



EFFECTS OF ARTIFICIAL AND NATURAL RIPENING AGENTS ON BANANA- A CLIMACTERIC FRUIT

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ABSTRACT

Artificial ripening of climacteric fruits is a very common practice by the fruit vendors. It is a controlled ripening method used to achieve desired characteristics which helps to earn more profits and to reduce the damage caused to ripe fruits during transportation. In view of this the present study is designed to assess the changes induced by various artificial and natural ripening agents in banana produce sold in Hyderabad.

The FSSAI has permitted the use of ethylene gas at a concentration up to 100ppm (100mcl/L) depending upon the crop variety and maturity for artificial ripening of fruits. Banana is a poor man's fruit and available perennially, is found in both super markets and local fruit markets. Bananas are a healthy source of fiber, potassium, vitamin B6, vitamin C, and various antioxidants and phytonutrients. They come with lot of health benefits. Artificially ripened fruits have a good change in peel color, but biochemical changes fail to occur which is a disadvantage. High consumption of fruits ripened artificially causes potential health hazards like memory loss, cerebral edema, headache, and neuropathy. To study the differences in the ripening of banana Artificial ripening agents like ethephon (permitted by FSSAI) and calcium carbide (banned by FSSAI) were used in ripening while natural agents used were paper bag and an apple, also a batch of banana were left for ripening with no agents. This study revealed that use of an apple was found effective in the ripening process among the other agents used. The study has concluded that use of an apple as a ripening agent which is natural in origin is considered as most potential ripening agent over the artificial ripening agents which were proven to have health hazards.

KEY WORDS: Banana, Artificial ripening, Ripening agents, Calcium carbide, Ethephon, Potential health hazards.

INTRODUCTION

The banana has been India's most versatile and revered fruit from time immemorial. Owing to its nativity, perennial abundance and affordability, it's the go-to fruit for nearly every occasion, and the banana tree in its entirety is deeply woven into the country's cultural fabric. They have been valued medicinally for thousands of years. The banana tree is considered sacred and every part of it is used, be it the fruit for eating or the leaf, flower and bark in medicinal treatments.

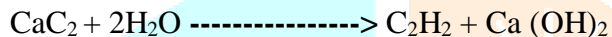
The banana is believed to be one of the world's earliest and most cultivated fruits and has travelled far and wide from its humble origins in India and South-East Asia.¹ In recent times there is much concern about artificial ripening of fruits in many parts of the world. Ripe fruits are not suitable to carry & distribute. Once harvested it is highly perishable, with short shelf life leading to high post-harvest losses of about 20-50% due to poor handling and quality deterioration. Hence fruit traders pick unripe fruits & use certain methods to increase the shelf life of them.²

Ripening is the final stage of development of a fruit which involves series of physiological and biochemical events leading to changes in color, flavor, aroma and texture that make the fruits both attractive and tasty.³

Banana is a fruit with nutritional properties and also with acclaimed therapeutic uses, is one of the most widely cultivated and widely consumed fruit crops in the world. It is said to be as one of the earliest fruit crops which is cultivated at the beginning of the civilization. Bananas are native to South East Asia and are cultivated in over 130 countries throughout the tropical and subtropical regions of the world. It is recorded as the fourth largest food crop of the world after rice, wheat, and maize. The annual world production of bananas is around 114 million metric tons from an area of 5.6 million ha.⁴ From this total banana production about 50% is consumed in cooked form which is often termed as plantains while the rest is dessert types cultivated widely throughout the tropics as source of food and income for people.^{4, 5, 6.}

Ripening agents are the substances which hasten the ripening process. There are different ripening agents like calcium carbide, acetylene; ethylene, propylene, ethrel, glycol, ethanol and various other agents are used for ripening of fruits and vegetables.^{3, 4}

CALCIUM CARBIDE: The most commonly used chemical for artificial ripening is Calcium Carbide (CaC_2) and is popularly known as ‘Masala’, though banned under PFA Rules, 1955 and also under Food Safety and Standards (Prohibition and Restrictions on Sales) Regulations, 2011 made there under. Calcium Carbide is colorless when pure, but greyish-white to black in colour otherwise, with garlic like odour. When it reacts with water, it produces acetylene gas (popularly referred to as carbide gas) which is an analogue to ethylene and quickens the ripening process. It is said to have the same effect as ethylene the natural ripening hormone.



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.

Ethrel: Ethrel is artificial ripening agent of fruits. On dipping the mature fruits in ethrel, it enters fruit cells, releases ethylene and hastens the ripening process. Changes in ascorbic acid content may occur with ethrel spray which influences the carbohydrate metabolism in related fruits.

Ethylene gas up to 100 ppm based on the crop variety and maturity is permitted by the FSSAI authorities for artificial ripening. The permitted forms of use are Ethephon or Ethrel.⁷

Ethylene glycols: Ethylene reacts with hydrogen peroxide to produce the agent ethylene glycol. Ethylene glycol is colorless, odorless and sweet tasting liquid which is found in everyday materials used in the present day, such as coolant, antifreeze. In case ethylene glycol is applied (after being diluted with water) to various fruits, then it will speed up the ripening process of the fruits in colder climactic conditions, cutting down at least a quarter of the time it usually takes for the fruits to ripen.

Most of the ripening agents are toxic and their consumption can cause serious health problems, such as heart disease, skin disease, lung failure and kidney failure. Consumption of carbide ripened fruits is extremely hazardous for health, mainly for the nervous system. Acetylene, generated from carbide reduces oxygen supply to the brain. In acute stage, it causes headache, vertigo, dizziness, delirium, seizure and even coma. In the long term, it may produce mood disturbance and loss of memory. Immediately after consumption, there may be abdominal pain, vomiting and diarrhoea.^{8,9.}

The Indian regulatory authority FSSAI, under PFA act stated that artificial ripening of fruits by substances like calcium carbide or acetylene gas pose serious threat to the health and Regulation 2.3.5 of the Food Safety and Standards (Prohibition and Restriction on Sales) Regulations, 2011, provided that no person shall sell, or offer, or expose for sale, or have on his/her premises for the purpose of sale under any description, fruit which have been artificially ripened by the use of acetylene gas, commonly known as calcium carbide gas.^{10,11}

In light of the above regulatory norms a study has been conducted in Hyderabad to illustrate the effects of artificial and natural ripening agents on banana.

MATERIALS AND METHODS

Unripe bananas were procured from a local market in Hyderabad. Batches of 4 bananas each were ripened using artificial ripening agents Ethephon (batch 1), Calcium carbide (batch 2), paper wrapper (batch 3) and use of an apple along with unripe bananas wrapped in paper bag (batch 4) and one set of bananas were left without use of any ripening agents at room temperature (batch 5).

Various physical and biochemical changes were recorded. Change of color of the peel is noted using color scale 12, acidic content was checked using Titratable acidity¹³, and the sugar content was checked using Benedicts qualitative test¹⁴ and Iodine staining¹⁵.

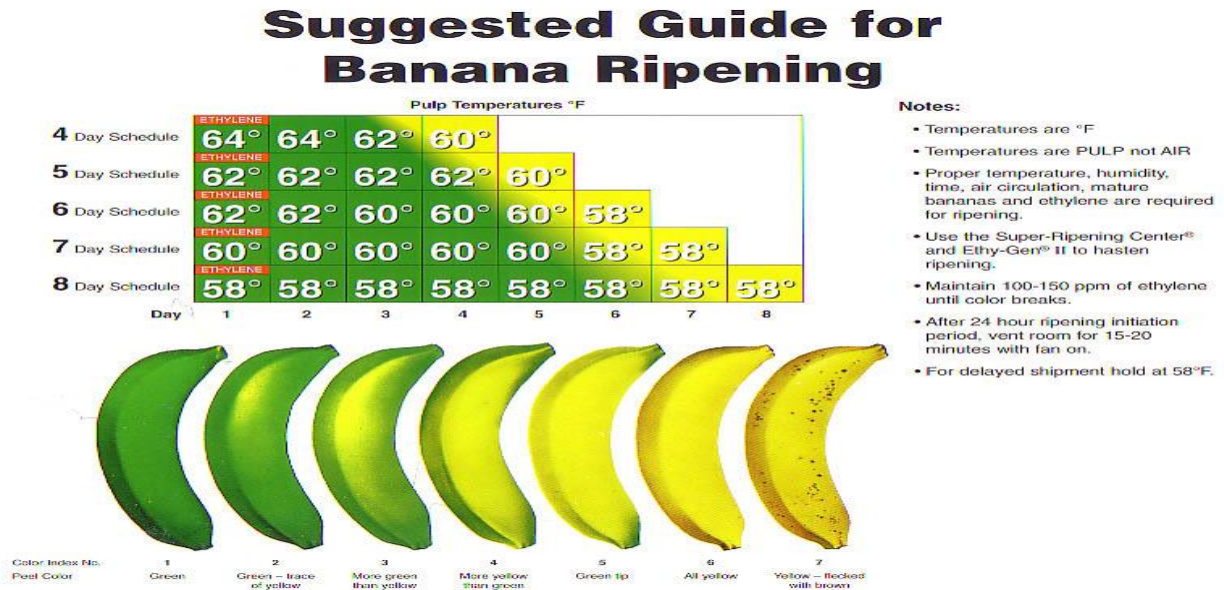


Fig 2.1: Color Scale

RESULTS AND DISCUSSION

The results have shown that variation was found in the ripening time with the use artificial and natural ripening agent. By using artificial ripening agents the peel color has been changed same as that of ripe fruits while there is no complete biochemical convert of starch to sugar which is characteristic feature of ripened fruits which gives sweetness to the fruits. Hence the following tests have been performed.

RIPENING TIME: Ripening time was noted using color scale. Batch ripened with ethephon took 5 days to ripen, batch with calcium carbide took 7 days, batch wrapped in paper took 11 days, batch along with an apple wrapped in paper bag took 7 days, and batch with no ripening agent took 14 days.



Fig: 3.1 Unripe Bananas



Fig. 3.2: Ripe bananas with flecked brown

TITRATABLE ACIDITY: Titratable acid is the indicators for the quantity of organic acids and its salts contained in a fruit. Batch ripened wrapped along with an apple in paper bag showed the highest % acidity 0.16, batch ripened with ethephon 0.153, batch ripened in wrapped paper 0.111, batch ripened with carbide 0.107, batch ripened with no ripening agent showed the lowest % acidity 0.1.

BENEDICTS QUALITATIVE TEST: Batch of Bananas ripened with ethephon gave dark orange color indicating complete conversion of starch to sugar, batch ripened with carbide gave orange color indicating partial conversion of starch to sugar, batch ripened in wrapped paper and batch ripened along with an apple in wrapped paper bag gave dark orange color indicating complete conversion of starch to sugar and batch ripened with no ripening agent gave green color indicating minimal conversion of starch to sugar.

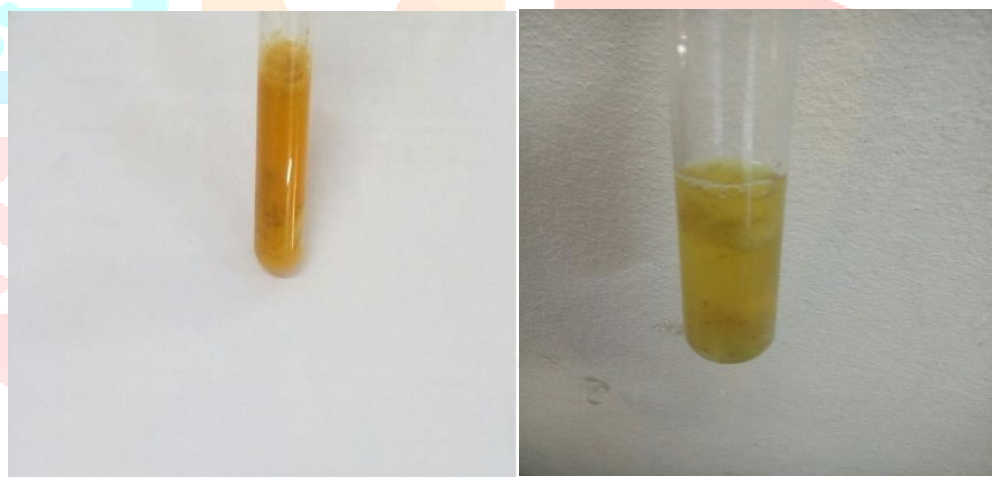


Fig 3.3: Test tube with dark brown colored precipitate and green color in benedicts result

IODINE TEST: The iodine test is used to test for the presence of starch. Starch turns into an intense "blue-black" color upon addition of aqueous solutions of the triiodide anion. Batch of bananas ripening with ethephon, batch in paper bag and batch along with an apple wrapped in paper bag showed total conversion of starch to sugar while batch of bananas ripened with calcium carbide and batch ripened with no ripening agent showed traces of starch.



Fig 3.4: Petri dish with banana sample with total and partial conversion of starch to sugar

Table 3.1 Effect of various natural and artificial agents on Banana summarized results

Ripening Methods	Ripening time using Color Scale	Titratable acidity	Benedicts qualitative	Iodine staining	Sensory evaluation
					Total score
Ripened with Ethephon	5 days	0.153%	Dark orange color	Total conversion of starch to sugar	19.9
Ripened with Calcium carbide	7 days	0.109%	Yellow color	Presence of starch	17.5
Ripened in paper bag	11 days	0.121%	Dark orange color	Total conversion of starch to sugar	18.8
Ripened in paper bag with an Apple	7 days	0.17%	Dark orange color	Total conversion of starch to sugar	21.5
Ripened with no agent	14 days	0.1%	Green color	Partial conversion of starch to sugar	10.9

Use of an apple wrapped along with bananas in a paper bag was found similarly effective as the artificial ripening agent calcium carbide along with high percentage of acceptability rate.

CONCLUSION

This study concludes that artificial ripening agents like ethephon and calcium carbide as well as natural agents like paper bag and an apple along with paper bag accelerates the ripening process. Based on the results observed an apple along with the fruit wrapped in paper can be used as an effective ripening agent with no harmful effects by their use. The vendors can also overcome the violation of regulatory norms with the usage of biological ripening agents.

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