# Effect of Different Forms of Keppetiya (*Croton aromaticus* L.) Leaves on Promotion of Ripening in Banana Variety Embul

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**Abstract**
In commercial fresh fruit trade, artificial ripening is an essential part of the business as ripe fruits are highly susceptible to handling damages and decay. Industrial byproducts such as calcium carbide and ethephon as artificial ripening inducers are widely used by the traders. Since these are quite cheap, excessive doses are used, and traders usually do not follow the methods recommended by the authorities when applying them. Consumption of such products poses health risks, sometimes life threatening. Therefore, the proposed study was conducted as the first step in developing traditionally used biomaterials as organic ripening enhancers and to come up with a sustainable product to be used in fresh fruit ripening industry. Different forms of Keppetiya (*Croton aromaticus)* leaves (paste, aqueous extract, fresh powder and fresh leaves) were evaluated against an untreated control for their ability to promote ripening of banana variety Embul under laboratory scale. Peel colour (*L*, a*, b**), pulp firmness, total soluble solids, titratable acidity and sensory qualities were evaluated. The results revealed that banana variety Embul treated with fresh powder of Keppetiya leaves promoted the ripening of these fruits in contrast to the untreated control.

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## Introduction

Commercially, the climacteric fruits such as banana, mango and papaya harvested at mature green stage are exogenously treated with an ethylene source at the destinations prior to retailing, to get a ripe edible fruit. Currently, calcium carbide, ethephon and ethrel are extensively used by fresh fruit traders as sources of ethylene. However, use of these chemicals on fresh fruit ripening has become a controversial issue. Calcium carbide in particular, has carcinogenic properties as it may contain traces of arsenic and phosphorous hydride. Calcium carbide releases acetylene gas which is an analogue to ethylene that quickens the ripening process. Acetylene gas has unpleasant odour that results in unpleasant flavor of the ripened fruit. It is not only toxic to the consumer but also to the person who handles it. It affects neurological system resulting in headache, dizziness, sleepiness, and mental confusion in short term and in long term it can cause memory loss and cerebral edema (Siddique and Dhua, 2010).

Though relatively less harmful compared to calcium carbide, ripening agents such as ethephon, ethreletc, are also categorized as pesticides (WHO, 1990). Hakim *et al.* (2012) reported that these chemicals alter the nutritional composition of fruits as well as shorten their shelf life on the contrary to fruits ripen naturally. For instance, ethephon treated pineapple, banana and tomato had lesser contents of vitamin C and β-carotene and their shelf lives were shortened by 2, 4 and 5 days respectively, compared to control (naturally ripen) counterparts.

Therefore, it is imperative to develop a sound and sustainable product that can be utilized in commercial fresh fruit trade. Traditionally, biomaterials such as keppetiya (*Croton aromaticus* L) have been used in inducing fruit ripening. Therefore, this study was conducted to evaluate different forms of keppetiya (*C. aromaticus)* leaves (paste, aqueous extract, fresh powder and fresh leaves) for their ability to promote ripening of banana variety Embul under laboratory scale.

## Materials and Methods

Young and immature keppetiya (*C. aromaticus)* leaves were collected from local wilderness and were divided into four equal parts (about 01 kg each). Then, different treatment combinations were prepared as described below.

Firstly, one portion of leaves was cut into fine particles by a scissor. After adding water (t22 $^0$C), the leaves were ground to produce a paste by using a home scale grinder (T1). The second

portion was prepared the same as T1, but theground paste was squeezed through a muslin cloth to get an aqueous extract (T2). The third portion was ground without adding water to produce a fine powder (T3). A portion of intact fresh leaves was taken as the treatment 4 (T4). A banana sample without any biomaterial was used as the control. Banana variety Embul was harvested at their optimum maturity (mature green, round fingers) from a farmer field (Thuruwila, 20 km away from the institute) and transported in a medium sized plastic crate after dehanding. The first and last hands of the bunch were removed to minimize variation due to maturity gradient. The rest were separated into clusters containing 3-4 fingers and mixed well before allocating them into treatments. Approximately one kg of clusters was allocated into each treatment randomly in triplicates. Then the banana samples were kept in a hermetically sealed glass chambers (12 $cm^3$) along with their respective treatments, and were closed by a glass lid. The temperature and RH inside the glass chambers as well as ambient temperature and RH were measured by using temperature humidity meter (TECPEL 322 S) connected with k type thermocouples twice a day (11.30 and 14.30). The chambers were opened at 12h intervals and kept opened for 20 minutes in order to avoid excessive accumulation of carbon dioxide and to facilitate entering of fresh air.

***Data collection:*** One finger from each hand was taken and made into a bulk for collecting initial data (before treatment; also known as day 0 and green mature stage). The weight (top loading balance; OHAUS; model ARA 520), peel colour (colour difference meter; Konica Minolta CR 400), firmness (digital fruit firmness tester; TURONI, 53205), brix (refractometer; ATAGO, HR-5) and titratable acidity (by titrating known volume of juice with 0.1 N NaOH) were measured. The aforesaid parameters were measured again at six days after treatment. A sensory evaluation test (05-point hedonic) was also conducted on this date using a semi trained in-house panel.

***Statistical analysis:*** The treatments were distributed according to a complete randomized design (CRD) with three replicates. Data were analyzed for variance by using SAS (V 9.0, SAS Institute Inc, USA) package. When interactions between treatments were significant ($P \leq 0.05$), the effect of each treatment was determined separating the means by Least Significant Difference (LSD). Data on organoleptic quality was analyzed by Friedman test using MINITAB (V 16, Minitab Inc, USA).

**Results and Discussions**

The average temperature inside the treatment chambers was 34.7±0.1°C and was higher than the ambient temperature by 1.2 °C. Similarly, average RH inside the chambers was 94.5±5.3% and was higher than the ambient RH by 25.8%. It is reported that optimum relative humidity and temperature for ripening are 90-95% and 18-25 °C, respectively (Thompson and Crisosto, 2015). Treatment chambers achieved this optimum RH condition, but not the temperature (data not shown).

***Peel colour and pulp firmness***

At harvesting, bananas were green in colour having $L^*$, $a^*$, $b^*$ values of 52.8±2.3, -18.7±2.2 and 34.7±5.1, respectively. With ripening these three colour coordinates increased showing yellow ripe banana (Table 1). The lowest $a^*$ value indicates higher greenness and, the banana samples treated with aqueous extract, fresh leaves, and the control showed the lower values. Higher $b^*$ value shows more yellowness, but this was not significantly different among the samples except samples treated with aqueous extract. Banana samples treated with aqueous extract showed a significantly lower $b^*$ value (lesser yellowness) indicating delayed ripening than the control and other three treatment groups. The lightness ($L^*$) was not significantly different ($P > 0.05$) among treated and control groups.

At mature green stage, banana pulp had the highest firmness which decreased drastically during ripening despite treated or control (Table 1). However, the degree of reduction varied among the treatments and also with the control. The lowest pulp firmness was observed in samples treated with fresh powder of *Keppetiya* leaves and this was significantly lower than that of the control by 2.4 N.

***Total soluble solids (TSS), titratable acidity (TA) and TSS/TA ratio***

TSS of banana increased rapidly and significantly with ripening in spite of the treated or control. The highest TSS was observed in the samples treated with fresh powder of *Keppetiya* leaves (Table 1) and this was significantly higher than that of the control and other three treatment groups (*i.e.* paste, aqueous extract and fresh leaves). On the contrary to other fruits, generally the acidity of banana increased with

**Table 1**:Mean peel colour (*L*, a*, b**), firmness, TSS and TA of banana variety *Embul* at fully ripe stage (6 days after treatment) as affected by different forms of Keppetiya leaves

| Treatment | Peel colour | | | Pulp firmness (N) | TSS (°brix) | TA (%) |
|---|---|---|---|---|---|---|
| | *L** | *a** | *b** | | | |
| **Paste** | 66.8±3.1 | 3.2±0.7$^{a}$ | 54.0±1.2$^{a}$ | 3.1±1.0$^{b}$ | 22.2±0.06$^{d}$ | 0.469±0.001$^{d}$ |
| **Aqueous extract** | 65.1±3.1 | -3.9±0.2$^{c}$ | 42.4±3.7$^{b}$ | 3.4±0.2$^{b}$ | 22.4±0.06$^{c}$ | 0.301±0.001$^{e}$ |
| **Fresh powder** | 70.4±1.5 | -1.5±1.2$^{b}$ | 52.9±1.5$^{a}$ | 3.0±0.2$^{b}$ | 24.2±0.06$^{a}$ | 1.002±0.002$^{a}$ |
| **Fresh leaves** | 68.8±2.6 | -2.7±0.4$^{bc}$ | 55.3±1.7$^{a}$ | 3.3±0.3$^{b}$ | 22.6±0.06$^{b}$ | 0.738±0.002$^{c}$ |
| **Control** | 67.2±1.8 | -3.4±0.2$^{c}$ | 53.9±1.4$^{a}$ | 5.4±0.5$^{a}$ | 22.1±0.06$^{d}$ | 0.770±0.001$^{b}$ |
| ***P*** | 0.18 $^{NS}$ | 0.0001 | 0.0001 | 0.001 | 0.0001 | 0.0001 |
| ***LSD*** | -- | 1.23 | 3.82 | 0.95 | 0.105 | 0.003 |

Initial (day 0, at green): *L** = 52.8±2.3, *a**= -18.7±2.2, *b**= 34.7±5.1, firmness (N) = 36.4±7.2, TSS (°brix) = 3.6±0.05, TA= 0.506±0.004.
*L** 0=black, 100=white, *a**= (-) greenness, (+) redness, *b** (-) = blueness, (+) = yellowness.
Means in a column with the same letter are not significantly different at ($P< 0.05$) according to LSD.
Each value represents average of 3 replicates ± standard deviation. (n=10 for firmness and colour, n=3 for TSS and TA).

ripening (Pantastico, 1975).Similarly, in our experiment also we observed increased acidity with the progress of ripening. The highest acidity was observed in banana samples treated with fresh powder of *Keppetiya* leaves. Since, the titratable acidity is increased with ripening; the highest TSS/TA ratio (data not shown) does not indicate the highest ripened samples. Therefore, the banana samples treated with fresh powder of *Keppetiya* leaves which showed the highest TSS percentage and the lowest TSS/TA ratio was selected as the best ripening promoter among all the other treatments.

### *Sensory evaluation*

According to sensory evaluation, colour and overall acceptability showed significant difference while there was no significant difference in odour, taste and texture (data not shown). This is because the fruits induced to ripen artificially start the ripening process from its exterior changing the peel colour first while their naturally ripened counterparts initiate ripening from center resulting the change of peel colour as the last event. Thus, the peel colour of artificially ripened ones becomes poor in advance than the naturally ripened ones.

## Conclusion

It was revealed that banana variety Embul treated with fresh powder of Keppetiya leaves accelerated the ripening of these fruitscomparedto the control. Therefore, furtherstudieswill be conducted to develop a sound productwhich can be used as a commercial tool for fresh fruit industry.

## References

Hakim MA, ObidulHuq AK, Alam MA, AlfiKhatib, Saha BK, FormuzulHaque KM and Zaidul ISM 2012. Role of health hazardous ethephone in nutritive values of selected pineapple, banana and tomato. Journal of Food Agriculture and Environment. 10 (2): 247-251.

Pantastico B 1975. Postharvest physiology, handling, and utilization of tropical and subtropical fruits and vegetables AVI Publishing Co. Westport, Connecticut. P.560.

Siddiqui MDW and Dhua RS 2010. Eating artificially ripened fruits is harmful. Current Science. 99: 12-25.

Thompson J and and Crisos to C 2015. Fruit ripening and ethylene management. Department of Plant Sciences-Mail Stop 2, One Shields Avenue, University of California, Davis, CA. 95616-868.

World Health Organization 1990. Public health impact of pesticides used in agriculture. 90/8430, Macmillan/Clays, 4500, England. ISBN: 9241561394. P.103.