

COMPREHENSIVE INVESTIGATION ON BANANA RIPENING BY USING NATURAL AGENTS AND CHEMICALS

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Abstract

*The objective of this study was to select natural ripening agents in banana ripening that can be a safe agent and can be used as an alternative to chemical agents. For this purpose, some natural medium was selected like Venna leaf (*Ricinus communis* L), Banngi fruit, Ripened banana, Bilimbi fruit (*Averrhoa bilimbi* L) and examined their performance in banana ripening. Results were compared with banana ripened by chemical agents for suitability analysis. This study finds out Venna leaf is more suitable, effective and appropriate for Sobri banana ripening. Bilimbi fruit is another promising agent after Venna leaf in Sobri banana ripening. It gave the same result as like Calcium Carbide (CaC_2) for Sobri banana. Banngi fruit, Ripened banana also gave quite a good result. However, Banngi fruit is costly and damage of the ripened banana started quickly. Ripened banana also gave the same result as like Banngi fruit. Therefore, Banngi fruit and Ripened banana are not preferable. Bilimbi fruit is appropriate and effective for Sagor banana ripening as a natural ripening agent. Venna leaf is another promising agent after Bilimbi fruit, in Sagor banana ripening. It gave the same result as like Calcium Carbide (CaC_2) and Calcium Oxide (CaO). It can be concluded that Venna leaf and Bilimbi fruit can be used as an alternative ripening agent as replacement of Calcium Carbide (CaC_2) and Calcium Oxide (CaO).*

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1. INTRODUCTION

Banana is the ordinary name for herbaceous plant life of the species *Musa* and for their fruit production. It is one of the eldest harvested plants. Preliminary the banana cultivation ensued in pre-Islamic times in India and Southeast Asia. The entire world production of the banana plantation is 145.4 million tons. It was observed that among the overall banana production, 20% is the yield in India, 29.7 million tons and about 29% percent of world whole exports is completed by Ecuador, 5.2 million tons. The area under banana in Bangladesh is about 58,000 hectare and the yearly production is about 1,004,520 metric tons (BBS 2009). Nearby 19.29% of GDP is resulting from agriculture in the fiscal year 2011-12 (BBS-2012). The annual banana production of Tangail district is 152048.20 Metric ton (According to BBS). Bangladesh is a country of the high yielding capacity of bananas. Usually banana plants are found all over the country in most of the pastoral farms.

Among the numeral banana cultivars BARI Kola-1, Amritsagar, Sabri, Champa and Kabri are the commercial cultivators in Bangladesh. There are some others also such as Mehersagar, Dudsagar, Agniswar, Genasundari, Kanaibanshi, Basrai, Binisuta etc. Total assessed banana manufacture was 801000 metric tons in Bangladesh and banana-producing area was 131 acres in 2010-11.

Ripening process

Ripening process is a hereditarily planned with the vastly harmonized method of biological transformation from the immature to the ripe state. Different chemical changes occurred during this process including color, sweetness, softness, and deliciousness (Prasanna V. et al., 2007). Chlorophyll degradation is responsible for changing the color by uncovering the carotenoids existing in the fruit peel and regulating the changes of pigments (John P et al., 1995 and Seymour GB et al., 1993). In the ripening period, the propensity of decreasing unsaturated fatty acids and the small upsurge of

saturated fatty acids concentration was perceived (Palmer, 1971). Ripening comprises some modifications in the matured fruit, which make it fit for human consumption. Changes observed in ripening process like loss of green color and turned into yellow, red and other varieties. Some physiological characteristic also detected as the softness of fruit, the acidity level alteration of pigment which is responsible for characteristic aroma (Chapman G.W. et al., 1990 and Do J.Y. et al., 1969).

Chemical agents in ripening of fruits

Ethylene is the major ripening agent produced naturally in the fruits, which facilitates the ripening procedure (Nagel M.C. et al., 1989). There are multifarious practices of numerous ripening agents, which produce ethylene in order to promptness the ripening procedure. Chemicals like ethanol, methanol, ethylene glycol, ethephon, calcium carbide are used to ripen fruits and vegetables artificially (Chace E.M. 1934; Goonatilake R. 2008; Nagel M.C. et al., 1989). Calcium carbide is widely used in different parts of the world (Hoque M.A. 2012). Calcium carbide originates into the contact of the moisture and releases acetylene, which has fruit ripening characteristics similar to ethylene. Ethephon penetrates plant tissues and is progressively translocate, and it then decomposes into ethylene, affecting the growth process (Tomlin C 1994). Ethephon treatments are known to accelerate the chlorophyll degradation or synthesis of carotenoids by stimulating the synthesis of chlorophyllase enzyme in calamondin tissue, which is responsible for chlorophyll degradation, and expression of β -carotene pigments (Mahajan BVC et al., 1970).

Natural agents in ripening of fruits

Apple is a useful ripening agent owing to faster ripening as compared to the use of controversial calcium carbide and it also reduces the time of ripening Bio ethylene can also be obtained from fruits and vegetable peels which give off relatively high amounts of ethylene (Bautista J. et al., 1990). Fruits of Bilimbi (*Averrhoa bilimbi* L.), also known as

the lime tree or locally as kamias, are believed to be a possible source of bio-ethylene as they were observed to soften fast especially when injured, which could mean that they produce a high level of ethylene. The fruits are commonly used as the food flavoring, as a souring agent for local dishes, or they may be eaten raw. Bilimbi fruit is also used to remove stains on clothes and metal blades and as a hand washes due to its high acidity and high oxalic acid content (Morton J. F. 1987).

Health hazards of chemical ripening agents

Along with the improvement of science and technology, various artificial fruit ripening methods has been perceived generally to fulfill the users' petition and other commercial influences. However, in the recent years, artificial fruit ripening has been considered a matter of concern and the effect of artificial ripening has become questionable because of various health-related issues (Fattah S.A. et al., 2010; Jayan T.V. 2011 and Vila R. 2003). Acetylene is responsible to reduce the oxygen supply into the brain if it consumed directly and can further because prolonged hypoxia (Fattah S.A. et al., 2010). CaC_2 contains traces of arsenic and phosphorus hydride (Delpierre M et al. 1974). It causes several acute and chronic health effects. Calcium Carbide is the alkaline group, which aggravates the mucosal tissue in the intestinal region. An upset stomach after eating carbide-ripened mangoes has been reported recently. Although consumption of the fruit ripened by using calcium carbide might have no immediate allergic response, during the applying procedure on the fruits can causes several harmful effect like confiscation headache, drowsiness, dizziness, frequent thirstiness, annoyance in mouth and nose, faintness, eternal skin damage, swallowing difficulties, nausea, skin ulcer, and so on (Siddiqui M.W. et al., 2010). In humans, acetylene is not acutely toxic below its lower explosive limit of 2.5% and inhalation of 10% acetylene for 1 hr does not cause acute toxicity, whereas inhalation of 33% or 35% cans causes unconsciousness within 7 and 5 min respectively (Bingham E et

al., 2001). Various scholarly sources depict that beside chemical agents, some natural agents have high ethylene production rate. These natural agents might be used as a ripening agent in banana ripening.

The aim of this study was to identify more convenient natural ripening agents in banana ripening that can be used as a substitute for chemical agents without any damaging effect.

2. MATERIALS AND METHODS

Sample Collection

One bunch of Sobri banana was collected from the area of Kayamara, Tangail Sadar and one bunch of Sagor banana was collected from the area of Vinnafoir, Tangail Sadar. The natural ripening agent (Bilimbi fruit, Banngi fruit, Venna leaf, Ripened banana) was collected from the different area of Tangail Sadar. The artificial ripening agent (Calcium Oxide, Calcium Carbide) was provided by research laboratory of the Department of Food Technology and Nutritional Science.

Study area

The analysis has been done in the lab of Food Technology and Nutritional Science department, Mawlana Bhashani Science and Technology University, Santosh, Tangail-1902.

Study period

The study work has been done From May to July 2016.

Data analysis

To get the proper analysis of the study, sensory evaluation was used. This evaluation was done

by a group of trained people consisting 10 members. Initial ripening time (day), changes of texture, physical appearance, and shelf life were observed by this group.

3. RESULTS AND DISCUSSION

Normal ripening process of Sobri and Sagor banana by using natural agents and chemicals is described below.

Sobri banana

There were no significant physical changes occurred in Sobri banana on day 1 and day 2. Physical changes noticed in day 3 showed in Figure 1 and the color turned into light yellow which indicates ripening started in Sobri banana. On day 4, physical changes occurred more than day 3 but not fully ripened. The light yellow color turned into more yellowish but it was not ready to eat. The banana was fully ripened to eat on day 5, the color was more yellowish and the texture was soft than the previous day but damage started in banana from day 6.

Sagor banana

There were no significant physical changes occurred in Sagor banana till day 3. Changes occurred in day 4, but not fully observed by seeing the picture in Figure 1. In day 5 initial ripening started in the banana but not fully ripened. The color turned into green to light yellow and was not ready to eat. The banana was fully ripened on day 6 and was ready to eat. The color turned into light yellow to more yellowish but damage started in banana on day 7.

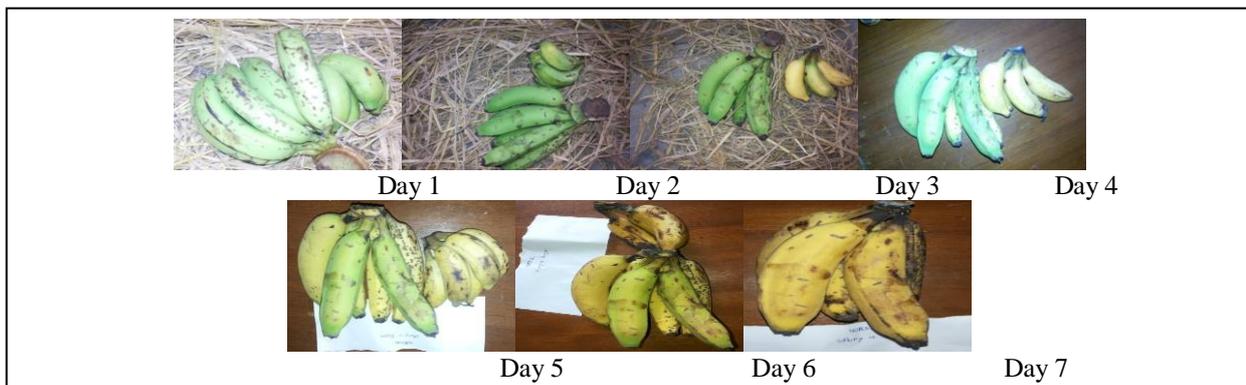


Figure 1. Picture of Sobri (right side, day 1-5), and Sagor (left side, day 1-7) banana ripening in normal way

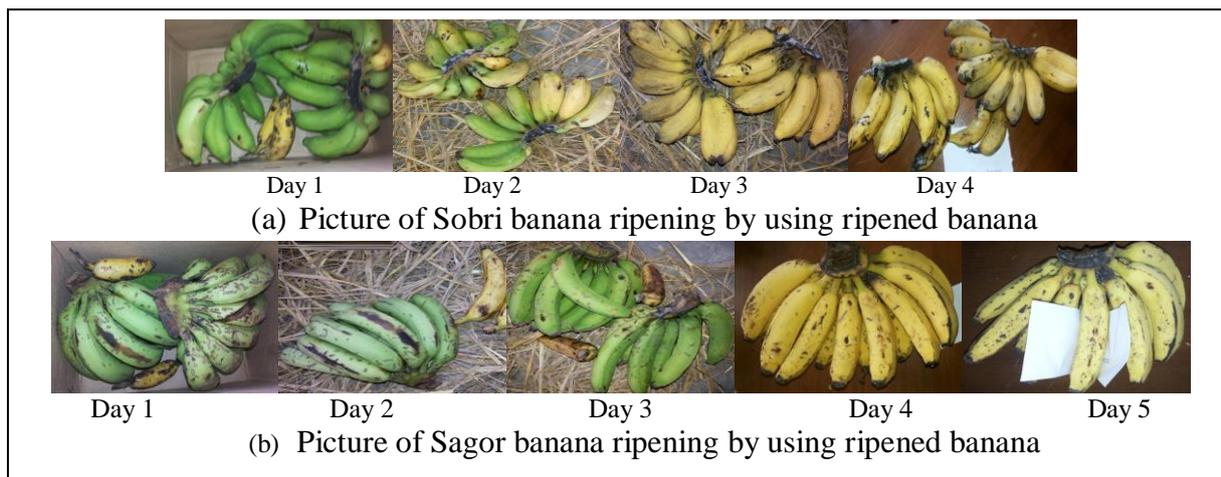


Figure 2. Picture of banana ripening by using ripened banana (a) Sobri, (b) Sagor

Sobri banana

No physical changes occurred on day 1 and it was quite similar with ripening banana by normal way. The physical changes occurred on day 2 and initial ripening started. The green color turned into lightly yellowish presented in Figure 2 (a) and the banana was ripened more quickly than the normal way of ripening. On day 3, there were huge physical changes occurred in banana showed in Figure 2, the color and texture were turned into more yellowish and softer than the previous day. The banana was fully ripened on day 3 and it was surely the more quick process of banana ripening than the normal way. The damage started on day 4 and the shelf life was very little as like normal way of banana ripening. This proved that ripen banana has more ethylene production rate than the normal way of banana ripening. As a result, the banana was ripened so quickly but the shelf life was not too high.

Sagor banana

Figure 2 (b) represents that, there was no significant change noticed in Sagor banana till day 3 by using the ripened banana as a ripening agent. Ripening started on day 4 whereas it was day 5 for naturally banana ripening process. The damage started on day 5 shown in Figure 2 (b) whereas, in the normal way of ripening, it was on day 7. Though ripened banana used as natural agent due to its ethylene production, its effect on ripening banana was not so much

noticeable. It has less effect on banana ripening.

By using Calcium Oxide (CaO)

Sobri banana

No physical changes noticed on day 1 but initial ripening started at day 2. Color lightly changed into from green to yellowish, which showed in Figure 3 (a1). This conditions, is as similar as the ripened banana. The banana was fully ripened on day 3 and ready to eat but damage started on day 4.

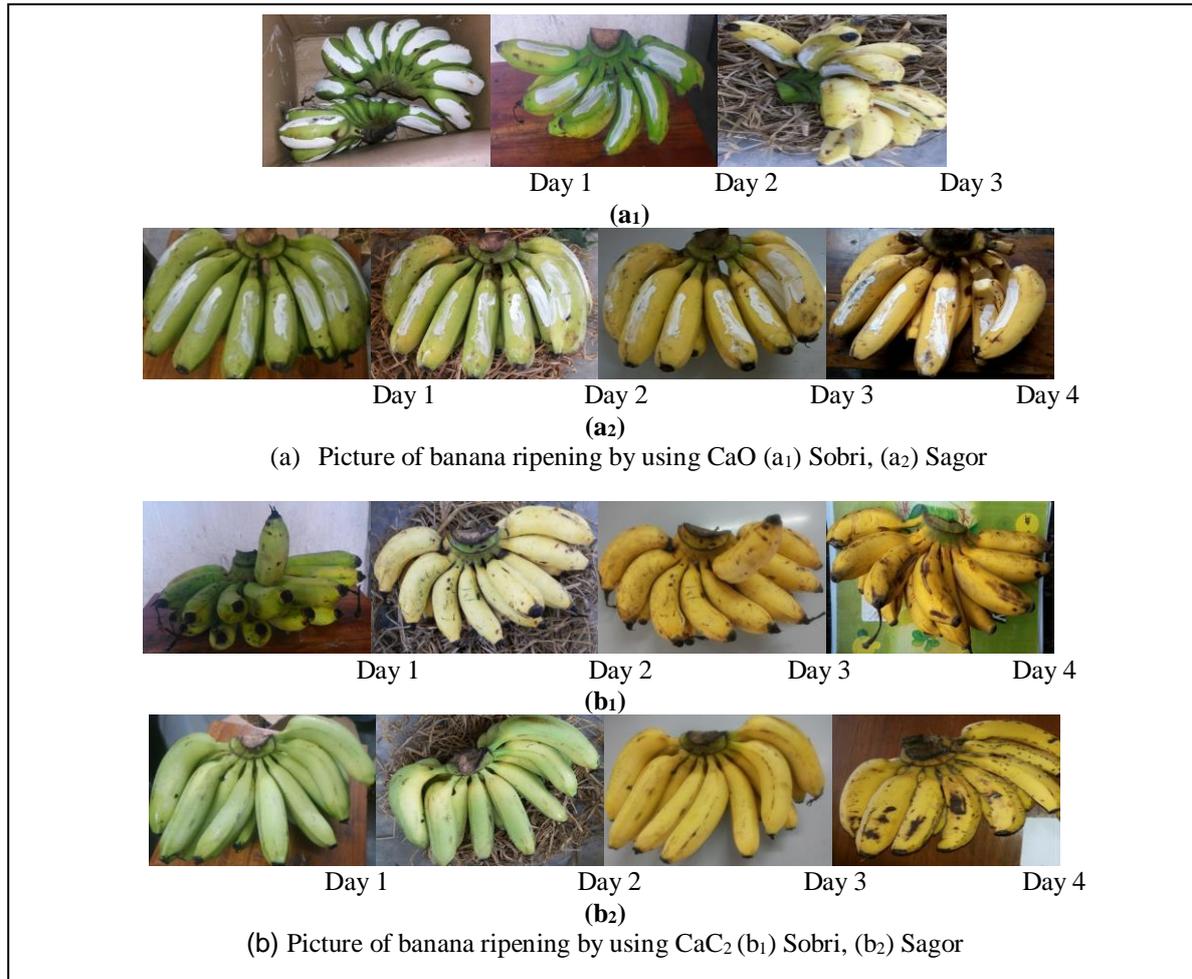
Sagor banana

No physical changes noticed on day 1 as reported in Figure 3 (a2). Initial ripening started at day 2 and color lightly changed into from green to yellowish. On day 3, the banana was fully ripened and damage started on day 4. From this information, Venna leaf, CaC_2 , and CaO this three ripening agents were ripened banana quickly. These have high ethylene production rate and same ripening ability on the banana.

By using Calcium Carbide (CaC_2)

Sobri banana

Ripening started on day 1 and the color was changed into green to light yellow presented in Figure 3 (b1). In comparison to other agents, CaC_2 have huge ethylene production rate and for this reason banana samples initially ripened so quickly.



It was found that CaC₂ was faster than any other agents to ripen banana faster whereas ripening process start from second day by using other agents like ripened Banana, Banngi Fruit and Calcium Oxide (CaO). On day 2, the banana was fully ripened and on day 3 it stayed good enough for 1 day for the first time and not damaged early in Figure 3 (b1). However, CaC₂ has high ethylene production rate and shelf life, as like other agents it started to damage from day 4.

Sagor banana

There were no changes on physical appearance of ripened bananas in first day. Initial ripening started at the end of day 2 and the color turned into lightly yellowish according to Figure 3 (b2). In comparison to another agent, it took short time to ripen banana. The banana was fully ripened on day 3 with very nice color and was ready to eat at any time but damage started

on day 4. It was observed that Sagor banana ripened very quickly by using CaC₂ and applied in the commercial basis. However, as an artificial agent it is harmful to human health; whereas Venna Leaf is a natural agent without any harmful effect on human body.

Ripening banana by using Banngi fruit

Sobri banana

There were no physical changes occurred on day 1 as reported in Figure 4(a). Ripening started significant changes in banana on day 2 and the color turned into green to yellowish. The banana was fully ripened on day 3 and ready to eat but on day 4 bananas started to damage. The shelf life was very little all these agents like the normal way, ripened banana, and Banngi fruit. It can be stated that, after using Banngi fruit, same results were observed as like as ripened banana. But by applying

Banngi fruit as a ripening agent it may produce fungus, off-flavor and acts as a platform to produce microorganisms.

Sagor banana

There were no significant physical changes occurred in banana on first two days by using Banngi fruit as a ripening agent. It was observed that physiological changes occurred on day 3 and the color was turned into

yellowish with the beginning of ripening as presented in figure 4(a). The banana samples were ripened quickly than normal way and ripened banana by using Bangi fruit as a ripening agent. In comparison with this two, Banngi fruit has more ethylene production rate. The banana was fully ripened on day 4 and ready for consumption but damage started on day 5.

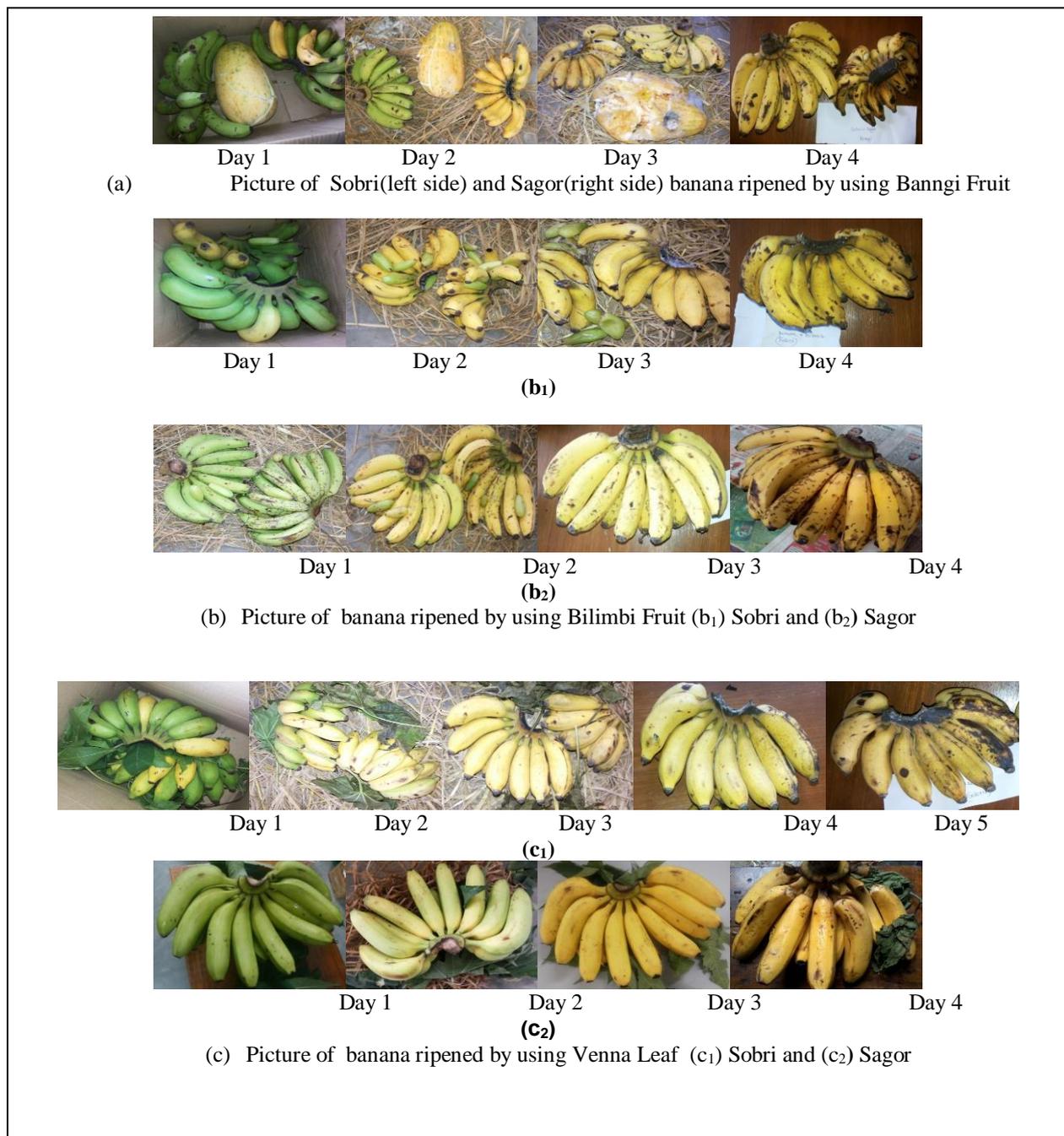


Figure 4. Picture of banana ripening by using (a) Banngi Fruit, (b) Bilimbi Fruit and (c) Venna Leaf

Table 1. Ripening performance of Sobri Banana

Ripening Agent	Ripening Started	Fully Ripened	Scenerosis Happened
1. Normal Way	Day 3	Day 5	Day 6
2. Ripened Banana	Day 2	Day 3	Day 4
3. Banngi Fruit	Day 2	Day 3	Day 4
4. Venna Leaf	Day 1	Day 3	Day 5
5. Bilimbi Fruit	Day 1	Day 2	Day 4
6. Calcium Oxide	Day 2	Day 3	Day 4
7. Calcium Carbide	Day 1	Day 2	Day 4

By using Bilimbi fruit**Sobri banana**

The physical changes occurred on day 1 and banana initially ripened on its first day as similar as CaC₂. Banana fully ripened on day 2, the color turned into green to yellow and ripened very quickly due to high ethylene production rate as like as CaC₂. The ripe banana stayed good for one day and the color and texture were very good to see as represented in Figure 4 (b1). Damaging started at day 4 in the banana but in CaC₂ using, the color of banana was quite damaging than earlier and the texture was scratched in many places whereas it was not found in this process by using Bilimbi fruit. Besides this result, almost all things as similar as ripen by CaC₂. Therefore, it can be stated that Bilimbi fruit is more effective than CaC₂. Though both of this gave the same result, CaC₂ is a chemical agent which is harmful to human being and Bilimbi was a natural agent to ripen banana quickly as same as CaC₂.

Sagor banana

As reported in Figure 4(b2) there were no significant physical changes occurred in banana on the first day and initially ripened on day 2. On day 3 banana was fully ripened, ready to eat and it stayed good enough on day 4. The damage started on day 5. It was found that Bilimbi fruit contributed same ethylene production rate and ripening ability as like Venna leaf, CaC₂, and CaO but it has more shelf life than this agent does.

By using Venna, leaf**Sobri banana**

Physical changes occurred on day 1 and initially ripened on its first day. From the

picture in Figure 4(c1), it was observed that all the banana samples not fully ripened until day 2 but it ripened on day 3 and stayed good enough for 1 day. The color and texture were as good as seen in Bilimbi fruit and damaging started on day 5 whereas in all other agents damaging started on day 4. Though ripening process was not as quick as CaC₂ and Bilimbi fruit occurred but by using Venna leaf as a ripening agent, it was not quickly damaged as like them and it stayed for more time than any agent used.

Sagor banana

There were not enough physical changes noticed on day 1. Initial ripening started on day 2 and the color turned into lightly yellowish at the end of day 2 as presented in Figure 4(c2). The banana was fully ripened on day 3 with very good color and damage started on day 4. It was observed by the information that the Sagor banana was ripened very quickly by using Venna leaf in comparison to ripened banana and Banngi fruit but it has the too short shelf life as same as others stated above.

Overall performance of Sobri banana

Table 1 represents the overall ripening performance of Sobri banana. By using calcium carbide (CaC₂) and Bilimbi fruit, respectively it enhances banana to ripen as quickly as possible. Both these agents have high ethylene production rate and ripen banana quickly, but damaging also started quickly.

CaC₂ is a chemical agent, so it is not appropriate for using due to some hazardous effect. Bilimbi fruit may be effective as bananas found in good condition for one day and started to damage quickly.

Table 2. Ripening performance of Sagor banana

Ripening Agent	Ripening Started	Fully Ripened	Scenerosis Happened
1. Normal Way	Day 5	Day 6	Day 7
2. Ripened Banana	Day 4	Day 5	Day 6
3. Banngi Fruit	Day 3	Day 4	Day 5
4. Venna Leaf	Day 2	Day 3	Day 4
5. Bilimbi Fruit	Day 2	Day 3	Day 5
6. Calcium Oxide	Day 2	Day 3	Day 4
7. Calcium Carbide	Day 2	Day 3	Day 4

Therefore, it cannot be the most effective agent. However, it can be a promising way of ripening banana naturally. Besides these two, other agents like ripened banana, Banngi and CaO have quite similar and less effect on banana ripening.

Venna leaf is the most effective than any other agents in Sobri banana ripening. Though it cannot ripen banana as much quickly as like CaC₂ and Bilimbi after ripening banana it stayed for more time than other did which specifies the higher shelf life by using Venna leaf as a natural ripening agents. As per physiological observation, Venna leaf is the most appropriate natural agent for Sobri banana ripening.

Overall performance of Sagor banana

As reported in Table 2 it can be stated that Bilimbi fruit is more effective and appropriate in Sagor banana ripening. Though ripening agents Venna leaf, CaC₂ and CaO gave the same result as Bilimbi fruit except the shelf life of bananas. It will be mentioned that, shelf life of ripen bananas using these agents is lower than Bilimbi fruit. By applying Venna leaf, CaC₂ and CaO as a ripening agent damage started on day 4 whereas, by using Bilimbi Fruit, it started on day 5 and the samples stayed good for one day more than others did. It has more shelf life than using Venna leaf, CaC₂, and CaO as a ripening agent. It was observed that ripening process of bananas started from day 2 by using Venna leaf, CaC₂ and CaO as ripening agents. This means as a ripening agent Venna leaf, CaC₂ and CaO have equivalent ripening ability. This can also be an alternative

way of banana ripening than applying chemical agents.

4. CONCLUSIONS

Banana is an edible part, which provides the high amount of carbohydrate, vitamin C, as well as mineral (Ca, K, Mg, Fe and ZN). It is the cheapest source of nutrient and also available in the market. The study has been carried out in Tangail Sadar area. Results show that Venna leaf is more suitable, effective and appropriate for Sobri banana ripening and Bilimbi Fruit is appropriate, effective for Sagor banana ripening as a natural ripening agent. Besides these two natural agents, Bilimbi Fruit is another promising agent after Venna Leaf in banana ripening naturally as it gave the same result as like CaC₂ for Sobri banana. Venna leaf is another promising agent after Bilimbi Fruit in the ripening of Sagor banana. It gave the same result as like calcium carbide (CaC₂) and calcium oxide (CaO). This study finds out the solution and it is applied in small scale. This is healthy and totally risk-free, safe and beneficial but it should be applied to large scale and government, non –government authority should work on it.

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