

Comparative Studies on the Nutritive Values of Natural Ripen and Artificial Ripen *Carica papaya* L. (Papaya)

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Abstract

In this research work, papaya (*Carica papaya* L., Myanmar name, Thin-baw-thee) was selected for investigation of its nutritional compositions. Papaya fruits were collected from Thazi Quarter, Sagaing Region of Myanmar. In this study, the fruit of papaya were ripened with artificial ripening agent (Ethephon) by dipping and touching methods. And also natural ripening fruit was analysed. In addition, the nutritional contents such as moisture, ash, fat, fibre, protein and carbohydrate of ripening fruit samples were investigated. pH values of papaya samples were also measured by using pH meter. Water and fibre content were determined by AOAC method. Elemental content of natural and treated ripening samples were determined by Energy Dispersive X-ray Fluorescence Spectroscopic (EDXRF) and Atomic Absorption Spectroscopic (AAS) methods. Fat content was determined by Soxhlet Extraction method. The content of protein was determined by Kjeldahl's method. Moreover total sugar, reducing sugar and non-reducing sugar of natural and ethephon treated ripening samples were determined by Somogyi's reagent, using iodometric method.

Key words : *Carica papaya*, papaya, Ethephon

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Introduction

Papaya *Carica papaya* L. is the most edible fruit of the family Caricaceae. The papaya is a delicious and nutritious fruit with a sweet flavor and soft texture. Vitamin C, carotenes and flavonoids are antioxidants present in papaya and also the B vitamins, pantothenic acid and

folate are present. The papaya plants can be grown in many parts of the world. It is a large tree-like plant, with a single stem. It consists of five parts: leaves, fruits, seeds, stem and roots. The most commonly eaten part of the papaya is the fruit. Papaya is high in containing magnesium, iron, copper, several essential amino acid. It contains the enzyme papain. Papaya is one of the trees which is commonly found in Union of Myanmar especially in the upper and lower part of the Myanmar. The present investigations were carried out to study the nutritional content in artificial ripen and natural ripen of papaya fruits. In this research work, the ripening agent is ethephon, dipping and touching methods were used.

Botanical Description

Family	: Caricaceae
Genus	: <i>Carica</i>
Botanical name	: <i>Carica papaya</i> L.
English name	: Papaya
Myanmar name	: Thin-baw-thee
Part used	: Fruit

Health Benefits of Papaya

The papaya fruit is very low in calories and contains no cholesterol. It is a rich source of antioxidant, phytonutrients minerals, and vitamins. It contains soft, easily digestible flesh with a good amount of soluble dietary fiber that helps to have normal bowel movements. It is also rich in many essential B-complex vitamins. These vitamins are essential in the sense that body requires them from external sources to replenish and play a vital role in metabolism. Papaya is a very nutritious fruit. There are many benefits for health and this beautiful orange yellow tropical fruit is proof that nutritious food can also have an amazing taste.

Ethephon

Ethephon, $C_2H_6ClO_3P$ is a plant growth regulator. The chemical name of ethephon is 2-Chloroethylphosphonic acid. Ethephon is used to promote fruit ripening, abscission, flower induction, breaking of apical dominance and other plant responses. It is also used to accelerate

post-harvest ripening. It penetrates into tissues and is translocated. It decomposes to ethylene which is the active metabolite. Although many environmental groups worry about toxicity resulting from use of growth hormones and fertilizers, the toxicity of ethephon is actually very low, and any ethephon used on the plant is converted very quickly to ethylene.

Nutrients

Every person and other living organism needs certain substances called nutrients to build and maintain the body's structure and to supply the energy that powers all vital activities. All nutrients needed by the body are available through food: many kinds and combination of food can lead to a well-balance diet. Each nutrient has specific uses in the body. It is the relationship of food to the health of the body that determines nutritional status. Proper nutrition means that all the nutrients are supplied and utilized in adequate amount to maintain optimal health and well-being.

Aim and Objectives

The main aim of this research is to investigate the nutritional compositions of papaya fruit.

- To determine the nutritional compositions (protein, fat, mineral, fibre, moisture, carbohydrate) of papaya fruit samples using chemical methods
- To determine pH
- To investigate the qualitative elemental compositions of papaya samples by EDXRF
- To determine the elemental compositions by AAS
- To determine the total sugar, reducing sugar and non-reducing sugar contents of papaya fruit samples using chemical methods

Materials and Methods

Sample Collection

Fresh ripe Papaya (*Carica papaya* L.) fruits were collected from Thazi Quarter, Sagaing Region. For study of the effect of ripening agent on papaya cultivar, unripe but mature fruits were also collected.

Sample Treatment

Samples were chosen for artificial ripening. Ethephon imported from China was used as ripening agent. Papaya samples were treated with ethephon in two processes, dipping and touching. In dipping process, samples were dipped with 0.08 % (v/v) of ethephon solution (2.4 ml ethephon in 3 L water) (Figure 1). In touching process, samples were touched with 0.05 ml of ethephon solution (Figure 2). Natural ripen samples were used as control. At the stage of ripening, papaya fruits were peeled and sliced with a stainless steel knife and dried in shade at room temperature. The dried slices were pulverized with the aid of a ball grinder, kept in air-tight bottle for chemical analysis (Figure 3).



Figure 1. Dipping Process of Papaya



Figure 2. Touching Process of Papaya



Figure 3. The Papaya Fruit Samples

Chemical Analysis of Papaya

pH was determined by a pH meter. Moisture was determined by oven drying and ash by dry ashing in a muffle furnace. Crude protein was determined by Kjeldahl digestion method and crude fat was determined by Soxhlet extraction method. Crude fibre was determined by acid-base digestion method. The total carbohydrate content was obtained as the difference between 100 and the sum of percentages of moisture, protein, fat, ash and fibre. The reducing sugar and total sugar were determined by Somogyi's reagent using iodometric technique.

Determination of Elemental Concentrations in Papaya

Elemental compositions in papaya samples were qualitatively determined by using EDXRF-700 spectrometer (Shimadzu Co. Ltd. Japan). EDXRF spectra were recorded at Department of Physics, Mandalay University. The amounts of trace elements were quantitatively determined by Atomic Absorption Spectrophotometric method using a Perkin Elmer A Analyst 800 atomic absorption spectrophotometer (England) at Universities' Research Center, Yangon.

Results and Discussion

Ripening Process (Dipping and Touching) of Papaya Samples

In this research, unripe papaya fruits were subjected to artificial ripening by using ethephon. After treating with ethephon for three days, the papaya fruits started to ripen (Figure 4. a). After another three days, it was noted that ethephon treated papaya fruits ripen with uniform yellow color (Figure 4. b). In this ripening process ethephon penetrates plant tissue and is decomposed to ethylene which accelerates the ripening of papaya fruits. It was also that the ripening (natural) papaya fruit ripen only after eight days of the experiment. It was noted that artificially ripened papaya had black blotches on the skin (Figure 4. c).



(a) (b) (c)

Figure 4. (a) After a three day treatment
 (b) After a six day treatment
 (c) ethephon treated papaya with black blotches

Analysis Data of Natural Ripen and Artificial Ripen Papaya Samples

pH values of artificial ripen papaya samples were 5.6 for touching and 4.9 for dipping processes respectively (Table 1 and Figure 5). Natural ripen sample was found to be 4.7. pH of the samples were acidic due to the presence of organic acids such as citric, malic, tartaric, ascorbic and oxalic acids. Lower moisture content (15.7 %) was observed in natural ripen papaya sample. Moisture contents of artificial ripen papaya samples were found to have (15.9 % and 16.0 %) (Table 1 and Figure 6). Low fat contents (dried-weight basis) were observed in papaya samples (Table 1 and Figure 7). Fat content of natural ripen sample was observed as 0.30 % whereas artificial ripen samples were 0.37 % (dipping) and 0.50 % (touching). Fat contents in their papaya samples were found to be comparable.

Crude fibre percentages of all papaya samples were comparable i.e., 0.70 % for touching, 0.60 % for dipping and 0.40 % for natural sample (Table 1 and Figure 8). Papaya samples were found to have very low fibre contents. Thus, it is well known as fibreless variety. Furthermore, crude protein (%) ranged from 3.36 % to 3.75 % were found in papaya samples (Table 1 and Figure 9). Thus, low protein contents were observed in papaya. Artificial ripen papaya fruits were found to have lower protein content than that of natural ripen fruits.

Ash content in natural ripening papaya fruits and artificial ripen sample dipping and touching samples were 5.70 %, 5.40 % and 5.10 % respectively. Highest amount of ash content was observed in natural ripen sample (Table 1 and Figure 10). High amount of available carbohydrates ranged from 74.15 % to 74.34 % were observed in these two samples (Table 1 and Figure 11). Carbohydrate performs many vital roles in living organisms.

Table 1. pH, moisture and nutritional compositions in natural ripen and artificial ripen (ethepon) Dipping and Touching papaya samples

Sample	pH	Moisture (%)	Crude fat (%)	Crude fibre (%)	Crude protein (%)	Carbohydrate (%)	Available carbohydrate (%)
Natural ripen sample	4.7	57.1	0.30	0.40	0.75	3.70	74.15
Artificial ripen sample (dipping)	4.9	59.1	0.37	0.60	0.40	3.40	74.33
Artificial ripen sample (touching)	5.6	60.1	0.50	0.70	0.36	3.10	74.34

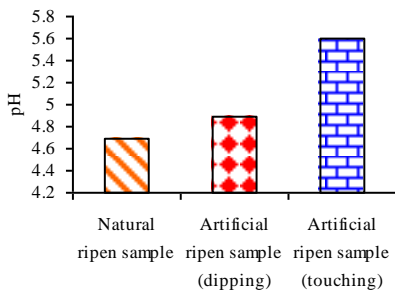


Figure 5. pH in Natural Ripen and Artificial Ripen Papaya Samples

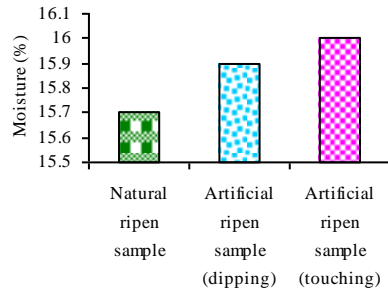
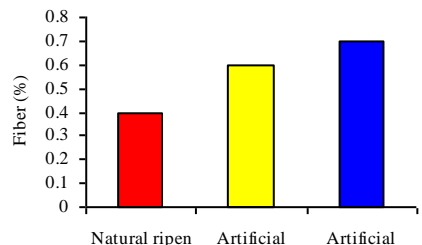
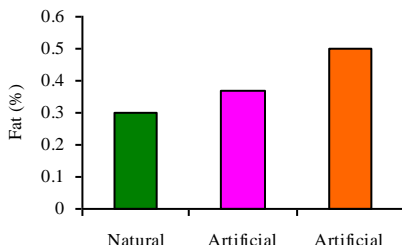


Figure 6. Moisture in Natural Ripen and Artificial Ripen Papaya Samples



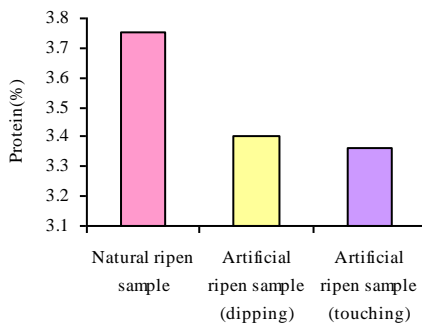


Figure 9. Crude Protein in Natural

Ripen and

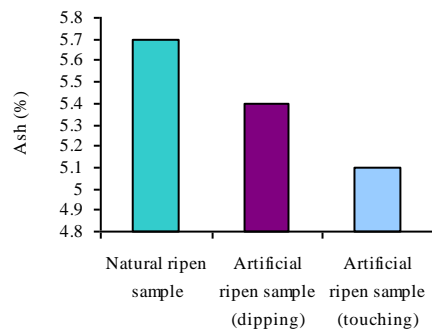


Figure 10. Ash in Natural Ripen

and

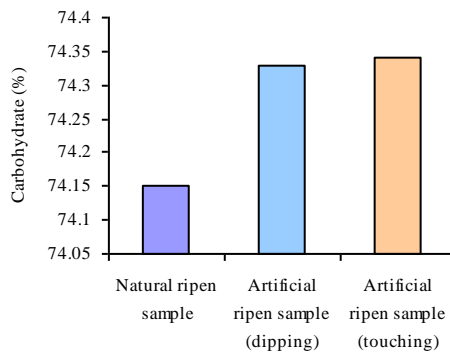


Figure 11. Carbohydrate in Natural

Ripen and

Total Sugar, Reducing Sugar and Non-reducing Sugar in Natural Ripen and Artificial Ripen (Dipping and Touching) Papaya Samples

Table 2 and Figure 12 show the contents of total sugar, reducing sugar and non-reducing sugar in papaya sample. Total sugar contents were 9.90 %, 8.72 % and 7.92 % in natural ripen and artificial ripen (dipping and touching) papaya sample respectively. The total sugar content in a range of papaya is roughly 5-12 g/100 g. Reducing sugar (%) was in the range of 3.078-3.402 % and the values were not much different. Non-reducing sugar percentages were obtained by difference between total sugar and reducing sugar. Reducing sugar as a percentage of total sugar was also shown in (Table 2) and found as 34.36 %, 37.77 % and 38.86 % for natural ripen and artificial ripen (dipping and touching) respectively.

Table 2. Total Sugar, Reducing Sugar and Non-reducing Sugar in Natural

Ripen and Artificial Ripen (Dipping and Touching) Papaya Samples

Sample	Total sugar (%)	Reducing sugar (%)	Non-reducing sugar (%)	Reducing sugar as a percentage of total sugar
Natural ripen sample	9.90	3.402	6.498	34.36
Artificial ripen sample (dipping)	8.72	3.294	5.426	37.77
Artificial ripen sample (touching)	7.92	3.078	4.842	38.86

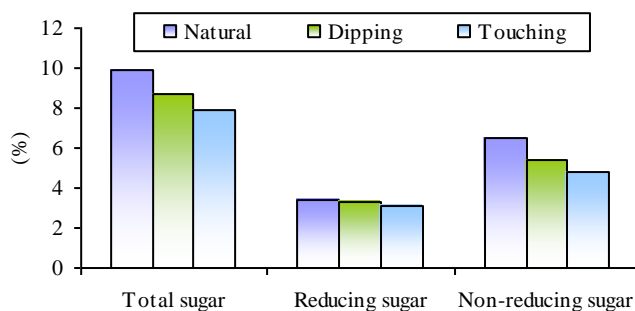


Figure 12. Total Sugar, Reducing Sugar and Non-reducing Sugar in Natural

Ripen and Artificial Ripen (Dipping and Touching) Papaya

Elemental Analysis by EDXRF

Elemental compositions in papaya samples were qualitatively determined by EDXRF Table (3). It was noted that a very high amount of potassium is present in papaya sample. Ca, Fe, Cu and Zn were also observed in the samples. Decreasing order of elemental concentrations in papaya is as follows;

$$K > Ca > Fe > Cu > Zn$$

Very high amount of potassium was observed in papaya samples. Since, potassium is highly essential for humans eating papaya provide health benefits. Calcium is important for bone growth, nerve, muscle function, blood-clotting and teeth. Iron was also found in papaya sample. It is an essential element in body tissue as the form of hemoglobin in blood. Copper stimulates the immune system to fight infections, to repair injured tissues and to promote healing. Zinc is required for normal growth and development, maintenance of body tissues, help antioxidants.

Table 3. Elemental Concentrations (Dry Weight Basis) in Natural Ripen and Artificial Ripen (Dipping and Touching) Papaya Samples

Sample	Mineral Concentrations (%)				
	K	Ca	Fe	Cu	Zn
Natural ripen	0.5 6570	0.1 663	0.0 1304	0.0 0056	0.0 0080
Artificial ripen (dipping)	0.4 4710	0.0 8826	0.0 1165	0.0 0042	0.0 0076
Artificial ripen (touching)	0.4 5980	0.1 410	0.0 0468	0.0 0045	0.0 0067

Elemental Concentrations by Atomic Absorption Spectroscopy (AAS)

Elemental concentrations in natural ripen and artificial ripen (dipping and touching) papaya samples are shown in Table 4. It was observed that papaya contained very high amount of potassium compared to other elements. Potassium contents were 58.67 mg/L, 56.00 mg/L and 56.27 mg/L in natural ripen and artificial ripen (dipping and touching) respectively. Sodium contents were found to be in the range of 25.76-28.68 mg/L. From the result it was shown that the concentration of potassium was about 2 times greater than that of sodium. The ratios of potassium to sodium were 2.05, 2.17 and 2.06 for natural ripen sample and artificial ripen samples (dipping and touching) respectively. Magnesium contents in artificial ripen and natural ripen papaya samples were in the range of 9.47-9.56 mg/L and observed to be comparable. Calcium contents in natural ripen, artificial ripen samples (dipping and touching) were 48.78 mg/L, 34.69 mg/L and 46.76 mg/L respectively. Calcium is an essential nutrient needed to help muscles contract, blood to clot and nerves to carry messages. Iron contents were found to be 23.90 mg/L, 23.32 mg/L and 23.71 mg/L in natural ripen papaya sample and artificial ripen samples (dipping and touching) respectively. Copper contents in natural ripen and artificial ripen samples (dipping and touching) were 3.79 mg/L, 2.45 mg/L and 3.16 mg/L respectively. Very low concentration of zinc (0.37-0.39 mg/L) were found in papaya (Thin-baw-thee) samples. It indicates that papaya contains essential nutrients for our body.

Table 4. Elemental Concentrations (Dry Weight Basis) in Natural Ripen and

Artificial Ripen Papaya (Thin-baw-thee) Samples by AAS

Sample	Mineral Composition (mg/L)						
	a	g		a	e	u	n
Natural ripen sample	8.68	.56	8.67	8.78	3.90	.79	.39
Artificial ripen sample (dipping)	5.76	.49	6.00	4.69	3.32	.45	.37

Artificial ripen sample (touching)	7.25	.47	6.27	6.76	3.71	.16	.38
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Conclusion

In this research work, the papaya fruits were collected from Thazi Quarter, Sagaing Region. These samples were selected for investigation of nutritive values. pH of each of papaya sample was found to be slightly acidic due to the presence of ascorbic acid (Vitamin C). Moisture contents of treated samples were higher than natural ripen sample.

The nutritional composition of papaya in natural ripen and artificial ripen (with ethephon, by dipping and touching methods) were investigated. From the results of EDXRF, papaya samples contained the mineral element as K, Ca, Fe, Cu and Zn. Furthermore, elemental compositions by AAS confirmed the mineral element as Na, Mg, K, Ca, Fe, Cu and Zn in papaya samples.

According to the results, fat, fibre and carbohydrate contents were slightly higher values in treated samples. And also ethephon can convert the carbohydrate or starch to sugars. This fact leads to cause more sweetness after treatment with it. But slightly lower values were observed for protein content in artificial ripen samples. Generally, the data showed slight differences between these two samples.

This study revealed that artificially ripening process by ethephon keeps the fruit with attractive uniform color and minimizes the losses of nutrient compositions. Moreover, among two treating processes, dipping process is seemed to be preferred based on the total sugar (%).

Acknowledgement

I would like to acknowledge Rector Dr Aye Kyaw and Pro-rector Dr Aung Aung Min, Yadanabon University for their encouragement. Grateful thanks are extended to Dr Hlaing Hlaing Myat, Professor & Head of Chemistry Department for providing research facilities.

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