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Post-Harvest Ripening of Grapes and Bananas Using Intact Apple, Apple Cut into Pieces and Calcium Carbide: A Comparative Study

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ABSTRACT
The purpose of the study was to demonstrate acquaintance, skills and the traditional know-hows of the post-harvest handling and management of bananas and grapes. Here, the effects of matured intact apple and apple cut into pieces on post-harvest ripening of grapes (non-climacteric fruits) and bananas (climacteric fruits) were studied and the results were compared with those artificially ripened with calcium carbide. The early matured grapes and bananas were individualized in 6 groups i.e. 3 control groups and 3 treatment groups followed by planned treatments for 10 days. The 2 treatment groups (fourth and fifth) were treated with 250 g each of fresh matured intact apple and fresh matured apple cut into pieces. The 1 treatment group (sixth group) was treated with 1 g calcium carbide. All treatment groups are exposed to 85% ± 5% RH and 25 ℃ ± 2 ℃.
KEYWORDS: *Post-harvest ripening, ethylene, calcium carbide, apple, grapes, banana, climacteric fruits, non-climacteric fruits*

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INTRODUCTION

Ripening is the last stage of fruit development, involving a sequence of physiological and biochemical activities that cause the fruit's colour, flavour, fragrance, and texture to change, making it both attractive and healthful [1].In the world, India is considered as one of the biggest producers of bananas out of climacteric fruits. Simplified cultivation procedures, as well as a large demand for and recognition of these fruits in the native markets of these republics, permit their production, even if with poor class and/or productivity [2]. Cooperatives and associations are also key conduits for organising and supporting cultivation efforts for these fruits [3].The farmers of Borborema, Paraíba, Brazil use Bowdichia virgilioides leaves. Like calcium carbide, in banana fruits, these leaves promote respiration and ascorbic acid synthesis while lowering acidity, chlorophyll, and pH [4].The ripening of bananas is influenced by internal factors such as respiration and ethylene production/sensitivity, as well as market demands [5].Bananas for local marketing may be collected at a later stage of maturity, while bananas to be export should be reaped the day earlier or the day of delivery[6].In an event, air conditioning [7] persuades maturity normalization so as to fix commercialization and industrialization of these fruits [8].The acetylene, and the traces of, made from calcium carbide (CaC_2), hasten and normalize ripening (through uniformity of colour) without sacrificing the taste or quality [9]. Such harvests cannot be cast-off in agro-ecological produces [10], however, these have no checks in nation-states like India, Pakistan, Bangladesh and Nepal [11].

Bananas are usually ripened commercially by the traders using calcium carbide, a risky material that can lead to food poisoning and other serious side effects [6, 12]. Because of the chemical reaction of calcium carbide with water, it can cause coughing, headaches, motor coordination issues, mucous membrane and skin burns, respiratory tract inflammation, respiratory system irritation, and a drop in the oxygen flow to the brain [6]. Natural methods are effective and low-cost methods and can escape the injurious health effects of ripening inducers. Merchant banana producers in Borborema polo, Parana state, Brazil, ripe bananas with *Bowdichia virgilioides* Kunth (Fabaceae) leaves, achieving similar effects to calcium carbide but at a lesser cost .B. virgilioides leaves, used for this purpose are collected at the time that is coolest of the day, escaping dew and high humidity during following stages. The bananas are placed over these leaves placed on the ground followed by covering them with plastic sheets to prevent air exchange between the outside and the inside environments. Depending on the quantity of fruits, the cover is left for

24 hours or longer. Here, the proportion of leaves and fruits is not precise though it was later on done by Rivaildo da Costa Nascimento *et.al.* [4] .Keeping in view the use of Bowdichia virgilioides Kunth (Fabaceae) leaves by Merchant producers of the Borborema polo, Paraíba state, Brazil to mature bananas and its mechanism to ripe the bananas, we go through the literature and found that some fruits and leafy vegetables can be the potential ripening agents for bananas as these produce the ripening gas ethylene [13] . A research published in American Journal of Food Technology [14] reveals the potential of Moringa leaves as a natural ripening agent.

A further literature review reveals that there are two types of crop produces i.e. climacteric and non-climacteric. Climacteric produces are the produces those secrete ethylene gas for further ripening after harvesting at early maturation stage whereas non-climacteric produces are the produces those do not secrete ethylene gas for further ripening after harvesting at early maturation stage. In other words, climacteric produces can ripen further on their own after detaching from plant at early maturation stage as they produce ethylene gas hormone whereas non-climacteric produces cannot ripen further on their own after detaching from plant at early maturation stage as they do not produce ethylene gas hormone[15]. Thus, non-climacteric produces like strawberry, grapes and oranges can be simultaneously ripened along with climacteric produces like apples and bananas in a closed environment. It has also been established that ethylene, a plant hormone, is manufactured from every part of higher plants i.e. leaves, roots, flowers, stems, fruits, seedlings and tubers, and that ethylene production plays a vital role in controlling several plant procedures, right from germination to senescence [16].Thus, the various produces of every plant, whether climacteric or non-climacteric, can be ripened on keeping them with these plant parts i.e. leaves, stems, roots, flowers, fruits, tubers, and seedlings. In this research, this theme is taken to the ground and the plant produces bananas and grapes, thus ripened with ethylene secreted by apple, compared with those ripened using calcium carbide.

MATERIAL AND METHODS

Bananas, grapes, apples and calcium carbide were procured from local market. Other materials are also similarly collected.

PROCEDURE

The early matured grapes (non-climacteric fruits) and bananas (climacteric fruits) were divided in 6 groups i.e. 3 control groups and 3 treatment groups followed by planned treatments for 10 days as per Table 1 in plates wrapped with polystyrene film. The weight loss and chlorophyll depigmentation (visual effect)of the fruit were considered as the criteria for ripening.

Table 1. Treatments of grapes (non-climacteric fruits) and bananas (climacteric fruits) for artificial ripening with apples and calcium carbide

9	Non-Climacteric Fruit (1000 g)	Climacteric Fruit (1000 g)	Treatment*
1	Grapes	-	Control Group 1
2	-	Banana	Control Group 2
3	Grapes	Banana	Control Group 3
4	Grapes	Banana	Fresh early matured intact apple (250 g)
5	Grapes	Banana	Fresh early matured apple cut into pieces (250 g)
6	Grapes	Banana	Calcium Carbide (1 g)

*All treatment groups are exposed to 85% ± 5% RH and 25 °C ± 2 °C

RESULTS AND DISCUSSION

The results are displayed in Table 2 below.

Where grapes did not ripe at all alone in Control Group 1, bananas took 9 days in complete ripening alone in Control Group 2; and in Control Croup 3, where bananas completely ripened in 10 days, grapes become partially ripened in the same period. This result is in accordance with the fact that grapes being non climacteric did not produce ethylene after being detached from the plant (Control Group 1) while bananas being climacteric in nature endlessly produced ethylene even after detaching from the plant and got ripened (Control Group 2). In Control Group 3, both fruits got ripened by ethylene produced by bananas; however, bananas took 1 more day than that in Control Group 2. This might be due to the sharing of ethylene produced by bananas. However weight loss remains the same during this period. Now, defining the Groups 4 and 5 where these are treated with 250 g of intact apple and 250 g of apple cut into pieces respectively. The grapes from Groups 4 and 5 took 6 and9 days respectively for complete maturity. The similar trend was followed by bananas from Groups 4 and 5 completely maturing in 4 and5 days respectively. This might be due to the fact that the apple cut into pieces produced less ethylene than the same amount of intact apple[17]. Thus, fruits in contact with intact apple took lesser time to completely got ripened than those in contact with same amount of apple cut into pieces. When compared all these results with those ripened while exposing to 1 g of calcium carbide, grapes and bananas took 4 and 3 days

respectively for complete ripening due to production of ethylene by calcium carbide when come in contact with moisture supplied by test conditions of 85% ± 5% RH.

Table 2. Time taken by grapes (non-climacteric fruits) and bananas (climacteric fruits) for complete ripening after treatment with apples and calcium carbide

Group	Non Climacteric Fruit (1000 g)	Climacteric Fruit (1000 g)	Treatment*	Physiological Weight Loss (%)		Chlorophyll Depigmentation (Visual effect)		Time (Days) taken for ripening# of	
				Grapes	Bananas	Grapes	Bananas	Grapes	Bananas
1	Grapes	-	Control Group 1	2.35%	-	No	-	No Ripening	-
2	-	Bananas	Control Group 2	-	6%	-	Complete	-	09
3	Grapes	Bananas	Control Group 3	4%	5.9%	Partial	Complete	10 (Partial Ripening)	10
4	Grapes	Bananas	Fresh early matured intact apple (250 g)	5.25%	7.5%	Nearly Complete	Complete	6	4
5	Grapes	Bananas	Fresh early matured apple cut into pieces (250 g)	5.5%	6.25%	Nearly Complete	Complete	9	5
6	Grapes	Bananas	Calcium Carbide (1 g)	6%	8.5%	Nearly Complete	Complete	4	3

*All treatment groups are exposed to 85% ± 5% RH and 25 °C ± 2 °C
#Chlorophyll depigmentation (partial or complete) and change in taste to sweeter than earlier

The climacteric induction of respiration by the ethylene emitted by apple and calcium carbide, increased the respiratory rate of bananas and grapes ripened with apples and calcium carbide, respectively. This process is regulated by the activity of phosphofructokinase (8) that produces ATP energy from degradation of starch and hexose oxidation causing in climacteric respiration [18]. In addition, the exposure of the banana fruits to ethylene produced by apples and calcium carbide, respectively, may have upgraded the enzyme activity of oxidase and synthase enzymes of ACC [19] tempting climacteric respiration and rushing maturation. This has been supported by the physiological weight loss of the fruits during treatment, measured on complete ripening and compared with the initial weight.

CONCLUSION

This study reveals that the apple whether intact or sliced can be the ripening agent for both non-climacteric as well as climacteric fruits like grapes and bananas. Calcium carbide traces left after ripening with it is very difficult to wash out from fruits and produce very harmful effects on the body. So, apple can be its safer alternative having similar results as those obtained with calcium carbide.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest. The research received no specific grant from any funding agency in the public, community, or non-for profit sectors.

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