts as an artificial ripening agent.  $\text{CaC}_2$  may contain traces of arsenic and phosphorus which concerned about human health [18]. A deadly chemical, calcium carbide is used widely across the country to artificially ripen fruit, is risky to the health of consumers. Some fruits such as Mangos, Bananas, Apricots, Papayas and Plums are found to have been treated with calcium carbide. This hazardous and carcinogenic chemical creates short-term and long-term health problems [17]. Early symptoms of arsenic or phosphorus exposure include diarrhoea, thirst and irritation in the eyes, mouth, nose and throat. Chronic exposure to the chemical could lead to peptic ulcers [19].

Calcium carbide has carcinogenic and neurological disorders properties. It can result in tingling sensation, numbness and peripheral neuropathy. If pregnant women consume fruit ripened with carbide, the children born could develop abnormalities [17]. The use of calcium carbide is not only toxic to consumers, but it is also harmful to those who handle it. It affects the neurological system, resulting in headache, dizziness, mood disturbances, sleepiness, mental confusion and seizures on a short-term basis, while in the long-term it can cause memory loss and cerebral oedema [17].  $\text{CaC}_2$  decreased Hb, RBC, WBC, PVC, and some blood indices [20,21], alter DNA, RNA and protein [11,12,21]. The study revealed that calcium carbide alters blood indices in exposed rabbit as compared to control. The Hb level, RBC counts, PCV get reduced in exposed animal and MCV, MCH and MCHC were found to be raised in the toxicity animals [22].

**Ethephon:** Ethephon ( $\text{C}_2\text{H}_6\text{ClO}_3\text{P}$ ) is mostly used as plant growth regulator. It is formed by the metabolism of the plant and converted into ethylene. It is used on Wheat, Coffee, Tobacco, Cotton, Pineapple and Rice for an early maturity. Cotton is the most important crop on which ethephon applied. It initiates fruiting, promotes early boll opening and enhances defoliation. It is also sprayed on mature-green Pineapple fruits to de green them to obtain marketing requirements. It acts as growth hormones and fertilizers. The toxicity of ethephon is actually very low [23] and ethephon used on the plant is converted in to ethylene [24].

Ethephon is available in market as a common name ethereal and used as pre-harvest ripener in Mango, Pineapple, Coffee, Tomato, Cucumber, Groundnut and Rubber [17]. It reported toxicity, flammability, destructive, self-reactive and incompatible with water oxidizing and other symptoms.

Ethephon (organophosphate) produces organophosphate-like signs of toxicity including salivation, lacrimation, urination and defecation. These toxic signs occur in experimental animals at high doses of exposure. The most sensitive indicator of exposure to ethephon is the inhibition of red blood cell and plasmacholinesterase. In toxicity studies, ethephon caused developmental effects, only at doses greater than those which caused maternal toxicity. In a reproductive toxicity test, offspring effects occurred at similar doses to those causing parental toxicity. Ethephon did not produce oncogenic or delayed neurotoxic effects when tested on rats, mice and hens. Acute and subchronic exposure of rats to ethephon did not produce neurobehavioral or neuropathological effects. It is rapidly absorbed from the gut and eliminated in the urine with minimum metabolic transformation [25].

**Ethylene:** Ethylene ( $C_2H_4$ ) is a ripening hormone produced by fruits with the specific biological action of accelerating the normal process of fruit maturation and senescence. It can promote ripening in Tomatoes, Bananas, Citrus, Pineapples, Dates, Pears, Apples, Melons, Mangoes, Avocados and Papayas. Ethylene is a daughter of ethyl ( $C_2H_5$ ). Ethylene is plants hormone [26], It acts as stimulating or regulating the ripening of fruit. Crockerin [27] reported that it is plant hormone responsible for fruit ripening. It is produced in all parts of higher plants, including leaves, stems, roots, flowers, fruits, tubers and seedlings. The production is regulated by environmental factors such as flooding, drought, chilling, wounding and pathogen [28]. It can cause significant economic losses for florists, markets, suppliers and growers [29]. Some time it acts as anti ripener and delay ripening process for example Chrysanthemum flowering is delayed by ethylene gas [30]. Ethylene is harmful which cause damage to the neurological system, affects the eyes, skin, lungs, memory and leads to prolonged hypoxia. It is a plant growth regulator.

**Oxytocin:** Oxytocin is a mammalian neurohypophysial hormone. It played roles in parturition. It is released after distension of the cervix and uterus during labor, facilitating birth, maternal bonding and after stimulation of the nipples (breast feeding). The childbirth and milk ejection result from positive feedback mechanisms [31]. Lee [32] reported oxytocin's role in various behaviors including orgasm, social recognition, pair bonding, anxiety and maternal behaviors. Hence it is known as the love hormone. The inability to secrete oxytocin and feel empathy is linked to sociopathic, psychopathic, narcissism and general manipulateness [33]. There are some evidences that oxytocin promotes 'tribal' behavior, incorporating the trust and empathy of in-groups with their suspicion and rejection of outsiders, in individuals with autism spectrum disorders [34]. The Oxytocin is mispractised in melon, cucumber and also lactitating mammals and even prostitution (Not technical support or reference are not available).

**Acetylene:** Acetylene ( $C_2H_2$ ) is the chemical compound. It is a hydrocarbon and the simplest alkynes [35]. This colorless gas is widely used as a fuel and a chemical building block. It is unstable in pure form and thus is usually handled as a solution [36]. Pure acetylene is odorless but commercial grades usually have a marked odor due to impurities. Acetylene used in making a variety of polyethylene plastics, welding and involve its conversion to acrylic acid derivatives [36]. Acetylene is used for oxyacetylene gas welding and cutting, burning common fuel gas, illumination, including street lighting, carbide lamps, in radiocarbon dating.

Acetylene is not toxic but when generated from calcium carbide it can contain toxic such as phosphine and arsine [37]. Acetylene is a simple asphyxiant. Symptoms of exposure include dizziness, headache, fatigue, tachycardia, tachypnoea, nausea and vomiting. Exposure to high concentrations may cause loss of consciousness and death [38].

**Putrescine:** It is a pre-harvest ripener and used on early-, mid- and late-season maturing Japanese plum fruit. The putrescine (PUT) reduced the respiration rate and ethylene production. PUT application reduced the fruit softening, soluble solids content, titratable acidity ratio, and the levels of ascorbic acid, total carotenoids and total antioxidants in all plum cultivars. Pre-harvest application of PUT delayed the fruit ripening with reduced respiration rate, ethylene production, and activities of enzymes, levels of ascorbic acid, total carotenoids and total antioxidants in Japanese plum [39]. A putrescine displayed a behavioral pattern that included wet dog, male rat, shakes and motor in co-ordination. The concentration of PUT in the brain paralleled the severity of clinical signs. Histological examination showed the presence of perivascular edema and moderate spongiosis [40].

**Aminoethoxyvinylglycine:** Covering apple fruits with double layer waterproof bags to enhance fruit quality and evenness of blush color in Korea and Japan. Aminoethoxyvinylglycine (AVG) applied to unbagged apple fruits at 3-4 weeks before commercial harvest reduces ethylene production in the fruit, delays fruit ripening and reduces pre-harvest fruit drop. It applied to trees of bagged apples reduced pre-harvest fruit drop in apples [41].

Aminoethoxyvinylglycine (AVG) inhibits 1-aminocyclopropane-1-carboxylic acid (ACC) synthase, and thus blocks ethylene synthesis. Pre-harvest foliar application of AVG to apple fruit retards several key events of maturation including climacteric ethylene production, starch conversion to sugars, fruit softening, and abscission zone development. AVG applied four weeks prior to harvest significantly reduced internal ethylene levels, amylase degradation, and accumulation of sucrose, glucose and sorbitol [42].

**Carbon monoxide:** The carbon monoxide (CO) is also used on various fruits for ripening. Carbon monoxide is a colorless, odorless and tasteless gas that is slightly lighter than air. It is toxic to humans and animals. It is also produced in normal animal metabolism in low quantities and has some normal biological functions. In the atmosphere it is spatially variable, short lived, having a role in the formation of ground level ozone. In biology, carbon monoxide is naturally produced by the action of hemoxygenase 1 and 2 on the heme from hemoglobin breakdown. This process produces a certain amount of carboxyhemoglobin in normal person. It is a normal neurotransmitter [43,44]. In tissues gases are known to act as anti-inflammatory, vasodilators and promoters of neovascular growth [45].

Carbon monoxide poisoning is a fatal. It combines with hemoglobin to produce carboxyhemoglobin, which affect on oxygen carrying capacity. Concentrations as low as 667 ppm may cause up to 50% of the body's hemoglobin to convert to carboxyhemoglobin [46]. A level of 50% carboxyhemoglobin may result in seizure, coma and fatality. The common symptoms of carbon monoxide poisoning are headache, nausea, vomiting, dizziness, fatigue and a feeling of weakness. Neurological signs include confusion, disorientation, visual disturbance, syncope and seizures [47]. Carbon monoxide binds to myoglobin and mitochondrial cytochrome oxidase. Exposures to carbon monoxide may cause significant damage to the heart and central nervous system [48]. Carbon monoxide may have severe adverse effects on the fetus of a pregnant woman [49].

**Potassium dihydrogensulfate:** It is soluble salt which is soluble in water. It is commonly used in fertilizers, providing both potassium and sulfur [14]. The mineral form of potassium sulfate, arcanite is relatively rare. Natural resources of potassium sulfate are minerals abundant in the Stassfurt salt. These are co-crystallizations of potassium sulfate and sulfates of magnesium calcium and sodium [50]. The potassium sulfate ( $K_2SO_4$ ) is as a fertilizer, does not contain chloride, which can be harmful to some crops. Potassium sulfate is preferred for the crops such as tobacco, some fruits and vegetables. Crops which are less sensitive may still require potassium sulfate for optimal growth if the soil accumulates chloride from irrigation water [51]. Monopotassium phosphate (also potassium dihydrogen phosphate, or monobasic potassium phosphate, MKP)  $KH_2PO_4$  is a soluble salt which is used as a fertilizer, a food additive and a fungicide. It is widely used in additive in food, rubber, pharmaceuticals, food packaging, lubricants, paints and coating, paper and pulp industry, diluents, fragrances, and flavor [21]. It is also a buffering agent, when used in fertilizer mixture with urea and ammonium phosphates, it minimizes escape of ammonia by keeping the pH at a relatively low level. It also acts as an artificial ripener and traders use it for ripening.  $KH_2PO_4$  causes health hazards such as diarrhea, nausea, vomiting, cramps, and slow heartbeat; accelerate breathing, muscle weakness, paralysis. It also influenced on biochemical such as proteins, glycogen, calcium, cholesterol, and bilirubin [52].

**Some herbicides:** Chemical ripening of sugarcane is an important component to profitable sugar production in the United States as well as other sugarcane industries throughout the world. Harvesting of sugarcane often begins before the sugarcane reaches the desirable maturity level [53]. Research on the application of chemicals, mostly of herbicide origin, to enhance sucrose accumulation (ripening) or limit flowering to conserve stored sucrose has been conducted for more than 60 yr. The herbicide fluzifop is used as the primary ripener of sugarcane in South Africa. The herbicides glyphosate, fluzifop, and sulfometuron-methyl and the growth regulators ethephon, photoperphyrinogen and trinexapac-ethyl are registered for use in Brazil [54].

**Ethrel:** Premature banana were dip treated with different concentrations of ethrel to induced uniform ripening. Untreated control banana fruits remained shriveled, green and failed to ripen even after 8 days of storage. Fruits treated with ethrel ripened in 6 days at  $20 \pm 1^\circ C$ . But showed changes in total soluble solids, acidity, total sugars and total carotenoids increasing trends up to 6 days during ripening. The fruit shear force values; pulp pH and total chlorophyll in peel showed decreasing trends. Sensory quality of ethrel treated banana fruits (fully ripe) was excellent with respect to external color, taste, flavor and overall quality.

**Natural ripening:** It is the process of ripening, in which the starch in the fruit breaks down to sugar. Amylase which hydrolase starch to produce simple sugar and pectin which hydrolase pectin substances that keeps fruit hard. The fruit skin color changes green to bright red or yellow. These changes attract birds, animals and consumers. The ripening of a fruit depends on the season. The skin cells start making pigments which give color to fruit [55].

Ripened fruits cannot be stored and transported for a long time. Hence farmers pluck the fruits raw. The natural ethylene in the fruits makes them ripen, so that they are ready to eat by the time you buy them. Sometimes the fruits are not yet ripped when they are sold. Hence they have to be artificially ripened. There are several processes for ripening of fruits, and each and every fruit has a separate and specific process of ripening. Several ripener reacts with moisture to form acetylene. So why not buy organic fruit when you can, and enjoy its taste in full. The brief spell of pre-monsoon rain had enhanced the richness of color and taste of mangoes waiting to be harvested.

The high temperature ( $>40^{\circ}\text{C}$ ) and ultra violet (UV) rays damage the color pigments and taste of mangoes. So, it is not fit to eat until rains set in. Once it rains, the fruit becomes rich in color and flavor and thus becomes fit to eat. The practice of artificial ripening of mangoes is rampant in the mango growing region. The artificial ripening of mangoes is going on in the consumer market and no one can differentiate whether the mango is ripened with artificial or the natural or traditional method. Farmers harvest the mangoes as early the fruits attain maturity. The immature mangoes are supplied to far off places. Once the fruits reach sellers, they keep packets of carbide in the cartons, which change the color and size of the mango and it ripens artificially as soon.

The chemically ripened mangoes are harmful for liver, kidney, heart and stomach. Carbide is a hot compound and it destroys the sugary content and other nutrient before mango goes into the human body. The traditional ripening methods by putting layers of leaves with mangoes and covering the fruits covered with hay is not at all harmful. It can be adopted by vendors and retailers [56].

Fresh figs are very attractive but providing high quality fig fruit is a challenge. Fruit harvested too ripe has an extremely short postharvest life due to ethylene-induced over ripening. The inhibitor of ethylene action has been used successfully in various plant species to arrest the plant's response to elevated internal ethylene level. It has been used in figs as a postharvest treatment, but it only partly slowed the ripening [57].

Post harvest as water guava or water apple, a tropical fruit that is cultivated and grown throughout Malaysia. This due to the fact that when fruits are removed from the trees and plant it starts to age and ripen and is also naturally susceptible to damage. This is also true for fruits that fall to the ground. These injuries give rise to bruises, punctures and splits. Fruit growth and development involves many changes to its morphology, anatomy and physiology and biochemistry [58]. When a fruit matures the changes associated with changes in texture, juice composition and taste [59]. Thus the post harvest physicochemical characteristics of the fruits are important. In most fruits there is a change in firmness during ripening and the softening process which begins whilst the fruits are on the tree continues during harvesting, handling and storage [60-62].

To prospective consumers the appearance of the fruit can have a great influence and is an important determining factor. The relationship between color and degree of maturation in many fruits have been widely studied, such as in tomatoes [63], peaches, and nectarines [64] and is well documented. Water content is another parameter that affects fruit quality and during ripening. Other physiological factors are also important in ripening of fruit such as total soluble solids (TSS), organic acids, sugar to acid ratio and the flavor of fruits. Furthermore, pH and mineral composition may also affect the catalytic activity of cell wall enzymes and have effect on anthocyanin stability and color expression [65-67]. An important category of naturally occurring chemicals in fruits and vegetables are antioxidants as they have the potential to reduce the risk of free radical related health problems [68].

**Ripening indicators:** Iodine (I) is used to determine whether fruit is ripening, whether the starch in the fruit has turned into sugar. A drop of iodine on a slightly rotten part of an apple will turn a dark-blue or black color, since starch is present. If the iodine is applied and takes 2-3 seconds to turn blue/black, then the process has begun but is not yet complete. If the iodine stays yellow, then most of the starch has been converted to sugar.

**Skin color:** During fruit ripening, peel color is an important characteristic which is one of the major criteria used to determine whether a fruit is ripe or unripe [69]. Maturation of fruit is accompanied by a series of the physiological and biochemical changes [70]. It is due to the carotenoids or anthocyanin present in the skin [71] and change in sugar concentration are used up for respiratory purposes during storage [62]. It is a relationship between fruit weight and volume of the fruit [72]. The density of starch is very much higher than the density of the sugars. Density of more mature fruit is usually higher. The increase in weight is generally due to the increase in water content and during the storage weight loss increased after each period of storage [73,74] that it could be due to the water loss and leads to higher concentration of sugars in fruits [62,75].

**Pulp firmness:** Firmness is used as a ripeness test for many fruits. The firmness is effective for evaluating fruit maturity as the fruit ripens [76]. It has been reported from Clementine and peaches that firmness can be used as a

maturity index [73] and also to determine the period harvested and good quality after transport. Pulp firmness decreases while increasing ripening as the pectin content decreases [77].

**Total Soluble Solids (TSS):** It is an important quality factors for many fresh fruits because solids include the soluble sugars- sucrose, glucose fructose and acids [78]. Increase of TSS is due to the hydrolysis of starch to soluble sugars [77,79,80]. During ripening and softening process starch is broken down in to the simple soluble sugars and soluble pectin which increases fruit softening [81].

**Titrateable Acidity (TA):** It has been suggested that during storage, fruits utilize organic acids for metabolic activities and resulted in a decrease in the titrateable acidity. Various organic acids have been reported in fruits and which included citric, malic, acetic, fumaric, tartaric and lactic acids [82]. The decrease in acidity is coincided with an increase in sugar concentration in the pomegranate fruits. Kulkarni and Aradhya [83] reported that a slow decrease in acidity, with increased TSS and total sugar content, is an intrinsic process during ripening of fruits to impart the flavor.

**Total Phenol Content (TPC) and Total Flavonoid Content (TFC):** TPC is similar or less than blue berries, dogwood berries, sour cherry and black berry, more in plum and black grape. The amount of TFC is more in apple, yellow, fig and sweet cherry. From these data it can be seen that the *jambu air* fruits is rich in total phenolics and flavonoids. Marinova [84] has suggested that TPC and TFC were increased during storage. Changes in TPC and TFC during fruit ripening have been associated with pigment development of anthocyanin in fruit tissue [85] and increase in fruit color [70,86].

**Radical scavenging activity:** However the antioxidant activity always correlated with the total phenolic and flavonoid content in the fruits. It indicated that the phenolic and flavone compounds could be the main cause of antioxidant in the fruit [87]. Recently Kulkarni and Aradhya [83] reported from pomegranate juices showed higher ascorbic acid values attributed the increase to a higher concentration of anthocyanin pigments. The amount of total phenolics and chlorogenic acid in the fruits decreased during storage. The browning potential closely correlated with the enzyme activity, but not with the phenolic content [88, 89].

**Impact of artificial ripener:** Fruits and vegetables are highly nutritious and key food of the human. They are highly perishable due to their low life. These food materials are reported to be contaminated with toxic and health hazardous chemicals. Chemicals like calcium carbide, ethephon and Oxytocin are reportedly being used in fruit and vegetable for artificial ripening of fruits and for increasing the size of fruits and vegetables [90]. Calcium carbide is commonly used and banned under PFA Rules, 1955. Ethephon is a pesticide and it is not recommended as a ripening agent. Oxytocin is a mammalian hormone, used in veterinary services which are not advised for fruits and vegetables.

Chemicals used for artificial ripening of fruits can cause cancer. The IARC (International Agency for Research of Cancer) has listed a number of chemical agents or pesticides that can cause cancer. Public health authorities should look at more stringent enforcement of rules to prevent the hazardous practice of artificial ripening on various fruits and vegetables. Concerned authority should caution against illegal practices followed by fruit vendors. The artificial ripeners are growth promoters, regulators, hormones, internal chemicals, fertilizers, insecticides, or herbicides, etc. Ethephon, an insecticide is another chemical used for the purpose. Some vendors also resort to burning kerosene stove or incense sticks in closed rooms to quicken the process of ripening.

No one shall sell or offer or expose for sale or have in his premises for the purpose of sale under any description, fruits which have been artificially ripened by use of acetylene gas. Ministry of Agriculture (MoA) has clarified that the fruits are exposed to ethylene gas in low concentration to trigger their ripening. It is considered safe in the low concentration (0.001-0.01%) depending upon the crop, variety and maturity. There is no specific provision in PFA for ripening agents. PFA prohibits use of colors in fruits and vegetables. As per rule (48-E of the PFA Rules, 1955), fresh fruits and vegetables shall be free from rotting and also from coating of waxes, mineral oils and colors. However, there is provision for coating fresh fruits with food additive viz. bee wax (white/yellow) carnauba wax or shellac wax as glazing agent in accordance with the Good Manufacturing Practice for use of food additives under proper label declaration.

Pesticide residues, crop contaminants, naturally occurring toxic substances and heavy metals are the major contaminants in fruit and vegetables. Pesticides are used in IPM in Agricultural and Horticultural crops. Heavy metals are present in the irrigation water and other manures. Infested seeds, irrigation water and soil act as the source of the fungal toxins. Pesticides can leave adverse effects on the nervous system, diseases like cancer, liver, kidney, and lung damage. Certain pesticides also cause weight loss, appetite, irritability, insomnia, behavioral

disorder and skin problems. Heavy metals also cause adverse effect in human metabolic system, skin diseases, heart problems, etc.

Consuming seasonal fruits is the best ways to stay healthy. Dieticians advise to keep diseases away. But, how it is not possible because artificial agents are practiced which is concern carcinogenic agents. Indian families prefer carbohydrate-rich food and do not include adequate quantity of raw vegetables and fruits in their diet. Fruits like water melon, mangoes, plums, musk melon and jackfruit should be included in our diet during summer [91].

Water melon is rich in fiber and prevents dehydration, while mango serves as a source of nutrition which could replace diet supplements. Plum is rich in minerals and iron. Fruits contain plenty of fiber, which cleanse our system by getting rid of waste and toxins, keep bowel movements regular and prevent diseases like cholesterol, bowel cancer and diverticulosis. As for the nutritional content, the experts say that it is best to consume fruits in raw form which prevents loss of nutrients.

The antioxidants found in fruits help eliminate free radicals, carcinogenic by-products from metabolic processes, reducing the risk of cancer. Even while emphasizing the importance of seasonal fruits in diet ensure they are safe for consumption.

Artificial ripening of fruits is commonly reported. Though safer methods of ripening fruits are allowed in other countries, accordingly Food Safety and Standards Act, 2006 (Rules 2011) totally bans the practice of ripening of fruits in India. The road-side vendors are sensitized on hygiene aspects and are also directed to keep food covered and to supply them in closed containers. It is also important to ensure that the equipment used by fruits and fruits juice vendors are kept clean and maintained well.

The Prevention of Food Adulteration (PFA) Act, 1954 and 1955, both ban artificial ripening. Food adulteration has become common practices that the Departments of Health and Agriculture must check the practice. It is not solely the responsibility of the government but people must also become aware and avoid consuming contaminated fruits. But what can we do about the greed of the average Indian? It is not the government; it is we who don't really care about the lives of others like us. It is not fit for anybody who is really human [91].

This practice has been going on for ages. We will do nothing about it. India would be occupied by a billion mutants in a few years time. Apples are coated with wax then I could see that so much of wax is applied. Who asked for a shining apple? Everyone wants an apple which keeps us healthy. There is contamination in everything and youngsters finally think of calories and not to eat junk food, and stick to fruits if these kinds of things happen then what is left to eat? This is really bad, sad and painful to hear. It is time everybody started acting consciously in their duty.

**Advice to Consumer:** Select fruits and vegetables without spots or necrosis or any abnormality. Wash fruits and vegetables thoroughly with running potable water before eating and cooking. Purchase fruits and vegetables from known dealers. Peeling of fruits before consumption and vegetables before cooking will reduce exposure to pesticide. Do not buy and consume cut fruits from open market. Throw away fruits and vegetables infected by mould/fungus. To minimize the hazards of pesticide residues, discard the outer leaves of leafy vegetables such as lettuce and cabbage. Do not wash fruits and vegetables with detergents as they may get absorbed inside. Ensure the quality of fruits and vegetables by sending them to voluntary testing laboratories. Wash your hands with soap and potable water, use clean utensil and clean cutting board with stainless steel knives. Do not buy fruits when these arrive in the markets before the due period. You can be almost sure that they are artificially ripened for better marketing and earning profits. While eating mangoes and apples, cut the fruit into pieces, rather than consuming directly. What looks attractive outside may not be good for health. Fruits that have a uniform color, for example, a bunch of bananas having a uniform color, are more likely to have been artificially ripened.

Consumer awareness is the only way to get rid of these illegal activities. The issue must be brought to the notice of concerned officials if we see such illegal activities in our nearby areas. To protect from artificial ripening the precaution should be taken. To observe the physical status of fruits as like colour, smell etc. It have been advised to keep strict vigil to check the use of artificial agents and other hazardous chemicals for ripening of fruits, coloring of fruits and vegetables and to take legal action for violation.

Table 1. Calcium carbide used in Countries on various fruits

|          |   |
|----------|---|
| Banana   | Australia, Egypt, India, Philippines, South Africa, Sudan, Taiwan, U.S.A, Yemen |
| Mango    | Brazil, Costa Rica, India, Malaysia, Philippines, Senegal, South Africa         |
| Citrus   | Australia, Philippines, South Africa  |
| Tomatoes | Australia, Morocco, Philippines, U.S.A  |
| Plums    | South Africa  |
| Peaches  | South Africa  |
|          | [Source : Rehaman <i>et al</i> , 2008]  |

Table 2. Showing artificial ripeners and fruits.

| Sr No | Chemicals               | Fruits   |
|-------|-------------------------|--|
| 1     | Calcium carbide         | Banana, Mango, Citrus, Tomato, Plums, Peaches.   |
| 2     | Ethephon                | Apples, Currants, Blackberries, Blueberries, Cranberries, Morello cherries, Citrus, Figs, Tomatoes, Sugar Beet, Fodder beet, Coffee, Capsicum, Wheat, Tobacco, Cotton, Pineapple, Rice |
| 3     | Ethylene                | Apples, Avocados, Bananas, Melons, Peaches, Pears, Tomatoes, Broccoli, Cabbage, Cauliflower, Leafy Greens, Lettuce   |
| 4     | Oxytocin                | Melon, Cucumbers, Lactating mammals  |
| 5     | Aminoethoxyvinylglycine | Apple (Delay ripening)   |
| 6     | Putrescine              | Japanese plum  |
| 7     | n-Valeric acid          | Sugarcane  |
| 8     | Photoporphyrinogen      | Sugarcane  |

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