

IDENTIFICATION OF DIFFERENT PHYSIOLOGICAL PROPERTIES OF SAGOR BANANAS RIPENED BY USING CHEMICALS, HEAT, AND NATURAL PROCESS

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Abstract

The aim of the study was to identify different physiological properties like ripening time, peel color, stalk color, flavor, and the shelf life of bananas by using chemicals, heat and natural process. For this observational study, 500 pieces sagor bananas were collected from Madhupur, Tangail. It was taken into two batches A and B. Every batch had four group i.e. 1st group was for naturally ripened, 2nd group was ripened by ethephon, the 3rd group was ripened by calcium carbide and 4th was used by heat. 65 pieces of bananas were taken for natural and heat process whereas 60 pieces were taken for chemically ripened bananas in each group of both batches. Ethephon was applied on the banana with the concentration of 1ml/L and 2ml/L which took about 3 days for ripening. Peel color was uniform bright yellow and attractive. Ripened banana had very little flavor with yellow stalk color. It was observed that 2ml/L ethephon treated ripened bananas had the shelf life between 2-3 days where it was between 3-4 days in 1ml/L ethephon treated bananas. Calcium carbide was used on bananas with the concentration of 2gm and 5gm which took about 2-3 days to ripe. Peel color was uniform bright yellow, smooth and attractive without any spot. Ripened banana had very little flavor with yellow stalk color. 2gm calcium carbide applied bananas had the shelf life about 3 days where 5gm calcium carbide treated ripened bananas had the shelf life between 2-3 days. Heat applied bananas took 4-5 days to ripe. Peel color was uniform bright yellow with little flavor but spots were developed. Stalk remained green in bananas. Shelf life was between 3-4 days. Naturally ripened bananas took 5-6 days to ripe. Peel color was light yellow with the spot in the first stage of ripening and developed bright yellow after 1 day. Stalks were blackish yellow and ripe bananas had the shelf life between 5-6 days with very nice flavor.

Keywords: color, calcium carbide, ethephon, flavor, shelf life.

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1. INTRODUCTION

Food safety means food will not cause harm to the consumer. Ensuring safe and healthy food is an important pre-condition of food security. Food safety is a major concern all over the world nowadays because some deceitful businessman is using different illegal chemicals during production, processing, and preservation of food products. In Bangladesh, most of the food products are unsafe for consumption or adulterated in varying degree. Food safety is indispensable in Bangladesh to prevent food adulteration by conserving the nutritional value, quality of food (Huq, M.M. et. al., 2003).

Banana is available in numerous size and color with the prolonged and bent shape. The soft flesh is rich in starch which shielded with a yellow color skin. Banana is the only fruit which contains all essential vitamins and

minerals. It is world best seedless fruit most people like. Banana is the excellent source of Vitamin A, Vitamin k, Vitamin E(Alpha Tocopherol), Thiamin, Riboflavin, Niacin, Vitamin B6, Folate and Vitamin C. It is also a good source of dietary fiber and cholesterol free. It is the most available source of essential mineral exclusively potassium and magnesium calcium phosphorus copper and manganese. Medicinal value of bananas includes- lowering the risk of high blood pressure and stroke as they are the best source of potassium, an essential minerals for keeping normal blood pressure and heart function.

It is the most available and cheapest fruit in any region of the globe. It is one of the oldest cultivated plants starting in the pre-Islamic period of India and Southeast Asia. But it can be found other side of the world like Africa and South America, usually their own purpose. According to The United Nations Food and

Agriculture Organization, it is the world's fourth significant crop afterward the main cereals. In all over the world amongst the highest 20 bananas, producing countries Bangladesh ranks 14th and it yields approximately 1.00 million tons of bananas by the year.

The key areas for banana production in Bangladesh are known as Gazipur, Narsingdi, Rangpur, Nator, Bogra, Faridpur, Pabna, Khulna and Noakhali. It is assessed as 28 million tons of world production in which 65% from Latin America, 27% from Southeast Asia and 7% from Africa. One-fifth of the yield is traded to Europe, Canada, United States and Japan. In Asia, India is reflected as the foremost banana producer country (Morton, J. 1987).

However, banana is the most important fruit in Bangladesh as it contains all the essential nutrients. It should insure that they are safe for consumption. Safe consumption of banana is a major concern for everyone as various banned ripening agents are being applied by the unscrupulous businessman to fasten the ripening of bananas which can cause the serious health problem. During ripening, fruits need to go through some natural process like chemical changes in which fruit progressively develop the sweetness, color, flavor, softness, and palatability (Brady, 1987).

Several artificial methods have been perceived for fruit ripening to meet the consumers call and economic factors. Though nowadays artificial ripening has been measured as a matter of great concern and debatable because of its numerous health-related concern (Siddiqui, 2010).

Recently fruits ripened with harmful chemicals such as ethephon (2-chloro ethyl phosphoric acid), calcium carbide (CaC₂), ethylene, calcium oxide etc are consuming by people in Bangladesh. Calcium Carbide when applied reacts with water and produce acetylene which acts like ethylene a natural ripening hormone, and thus fasten the ripening process. Another notorious ethylene generating chemical is ethephon used for post-harvest treatment which is responsible to accelerate ripening and

developing color in bananas and mangoes (Lakshminarayana et al., 1975).

However, these ripening agents are capable to fulfill the consumers demand in a great extent but they also responsible for hazardous health disease.

Most of them are poisonous and responsible for heart disease, kidney disease, lung failure, skin disease etc. Scientists also found that regular intake of these chemicals may cause weakness, dizziness, skin ulcer and heart-related problem (Hakim et. al., 2012). A significant number of children born with abnormalities due to the consumption of carbide contaminated fruit during pregnancy (Rahim, 2012).

Banana ripens by artificially ripening agents not only pose health problem but also reduce the vitamin and mineral contain. Fruits which are ripened artificially they contain less amount of nutritional value like protein content, beta-carotene, vitamin-C and higher sugar content than naturally ripened fruits (Adeniji T.A. et. al. 2007; FAO. 2010; Hasib, N.I. 2014; Hoque, M.A. 2012; Islam, G.M.R. et. al. 2013).

The farmers and businessman who are linked with fruits business do not have adequate information about the health hazardous effect of chemical ripening agents. Even the consumers are not aware enough of the chemical ripening agents (Mursalat, M. et. al. 2012).

Therefore awareness should be build up among the farmers, businessman, and consumer.

2. MATERIALS AND METHODS

Type of study

An observational study was carried out in the laboratory of Department of Food Technology and Nutritional Science in Mawlana Bhashani Science and Technology University, Santosh, Tangail.

Selection of sample and sample area

A total of 500 pieces sagor banana were collected from Madhupur, Tangail, where bananas were cultivated on a large scale.

Basis of selection of study and place

Sagor banana is a common nutritious fruit consumed by most of the people. Madhupur under the district of Tangail is famous for the cultivation of banana. Banana is cultivated for commercial purposes in a large area at Madhupur which is supplied in different areas of the country.

Sample size

The study was carried out in two batches, batch A and batch B. Total 500 pieces sagor bananas were taken for the study. For batch A and B, there were 250 pieces sagor bananas.

Table 1. Experimented sample size of bananas

Batch	Group	Concentration	Sagor banana
A	Group 1	Natural	65
	Group 2	Ethephon 1ml/L	30
		Ethephon 2ml/L	30
	Group 3	CaC ₂ 2 gm	30
		CaC ₂ 5 gm	30
	Group 4	Heat	65
B	Group 1	Natural	65
	Group 2	Ethephon 1ml/L	30
		Ethephon 2ml/L	30
	Group 3	CaC ₂ 2 gm	30
		CaC ₂ 5 gm	30
	Group 4	Heat	65

CaC₂= calcium carbide, ml= milliliter, L= liter, gm=gram

Study Period

The study was carried out from October 2015 to March 2016.

Study Area

The analysis was enumerated in the lab of Food Technology and Nutritional Science Department, Mawlana Bhashani Science and Technology University, Santosh, Tangail-1902.

Analysis of the samples

Sensory methods were used to assess the difference of banana ripening between natural process and the process by using chemicals. Physiological properties such as peel color, stalk color, flavor, ripening time and shelf life were observed.

Instruments and apparatus

Cartoon bags, Plastic bags, Knives, Electric weight machine, Bowls, Glass rods and Plastic tapes.

Chemicals:

Ethephon, Calcium carbide.

Principle of ripening

1. Natural ripening process:

In this process, banana produces ethylene, a plant hormone which is incidentally affect the flavor and stimulate the amylase formation to break down the starch into sugar. It is also responsible for the taste of bananas. Furthermore, ethylene signals about the pectinase production, this enzyme helps to break down the pectin among cells in banana and make it soft to ripe. Ethelene also stimulates the conversion of green color to yellow color. The conversion of color occurred gradually.

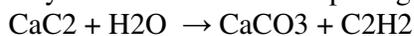
2. Chemical ripening process

Ethephon:

Ethephon is decomposed into ethylene in the solution (aqueous) to fasten up the ripening process. Ethylene stimulates the breakdown of starch into sugar also break down the pectin which causing the banana soften. Ethelene degraded chlorophyll and thus disappearance of green color and develop the yellow color.

Calcium Carbide:

When calcium carbide is applied to banana it comes to contact with moisture and produce acetylene which acts as natural phytohormone ethylene to influence the ripening of banana.



Green banana + C₂H₂ → Yellow banana

Reagent preparation and apply

1. Ethephon: Reagent was prepared in two concentrations. One was 1ml/L and another was 2 ml/L. (The local illegal businessmen applied ethephon 16-20 ml per 16-liter water for ripening 1000 pieces of banana). The banana bunches were cut and separated into hands. 1 ml/L and 2 ml/L ethephon were mixed with water in the separated bowl and the hands of bananas were submerged. After that hand of bananas were pull out from water and kept for

the removal of water then put into separate cartoon bags.

2. Calcium carbide: 2 gm and 5 gm calcium carbide (according to local illegal businessman application) was wrapped in a paper and dropped into separate cartons box containing bananas. They were tied up to store in the detached room.

3. Control: To ripen naturally, control samples were put into separate carton box with straw and stored in the separate room. Bananas were observed regularly and carefully. All the sample were monitored to note down the changes of peel color, stalk color, flavor, shelf life, start point of spoilage and other physical properties. Each treatment was carried out double in number.

3. RESULTS AND DISCUSSION

Ripening of sagor bananas using ethephon, calcium carbide(CaC₂), heat and natural process:

Physiological properties like peel color, stalk color, flavor and shelf life of sagor bananas shown in Table 3 and described below.

Ripening Time

Ripening time of sagor bananas has been shown in Table 2. It was observed that in batch A, Sagor bananas treated with the concentration of 1ml/L ethephon took 3 days for completely ripened where the concentration of 2ml/L ethephon took 2 days to ripen. In batch B, bananas took the same time as batch A. Both batch A and batch B sagor bananas ripened using 2 gm calcium carbide took 3 and half days and 5 gm calcium carbide treated bananas took 2 and half days for ripening. Heat treated bananas took 4 days for completely ripened.

On the other hand, bananas took 6-7 days in batch A and 5-6 days in batch B for completely ripened in the natural process.

Table 2. Ripening time of Sagor Bananas ripened using Ethephon, CaC₂, Heat and Natural process

Group	Ripening process (Naturally, using Chemicals and Heat)	Ripening Time(day), Sample Type	
		Batch A	Batch B
1 st	Natural (control)	6-7	5-6
2 nd	Ethephon (1ml/L)	3	3
	Ethephon (2ml/L)	2	2
3 rd	Calcium Carbide(2gm)	3	3
	Calcium Carbide(5gm)	2	2
4 th	Heat	4	4

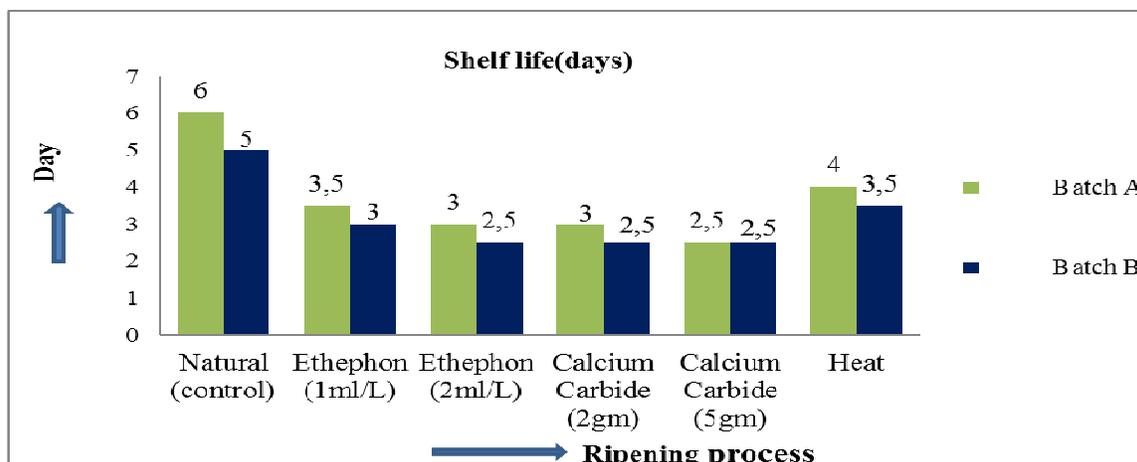


Figure 1. The comparison of the shelf life of sagor bananas ripened by using chemicals, heat and natural process

Shelf life

Figure 1 shows the comparison of the shelf life of batch A and batch B sagor bananas ripened by using chemicals, heat and natural process. It was found that 2ml/L ethephon treated ripe bananas had the shelf life between 2-3 days where 1ml/L ethephon treated ripe bananas had the shelf life between 3-4 days. In both batch A and batch B, 2gm calcium carbide treated sagor bananas had the shelf life from 2 to 3 days and 5gm calcium carbide treated bananas had 2 and half days. Bananas ripen by heat had higher shelf life than chemically ripened bananas and that was 4 days respectively. On the other hand, naturally ripened banana had the shelf life between 5 to 6 days. Therefore it showed that naturally ripened banana had higher shelf life comparison to chemically ripened bananas.

Peel Color

After full ripening, both 1ml/L and 2ml/L ethephon treated bananas had attractive, uniform, bright yellow color shown in Figure 2. Bananas treated with 2ml/L ethephon started to ripe first than using 1ml/L ethephon. Peel was smooth and there was no spot. Both 2gm and 5gm calcium carbide treated bananas developed uniform deep yellow color after fully ripened, but less attractive than ethephon applied bananas. When bananas were ripened by heat it took at least 4 days. Bananas had light yellow color in the first stage of ripening. Bright yellow color with spot was developed when fully ripened. It was observed that red spot in pulp and some pulp became hard. Naturally ripened bananas had light yellow

color in the first step of ripening. After full ripening, they had bright yellow color but not more than others ripe bananas using ethephon and calcium carbide. There was spot in the peel of the bananas.

Stalk Color

Stalk of ethephon applied sagor bananas of batch A and batch B remained green while full body showed bright yellow color which has been described in table 3. After full ripening, stalk became greenish yellow but remained fresh. Stalk of calcium carbide treated bananas remained green even growing bright yellow color. When bananas were completely ripened, stalk became greenish yellow but remained fresh. The stalks of ripe bananas using heat were green in the first stage. Stalk remained fresh even bananas began to spoil. On the other hand, the stalk of naturally ripened bananas became greenish yellow. After fully ripened stalk became blackish, shrink and dam.

Flavor

Ethephon treated bananas of batch A and B had no flavor in the first stage of ripening and got poor flavor after full ripening. No flavor was got in calcium carbide treated bananas in the first stage of ripening. But when the bananas were fully ripened there were light flavor. Heat treated ripe bananas had no flavor at first stage of ripening but when the bananas were fully ripened, developed little flavor. On the other hand, naturally ripened banana had the nice flavor from the first stage of ripening.

Table 3. The evaluation of different physiological properties of Sagor bananas ripened using chemicals, heat and natural process

Group	Ripening process	Physiological properties				
		Ripening time(day)	Peel color	Stalk color	Flavor	Shelf life (days)
1 st	Natural (control)	5-6	Unattractive, light yellow	Blackish Yellow	Nice	5-6
2 nd	Ethephon (1ml/L)	3	Attractive, uniform, bright yellow	Green	Poor	3 and half
	Ethephon (2ml/L)	2	Attractive, uniform, bright yellow	Green	Poor	2-3
3 rd	CaC ₂ (2gm)	3	Uniform, bright yellow	Green	Light	2-3
	CaC ₂ (5gm)	2	Uniform, bright yellow	Green	Light	2 and half
4 th	Heat	4	Light yellow	Green	Little	3-4



Naturally ripen banana



1ml/L Ethephon treated banana



2ml/L ethephon treated banana



2 gm CaC₂ treated banana



5 gm CaC₂ treated banana



Heat applied banana

Figure 2. Photographic presentation of Sagor bananas

Photographic presentation of Sagor Bananas:

Figure 2 shows the photographic presentation of ripened sagor bananas after using 1ml/L ethephon, 2ml/L ethephon, 2 gm calcium carbide, 5 gm calcium carbide, heat and natural process.

4. CONCLUSIONS

An observational study was carried out to identify different physiological properties of sagor bananas ripened by using chemicals, heat and natural process. Ethephon, CaC₂, and heat were applied on selected sagor bananas for ripening. Difference between natural and

artificially ripened bananas has been observed. Ethephon treated bananas had attractive, bright yellow color, smooth body with without any spot, little flavor, fresh and green stalk color. Calcium carbide treated banana had bright yellow color, smooth body, without spot, little flavor, fresh and green stalk. Heat applied bananas had light yellow color, no flavor at first stage of ripening, fresh and green stalk. Naturally ripened bananas had light yellow color in the first of ripening. There were spots on the peel, stalk was blackish yellow and had nice flavor on the other hand artificially ripened banana had little flavor. Pulp remained hard in artificially ripened bananas in the first stage of developing yellow color but in naturally ripened bananas it was soft from the first stage of ripening. There were no spots in artificially ripened bananas and the peels were smooth whereas spots were found in naturally ripened bananas.

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