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# Study of Artificial Ripening Agent and Its Effects on Banana (*Musa spp*.) Collected from TangailArea, Bangladesh

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**Abstract:***Ripening of banana is the major economical concern during post-harvest that improves the color, softness and characteristics aroma of banana and makes them ripened rapidly and palatable as well as more attractive to the consumer. This study was conducted to investigate the current situation of using artificial ripening agent and to determine their effects on nutritional properties and sensory attributes of banana. It was found that farmers and traders in this region treated banana with different types of growth hormones and artificial ripening agents available as locally brand pack that contains mostly of ethephon. From the practical enumeration, it was found that the moisture, fat, protein, fiber and ash contents of natural ripening banana were 78.26%, 0.017%, 1.65%, 2.06% and 0.71% respectively while the such contents of ripening agent treated banana were observed as decrease with gradual increase in concentration of ripening agent. The weight of banana was also decreased over the time. The vitamin C content of naturally ripen banana was 7.45mg while artificial ripening agent treated banana at a dose of 4ml/L and 8ml/L, it was found as 6.32mg and 5.83mg,correspondingly. Similarly the iron and zinc content were decreased rapidly as increase of artificial ripening agent but opposite phenomenon was observed for potassium content. Sensory evaluation tests revealed that the overall band score of the both types of banana was acceptable in quality although some variations were observed in their specific characteristic. Such findings suggest that artificial ripen banana might have dangerous effects on human health.*

***Keywords:****Artificial ripening agent, banana,mineral content, sensory attributes,vitamin C.*

## I. Introduction

Bananais a leading tropical fruit and it is one of the most popular fruit throughout the globe including Bangladesh. It is estimated that 100 million people subsist on banana and plantains as their main energy source [1]. It is the only fruit which is within the buying capacity of poor people. Considering the year round availability, popularity and production, banana is considered to be the number one fruit in Bangladesh. This crop accounts for 40.7% of the total fruit production in the country. Banana is an edible fruit produced by several kinds of herbaceous plants of the family *Musaceae*. Banana is variable in size, color and firmness but it is elongated and curved, with soft flesh rich in starch covered with a rind which may be yellow, purple or red when ripe. Banana fruits are wholesome and fairly well balanced source of nutrient containing various mineral salts, vitamins and high amount of carbohydrates withtrace oil and protein. Consumers are looking for variety in their diets and are aware of the health benefits of fresh fruits and vegetables. Banana is unique due to its high calorie and nutritive value. Banana is a rich source of calorie, as well as most of the vitamins essential for human nutrition. It has also medicinal value.

In banana, post-harvest compositional changes following are important since banana is a climacteric fruit[2]. Dramatic changes in banana peel color and pulp texture occur during the rise in respiration during storage of climacteric fruits[3]. The changes of physical, mechanical and chemical properties of banana fruits are occurred during ripening. Skin color changes from green to yellow, firmness is decreased, fruit gets softened and starch is converted into sugar [4].

Storage temperature influences the ripening changes in bananas[5].An increase in storage temperatures between 14°C and 30°C enhances the rate of ripening and the fruit softens at a faster rate [6]. The respiration rate and ethylene production were also shown to increase with an increase of temperature. High temperature can also result in damage to ripening fruit [7, 8].Temperatures less than 14°C can cause uneven ripening due to chilling injury [9].

During banana ripening, the peel color changes, the flavor develops and the pulp softens. The first observable sign of ripening is a color change from green to yellow [10]. The ripening treatment of banana fruits has been improved through a tentative method by the empirical of trained laborers into a programmatic ethylene gas control manner. However, this method has not always attained in bringing the uniformed ripening of banana fruits, because of its lacking of any monitoring system to detect the ripening quality of banana fruits[11]. Bananas are generally artificially ripened in local markets by the use of banned chemical, calcium carbide. The use of this chemical is prohibited due to health reasons[12].

Commercial ripening is an essential part of fruit business as ripe fruits are not suitable to carry and distribute due to their fast rotten. Therefore fruit traders pick up ripe fruits and utilize different methodologies to fasten the ripening processing of fruits.This study aimed to assess any changes between the naturally ripened banana and banana ripened by the artificial ripening agents.

## II. Materials and Methods

The experiment was conductedin the laboratory of Food Technology and Nutritional Science, MawlanaBhashani Science and Technology University, Tangail and in the laboratory of Fruit Technology Research Section, Institute of Food Science and Technology (IFST), Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhaka, Bangladesh.For analysis matured green banana was collected from field ofModhupur region atTangaildistrict.

### 2.1 Proximate analysis of banana

#### 2.1.1 Estimation of moisture content

Moisture was determined according to AOAC method [13]. At firstthe weight of crucible was taken then 5-10gm sliced sample was put into it. The crucible was then placed in an oven at 105℃ for overnight. Then the crucible containing sample was weighed in an electric balance and heated in an oven until constant weight was found each time. The crucible was cooled in desiccators before weighing. The moisture content was computed using the following formula:

$$\text{Moisture Content (\%)} = 100 \times \frac{A-B}{A}$$

In which:

A= Sample weight before oven drying, B= Final weight.The dried sample was then used for the estimation of crude fat, crude protein, crude fiber, ash, vitamin C, and mineral contents.

#### 2.1.2 Determination of fat content

Crude lipid content of the dried sample was determined based on Soxhlet method according to [14] and the results were calculated using the formula as follows:

$$\text{Crude lipid content (\%)} = 100 \times \frac{w_a - w_b}{w_c}$$

Where,

$w_a$ = Weight of flask (g) after extraction, $w_b$ =Weight of flask (g) before extraction, $w_c$ = Weight of dried sample (g).

#### 2.1.3 Determination of protein content

Crude protein content of the dried sample was determined by AOAC method[13] in which concentrated sulphuric acid ($H_2SO_4$), 40% sodium hydroxide (NaOH) and 0.1 M hydrochloric acid (HCl) were used for digestion, distillation and titration, respectively. The entire determination process was conducted by an automated protein quantification equipment system (VAPODEST 50S, Gerhardt, Germany). The VAPODEST-Manager software was used to control and monitor the entire process.

The crude protein content was determined using the following formula. Conversion factor, 6.25 was used to calculate the protein content.

$$\text{Protein content (\%)} = \text{Total nitrogen (N)} \times 6.25$$

**2.1.4 Determination of crude fiber**

Crude fiber content was determined as described [13]and the percentage of crude fibre content obtained from the experiment was computed by the following formula:

$$\text{Crude fiber (\%)} = 100 \times \frac{\text{Loss of weight of sample}}{\text{Weight of sample}}$$

**2.1.5 Estimation of Ash**

Ash content of the dried integument was determined according to AOACmethod[13] by incinerating the samples in porcelain cup and kept in a muffle furnace (Sybron Thermolyne 6000, USA) at 550˚C for 12 hours.The following equation was used to calculate the ash content:

$$\text{Ash content (\%)} = 100 \times \frac{w_a}{w_b}$$

In which:

$w_a$ =Weight of sample (g) after ashing, $w_b$ = Weight of sample (g) before ashing.

**2.2 Estimation of Vitamin C(Ascorbic acid)**

Total ascorbic acid content of banana was analyzed by titrimetric method [15].Ten ml of standard vitamin C solution was taken into a conical flask and was titrated it with the dye solution. Four to six grams of banana pulp were cut into small pieces and homogenized well with 3% metaphosphoric acids and filtered it through double layer of muslin cloth. The filtrate was centrifuged at 3,000 rpm for 10 minutes and the supernatant was titrated with 2, 6-dichlorophenolindophenol solution. The amount of vitamin C present in the extract was determined by comparing the titration result of standard vitamin C solution.

$$\text{Vitamin C content (\%)} = 100 \times \frac{\text{Vitamin C obtained}}{\text{Weight of banana pulp}}$$

**2.3 Estimation of minerals content**

Iron content of dried banana sample was determined as described by [16]andZinc was determined by the technique [17].Flame photometer was used to determine the content of potassium (K) outlined [18]. Potassium in solution was atomized into an oxy-hydrogen flame. The flame exits atoms of potassium, causing it to unit radiation to specific wavelength. The amount of radiation emitted was measured in a flame photometer, under standard condition; it is proportional to the concentration of potassium.

**2.4 Sensory evaluation**

Various methods have been used to measure food preferences. The most common method is a questionnaire of generated foods or food categories in which a hedonic scale is used to rate the degree of likings. Hedonic scale is an organoleptic quality rating scale where the judge expresses his degree of likings. 1 to 9 point balanced scale is used. Over all tests were conducted by using seven point Hedonic scale. The general form of the scale: 1. like extremely. 2. Like very much, 3. Like moderately, 4.Like slightly, 5.Neither like nor dislike, 6. Dislike slightly, 7. Dislike minor. 8. Dislike very much. 9. Dislike extremely.

Appearance, Color, Flavor and Texture, Sweetness, Sour, Overall Acceptance (Taste) tests of the samples were accomplished. This test has been used by expert and untrained consumers, but it is felt to be more effectively applicable to the latter. Ten member sensory panels were participated to accomplish these organoleptic tests. In Hedonic scaling, response, i.e., state of like and dislike, were measured on a rating scale. Points given by the sensory panel based on the liking and disliking were analyzed by SPSS software version 20.

## III. Results and Discussion

**3.1 Proximate analysis of banana**

The proximate analysis was conducted for comparing the banana between naturally ripening banana (chemical free) and artificial ripeningagents used banana. The results are represented in Table 1. Tableshows that moisture content of naturally ripening banana was78.26%. This value was gradually decreased with the increase of artificial ripening agents used in banana.

Table 1- Proximate composition of naturally ripening banana and ripening agent used banana.

| Sample | Moisture (%) | Fat (%)) | Protein (% | Fiber (%) | Ash (%) |
|---|---|---|---|---|---|
| Naturally ripening banana | 78.26±3.64 | 0.017±0.002 | 1.65±0.07 | 2.06±0.07 | 0.71±0.06 |
| Ripening agents (4ml)treated banana | 75.05±4.18 | 0.009±0.001 | 1.47±0.04 | 1.72±0.06 | 0.67±0.08 |
| Ripening agents (8ml) treated banana | 74.39±3.06 | 0.006±0.002 | 1.05±0.0.06 | 1.45±0.04 | 0.61±0.10 |

Table 1 indicates that fat and protein content of naturally ripening banana was0.017% and 1.65% respectively, which was gradually reduced with escalation of ripening agent used smoked banana. Similar trends were observed in the case of fiber and ash content. Such findings revealed that artificial ripening agenttreated banana is nutritionally poor as compare to naturally ripening banana. Ripening agent treated banana has poor nutritional quality [19].

**3.2 Vitamin C content**

Figure 1 shows that Vitamin C content of the naturally ripening banana is 7.45mg. The banana was soaked in the solution of ripening agent at the concentration of 4ml/L and 8 ml/L separately, where it was found that the Vitamin C content was 6.32mg and 5.83mg respectively. The results showed that the content of vitamin C in ripening agent treated banana were frequently decreased with escalation of agent used. Such findings discovered that ripening agents smoked banana had less vitamin C content as compare to naturally ripening banana. Similar trends were found in which the content of Vitamin C was decreased with increasing artificial ripening agent [20].

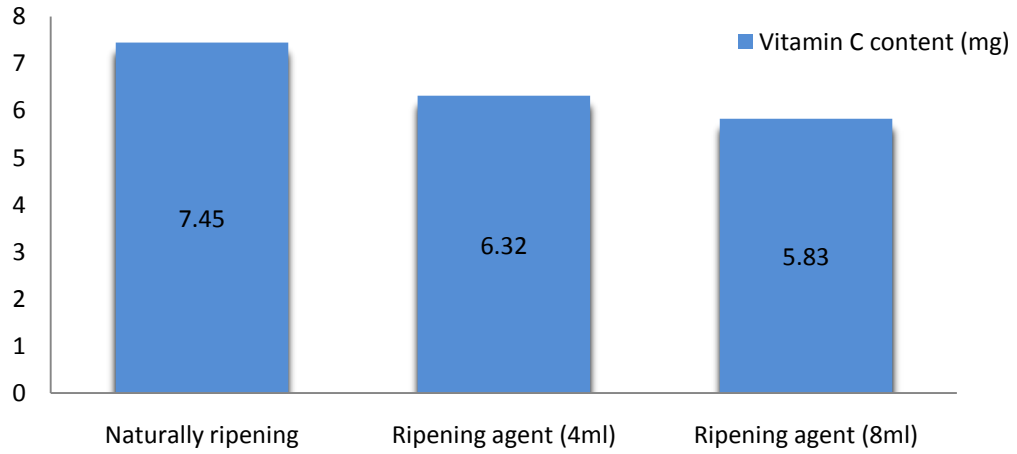


Fig 1- Vitamin C content of naturally ripening banana and different concentration of ripening agent treated banana.

**3.3 Mineral contents**

Banana is iron rich fruit .The iron content was found as 1.65mg/100gm in naturally ripening banana while ripening agent treated banana at concentration of 4 ml/L and 8 ml/L, the iron content was found as 1.44mg and 0.96mg/100gm respectively. The content of zinc were also deceased with increase the concentration of artificial ripening agent whereas the potassium level was gradually increased (Table 2).It was mentioned in the previous reports that values of some minerals were found to vary and some were nearby[21, 20, 19].

Table 2- Mineral contents of naturally ripening banana and ripening agent treated banana.

| Sample | Iron (mg/100gm) | Potassium (mg/100gm) | Zinc (mg/100gm) |
|---|---|---|---|
| Naturally ripening banana | 1.65 | 350 | 0.171 |
| Ripening agents (4ml) treated banana | 1.44 | 423 | 0.085 |
| Ripening agents (8ml) treated banana | 0.96 | 435 | 0.026 |

**3.4 Sensory evaluation**

Organoleptic tests of the bananadepend on its first appearance, color, flavor, texture and overall taste of the sample. Table 3 showsthe sensoryquality evaluation of naturally ripening banana and ripening agent treated banana.The overall band score of the both types of banana was acceptable in quality but their specific characteristics were found slightly different by the test panelists.

Table 3-Sensory evaluation of naturally ripening banana and ripening agent treated banana.

| **Parameters investigated** | **Naturally ripening banana** | | **Ripening agent treated banana** | |
|---|---|---|---|---|
| | Like (%) | Dislike (%) | Like (%) | Dislike (%) |
| Appearance | 60 | 40 | 80 | 20 |
| Color | 60 | 40 | 80 | 20 |
| Flavor | 80 | 20 | 40 | 60 |
| Taste | 80 | 20 | 30 | 70 |
| Texture | 50 | 50 | 70 | 30 |

The results of the panelist were based on their likings and disliking. Data in the Table 3showed that 60% member liked and 40% disliked the appearance of naturally ripening banana while 60% liked and 40% dislikedthe color. Flavor of naturally ripening banana was liked by 80% member and disliked by 20% member. Taste was liked by 80% and disliked by 20% member. The texture of naturally ripening banana was liked by 50% and disliked by 50% member.

Data in the Table 3 represented that 80% member liked and 20% disliked the appearance of ripening agent treated banana while 80% liked and 20% dislikedthe color. Flavor of ripening agent treated banana was liked by 40% and disliked by 60% member respectively. Taste was liked by 30% and disliked by 70% member whereas the texture of ripening agent treated banana was liked by 70% and disliked by 30% member, correspondingly.

Figure 2 shows that the shelf-life of the different samples was changed over the period of time where the weight loss of all sample was decreased. At the second day, the weight loss of naturally ripening banana was increased slightly while the weight losswas decreased sharply with the increase inconcentration ofartificial ripening agent (4ml and 8ml). Similar trends were observed at third day. Similar findings were reported in which the shelf life was gradually decreased with increase in concentration of artificial ripening agents [20].

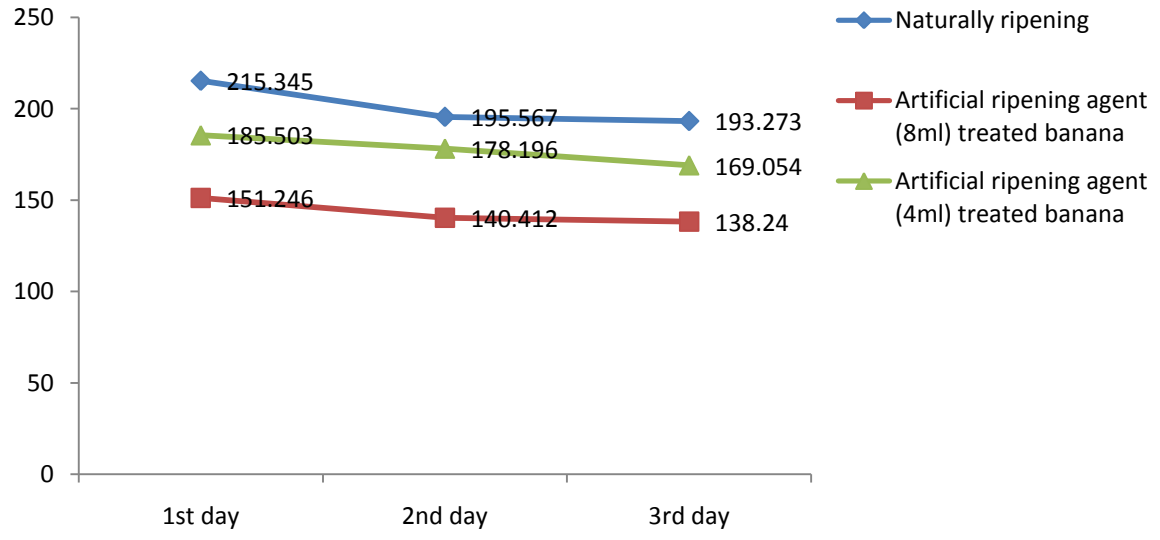


Fig2- Comparison of self-life of naturally ripening banana and different concentration of artificial ripening agent treated banana.

## IV. Conclusion

Banana is an edible fruit which provides high amount of calorie as well as vitamin, mineral and other essential nutrient. It is the cheapest source of nutrient available in the market.It might be concluded that harmful growth hormone and insecticide are being used by the farmer for production of banana and ripening agents are being used in ripening of banana by farmers and traders. Some cultivators have a little knowledge and others have no idea about the harmfulness of using such chemicals.These types of chemicals are most harmful and

responsible for many diseases such as cancer, liver cirrhosis, and abnormal child birth, etc.Proximate composition discovered that the common nutrient contents are more in naturally ripening banana as compare to artificial ripening agent treated banana.Similar trends were continued for vitamin C content but opposite phenomena are seen in the case of shelf life.This study revealed that the responsibleadministration for controlling the usageof growth hormone and ripening agent is not active enough and there has no active market surveying activities by the Government and Non-Government authority.

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