ELEMENTAL ANALYSIS OF DIFFERENT ETHYLENE TREATMENTS ON MUSA

Aye Aye Myint*

Abstract

Ethylene is a naturally occurring plant growth substance that has numerous effects on the growth, development and storage life of many fruits, vegetables. Harvested fruits and vegetables may be intentionally or unintentionally expose to biologically active levels of ethylene and both *endogenous* and *exogenous* sources of ethylene contribute to its biological activity. In this paper the concentration of elements contained in the musa samples were analyzed by using EDXRF method and discussed the effects of different ethylene treatments on the musa.

Keywords: ethylene, biological activity, concentrations of elements, **e**thylene treatment

Introduction

Wonderfully sweet with firm and creamy flesh, bananas come prepackaged in their own yellow jackets and are available for harvest throughout the year. The banana plant grows l0 to 26 feet and belongs to the *Musaceae* family of plants along with *plantains.* The cluster of fruits contain anywhere from 50 to 150 bananas with individual fruits grouped in bunches, known as "hands", containing 10 to 25 bananas.

Bananas are thought to have originated in Malaysia around 4,000 years ago. From there, they spread throughout the Philippines and India. Since the development of refrigeration and rapid transport in the 20th century, bananas have become widely available. Today, bananas grow in most tropical and subtropical regions with the main commercial product including Irrawaddy Division.

Musa

Banana fruits contain high nutrition sources of carbohydrate, minerals and vitamins. A banana is an edible fruit produced by several kinds of large herbaceous flowering plants in the genus Musa. The fruit is variable in size, color and firmness, but is usually, elongated and curved, with soft flesh rich in starch covered with a rind which may be green, yellow, red, purple, or brown when ripe. The fruits grow in clusters hanging from the top of the plant. Almost all modern edible parthenocarpic (seedless) bananas come from two wild species-Musa acuminata and Musa balbisiana.

Scientific classification of banana

Scientific name	:	*Musa paradisiacal* L.
Genus	:	*Musa*
Species	:	*paradisiacal*
Family name	:	Musaceae
English name	:	Banana
Myanmar name	:	Phee-gyan-hnget-pyaw
Distribution	:	tropical and sub-tropical regions of the world
Part used	:	Pulp

* Dr, Lecturer, Department of Physics, Hinthada University

Banana, a wonderfully sweet fruit with firm creamy flesh that available for harvest throughout the year consists mainly of sugars and filers which make it a source of immediate and slightly prolonged energy. When consumed, reduces depression, anaemia, blood pressure, stroke risk, heartburns, ulcers, stress, constipation and diarrhea. It confers protection for eyesight, healthy bones, kidney malfunctions, morning stickness, itching and swelling.

Table 1 The nutrient of Banana.

Nutrient of Banana, fresh 1.00 medium (118.00 grams)	
Vitamin B6	25%
Manganese	16%
Vitamin C	14%
Potassium	12%
fiber	12%
Copper	10%
biotin	10%

Growth Habit

Bananas are today grown in every humid tropical region and constitutes the 4th largest fruit crop of the world. The plant needs 10- 15 months of frost-free conditions to produce a flower stalk. Bananas, especially dwarf varieties, the plant will also need period repotting as the old plant dies back and new plants develop. Eventually producing the terminal inflorescence which will later bear the fruit. Each stalk produces one huge flower cluster and then dies.

Fruit Harvest

Stalks of bananas are usually formed in the late summer and then winter over. Occasionally, a stalk will form in early summer and ripen before cold weather appears. The fruit can be harvested by cutting the stalk when the bananas are plump but green. For tree-ripened fruit, cut one hand at time as it ripens. Once harvested the stalk should be hung in a cool, shady place. Since ethylene helps initiate and stimulate ripening, and mature fruit gives off this gas in small amounts, ripening can be hastened by covering the bunch with a plastic bag.

Ethylene

Ethylene is a naturally occurring plant growth substance that has numerous effects on the growth, development and storage life of many fruits, vegetables. Harvested fruits and vegetables may be intentionally or unintentionally exposed to biologically active levels of ethylene and both endogenous and exogenous sources of ethylene contribute to its biological activity. Ethylene synthesis and sensitivity are changed during certain stages of plant development. Exposure may occur inadvertently in storage or transit from atmospheric pollution or from ethylene produced by adjacent crops. Intentional exposure primarily used to ripen harvested fruit. The detrimental effects of ethylene on quality center on altering or accelerating the natural processes of development, ripening and senescence, while the beneficial effects of ethylene on quantity center on roughly the same attributes as the detrimental effects. A number of techniques to control the

effects of ethylene are discussed in relation to their application with commercially important fruits and vegetables.

Ethylene naturally occurring odourless and coluorless gas, which acts as a growth regulator in plants, and acts as in inhibitor of sprouting in long term storage of potatoes and onions, leaving no chemical residues on the surface of the produce after treatment. It is also used widely in ripening of bananas, citrus and other fruits.

There are two classes of fresh produce in terms of ethylene production. There are climateric products, mainly fruit that pruduce a burst of ethylene as they ripen, as well an increase in respiration and there are the non-climateric products that do not increase ethylene production when they ripen. The moreobvious way of establishing which class a product fits in to is whether or not the product ripens after harvest. Products that ripens after harvest are classed as climateric and they typically ripen by softening significantlv, by changing colour and become sweeter, examples are bananas. Non-climateric fruits do not change significantly after harvest. They will soften a little, lose green colour and develop rots as they become old but they do not change to improve their eating characteristics. Non-climateric crops include leafy vegetables, strawberries and grapes.

Table 2 Examples of climacteric and non-climateric and non-climateric product.

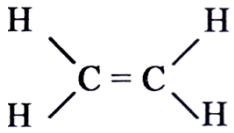
Climateric (Ethylene producting)	**Non-climateric (Non ethylene producing)**
Apples, pears, quince	Cherry, blackbemy, strau, berry
Apricot, nectarine, peach	Eggplant, cucumber, pepper
Mango, avocado, banana	Lemon, orange, mandarin
Tomato, sapodilla	Water melon, honey dew melon
Rock melon, passionfruit	Grape, lychee, loquat

General Information of Ethylene

1. Name (OECD) : Ethylene

2. Molecular formula : CH_2CH_2

3. Structure formula :



4. Use Pattern : Chemical industry; as raw material for synthesis of chemicals, petrochemicals and resins. Minor quantities used for fruit ripening and as an aesthetic gas.

5. Sources of explosure : Fuel, coal, and gas combustion. Leakage from chemical industry.

6. Environment : Ethylene is, due to its physical and chemical properties released mainly into the atmospheric compartment. About three quarters of atmospheric ethylene originates from natural sources.

7. Human Health : Relevant studies have indicated a low toxicity of ethylene and no risk to human health has been identified neither from occupational exposure of general public, either exposed directly or indirectly via the environment.

Experimental Procedure

Sample Collection

Banana hands were harvested at optimum stage of maturity from an orchard near the Hinthada Township. Irrawaddy Division. Mature-green banana samples were used for this experiment.

Ethylene treatment on Musa

There were six treatments of musa and ethylene concentration and post exposure storage temperature on the ripening process of musa. Thus the total number samples in the experiment were six banana hands. The treatments were carried out as follows.

Sample A. Non-treatment Control (72 hr)

Sample B. Exposure to ethylene 2% (48 hr)

Sample C. Exposure to ethylene 2.5% (42 hr)

Sample D. Exposure to ethylene 3% (36 hr)

Sample E. Exposure to ethylene 3.5% (30 hr)

Sample F. Exposure to ethylene 4% (24hr)

The first groups without ethylene treatment were used as controls.

Group II (sample B) were treated with 2% v/v ethylene solution for 5 min at 27˚C.

Group III (sample C) were treated with 2.5% v/v ethylene solution for 5 min at 27˚C.

Group IV (sample D) were treated with 3% v/v ethylene solution for 5 min at 27˚C.

Group V (sample D) were treated with 3.5% v/v ethylene solution for 5 min at 27˚C.

Group VI (sample D) were treated with 4% v/v ethylene solution for 5 min at 27˚C.

Table 3 Ripening conditions for Musa ethylene treatment.

Sample	Temperature (˚C)	% (v/v) of Ethylene	Treatment time (hr)
A	27˚C	control	72
B	27˚C	2%	48
C	27˚C	2.5%	42
D	27˚C	3%	36
E	27˚C	3.5%	30
F	27˚C	4%	24

Plate I Ethylene treatment was used as controls in 5 min at 27˚C

Plate II Ethylene treatment was used as controls in 36 hr at 27˚C

Plate III Ethylene treatment was used as controls in 72 hr at 27˚C

Plate IV Treated with 2% v/v ethylene solution for 5 min at 27˚C

Plate V Treated with 2% v/v ethylene solution for 36 hr at 27˚C

Plate VI Treated with 2% v/v ethylene solution for 72 hr at 27˚C

Plate VII Treated with 2.5% v/v ethylene solution for 5 min at 27˚C

Plate VIII Treated with 2.5% v/v ethylene solution for 36 hr at 27˚C

Plate IX Treated with 2.5% v/v ethylene solution for 72 hr at 27˚C

Plate X Treated with 3% v/v ethylene solution for 5 min at 27˚C

Plate XI Treated with 3% v/v ethylene solution for 36 hr at 27˚C

Plate XII Treated with 3% v/v ethylene solution for 72 hr at 27˚C

Plate XIII Treated with 3.5% v/v ethylene solution for 5 min at 27˚C

Plate XIV Treated with 3.5% v/v ethylene solution for 36 hr at 27˚C

Plate XV Treated with 3.5% v/v ethylene solution for 72 hr at 27˚C

Plate XVI Treated with 4% v/v ethylene solution for 5 min at 27˚C

Plate XVII Treated with 4% v/v ethylene solution for 36 hr at 27˚C

Plate XVIII Treated with 4% v/v ethylene solution for 72 hr at 27˚C

Result and Discussion

In this research work musa were collected from six different ethylene treatment, A=control, B=2% ethylene concentration. C=2.5% ethylene concentration, D=3% ethylene concentration, E=3.5% ethylene concentration, and F=4% ethylene concentration. These musa samples were dried and ground into fine power. These powders use made pallets using hydraulic pallet machine at Physics Department of Taungoo University.

Musa Samples

In powdered musa samples, Potassium (K). Calcium (Ca). Iron (Fe). Manganese (Mn), Rubidium (Rb), Copper (Cu), Zinc (Zn) and Strontium (Sr) elements were detected. All elements are determined as trance level. The elemental concentration for six kinds of Musa samples are shown in Table (4).

Figure (1) shows the comparison of potassium (K) concentration of element analyzed in this work. From this figure, potassium (K) was found in all samples. The amount of ethylene given in Musa increase, the concentration of elements (K) in musa gradually increase and was not much different or little changes in each sample.

Figure (2) shows the comparison of calcium (Ca) concentration of element analyzed in this work. From this figure, calcium (Ca) was found in all samples. The amount of ethylene given in musa increase, the concentration of elements (Ca) in musa gradually decrease and was not much different or little changes in each sample.

Figure (3) shows the comparison of elemental concentration of from (Fe), analyzed in this work. From this figure iron (Fe) was found in all samples. Among then, the concentration of (Fe) in samples (A) was highest and the other rest samples were in random. There was not much different in each sample.

Figure (4) shows the comparison of manganese (Mn) concentration of element analyzed in this work. From this figure, manganese (Mn) was found in all samples. The amount of ethylene given in musa increase, the concentration of elements (Mn) in musa gradually increase and was not much different or little changes in each sample.

Figure (5) shows the comparison of elemental concentration of rubidium (Rb), analyzed in this work. From this figure rubidium (Rb) was found in all samples. Among then, the concentration of (Rb) in samples (C), (E) were highest and the other rest samples were in random. There was not much different in each sample.

Figure (6) slows the comparison of elemental concentration of copper (Cu) analyzed in this work. From this figure copper (Cu) was found in all samples. Among then the concentration of copper (Cu) in sample (A) was lowest and the other rest samples were in random. There was not much different in each sample.

Figure (7) shows the comparison of zinc (Zn) concentration of element analyzed in this work. From this figure, zinc (Zn) was found in all samples. The amount of ethylene given in musa increase, the concentration of elements (Zn) in musa gradually decrease and was not much different or little changes in each sample.

Figure (8) shows the comparison of elemental concentration of strontium (Sr), analyzed in this work. From this figure strontium (Sr) was found in all samples. Among then, the concentration of (Sr) in sample (E) lowest and the other rest samples were in random. There was not much different in each sample.

Table 4 The elemental concentrations of musa control and ethylene treatment by BDXRF Method (Relative concentration %)

Element	Sample (A)	Sample (B)	Sample (C)	Sample (D)	Sample (E)	Sample (F)
K	61.678 %	65.617 %	68.389 %	70.133 %	71.994 %	75.391 %
Ca	31.678 %	27.597 %	24.470 %	22.740 %	20.165 %	16.619 %
Fe	2.449 %	1.849 %	1.706 %	1.259 %	1.427 %	0.987 %
Mn	1.569 %	1.818 %	1.865 %	2.677 %	3.136 %	3.290 %
Rb	1.077 %	1.353 %	1.855 %	1.514 %	1.658 %	2.015 %
Cu	0.607 %	0.809 %	0.792 %	0.852 %	0.945 %	1.070 %
Zn	0.712 %	0.703 %	0.680 %	0.593 %	0.518 %	0.444 %
Sr	0.260 %	0.254 %	0.243 %	0.232 %	0.157 %	0.184 %

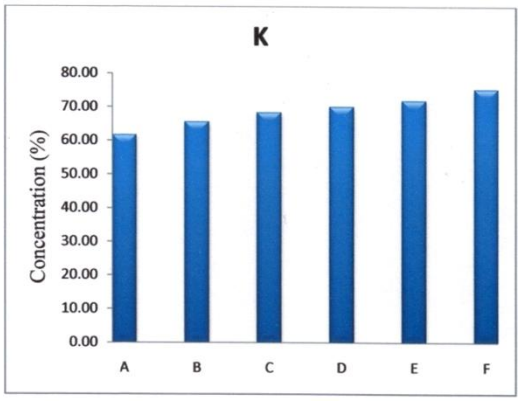


Figure 1 Potassium (K)

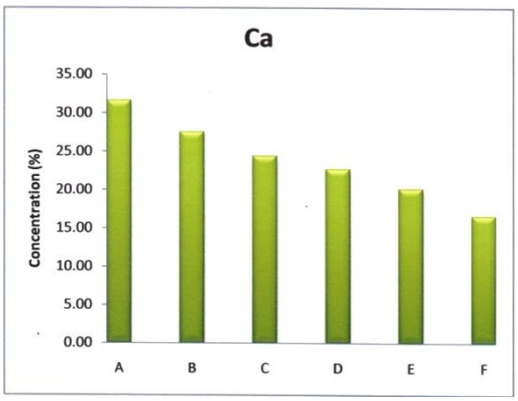


Figure 2 Calcium (Ca)

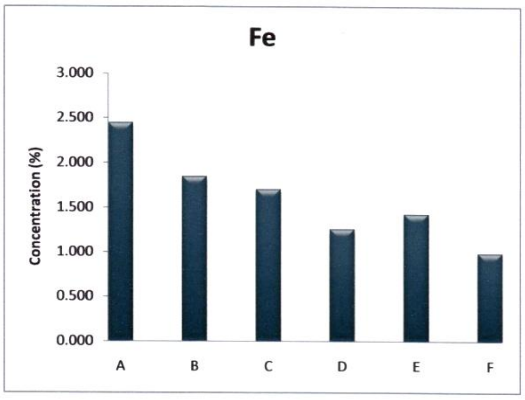


Figure 3 Iron (Fe)

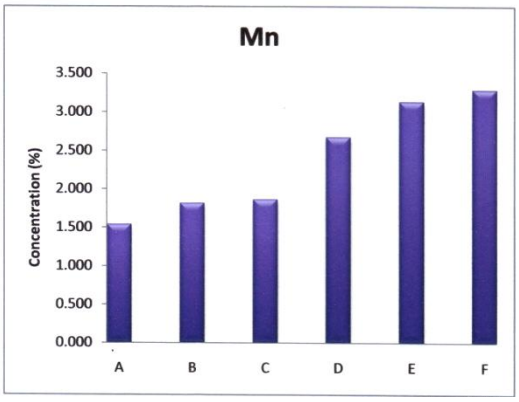


Figure 4 Manganese (Mn)

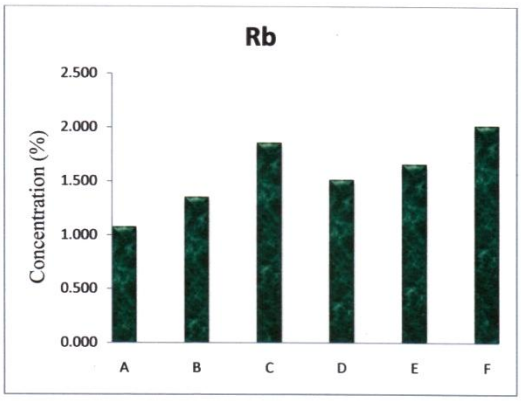


Figure 5 Rubidium (Rb)

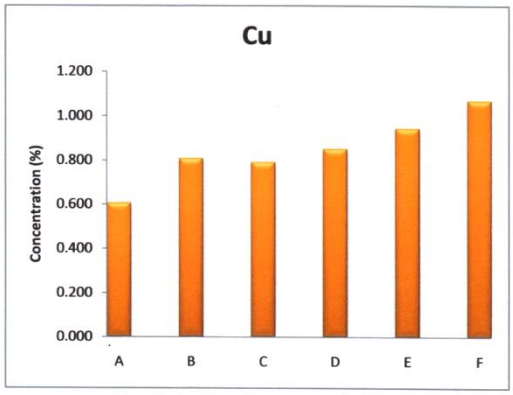


Figure 6 Copper (Cu)

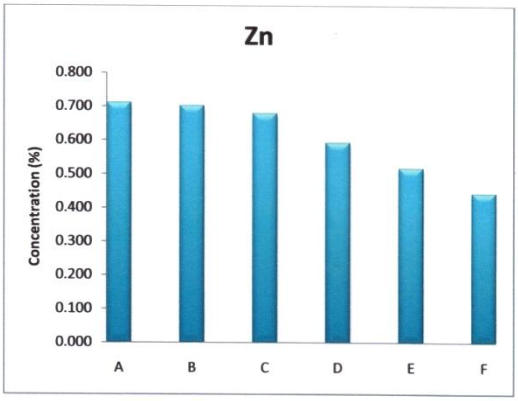


Figure 7 Zinc (Zn)

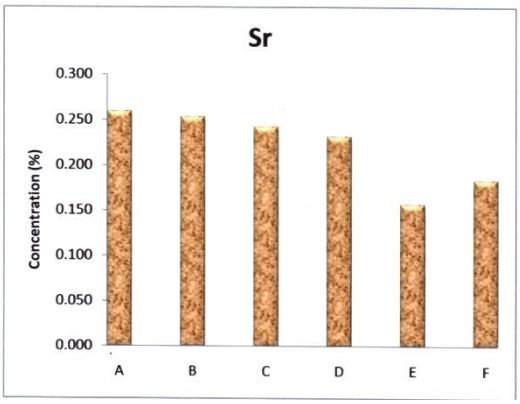


Figure 8 Strontium (Sr)

Figure (1 to 8) Comparison of concentration in six Musa samples (control and Ethylene treatments)

Conclusion

Fruits naturally ripen in trees. But generally 80% fruits are artificially ripened process. Ripe fruits are not suitable to carry and distributed. So unripe fruits and use certain methods to increase the ripening process.

Bananas are the developing world's fourth most important food up (after rice, wheat and maize) in terms of gross value of production. The crop is grown in more than 100 countries through the tropic and sub-tropics.

Banana is highly perishable fruit. It is often harvested in a mature but unripe condition, and is subsequently allowed to ripen further. In natural conditions, bananas ripen slowly, leading to high weight loss, desiccation, ripening is also uneven and fails to develop good colour and aroma. The marketable quality deteriorates.

Bananas are growing in a range of Irrawaddy Division and produce fruit throught the year and produce fruit through the year. However in the colder climatic condition the old type of smoke treatment is crude and ineffective of evolution carbon monoxide is hazardous to health. Improper smoke treatment leads to leads to uneven ripening and also poor external colour.

The present study was taken up to evaluate the effect of ethylene treatment. Commercially ethylene solution was used to ripen various fruits faster than the regular ripening rate of fruits.

The most commenly know use of ethylene is to trigger ripening is some crops, such as bananas and avocados. The concentration of ethylene required for the ripening of different products varies. In general, the concentration applied is within the range of 2% v/v and 3.5% v/v. The time and temperature also influences the rate of ripening with fruit being ripened at temperatures about 27˚C.

During transportation, the naturally ripened fruits may become over ripen and inedible. A part of naturally ripened fruits can also be damaged during difficult conditions of transportation. It is an economic loss for the fruit and marketing to minimize the loss, fruit. Therefore artificially have been ripen fruits before selling to the consumers.

The application of ethylene at a controlled rate means that these products can be presented to customer as 'ready to eat'. A number of techniques to control the effects of ethylene was discussed in relation to their application with commercially important fruits and vegetables.

Acknowledgement

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