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# Study on the Processing of Quality Improvement of Myanmar Palm Sugar

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## Abstract

Toddy palm jaggery (Myanmar name: Htan-Nyet) is a very important sweet foodstuff in Myanmar. In this study, the characteristics of toddy fresh saps were determined by Association of Official Analytical Chemists (AOAC) method. The effects of storage time on pH of toddy fresh saps (without and with liming) from Thanlyin Township, Yangon Region (TLT) and Pyinmana Township, Mandalay Region (PMT) were investigated. The pH adjustment of toddy fresh sap was carried out by using 10 ml of 5° Be′ milk of lime. An effective production technique was employed to obtain both high quality palm jaggery and palm sugar from toddy fresh sap and processed jaggery. The most suitable conditions for jaggery production were found to be 70 °C and pH 7.5. High quality palm jaggery (an average yield of 14 -18 % based on the palm sap weight) was produced by using a vacuum evaporator. The quality of processed palm jaggeries was determined by AOAC method and compared with those of palm jaggeries from local market. Palm sugar was produced from toddy fresh sap and processed jaggeries at the most suitable temperature of 60$^{o}$ C and pH of 5.5 in a vacuum evaporator to substitute cane sugar in confectioneries. The characteristics of processed palm sugar was also determined by AOAC method and compared with those of commercial palm sugar from local market. In this research, palm sugar from processed palm jaggery was utilized in the production of candy in place of cane sugar. The quality of processed palm candies from processed palm sugars (Grade A and B) were also compared with that of commercial candies from cane sugar.

***Keywords***: Palm Jaggery
Grade A Palm Sugar (Sugar from A Massecuite from Vacuum Evaporator)
Grade B Palm Sugar (Sugar from B Massecuite from Vacuum Evaporator)

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## Introduction

Asian palmyra palm or toddy palm (Botanical name - *Borassus flabellifer* L. and Myanmar name - Htanbin) is one of the tall dioecious palms of the family Palmae (Arecaceae). Sap of palmyra, Htan-Yei, is also known as toddy palm juice. Htan-Yei is of two kinds: Htan-Yei-Jo, the sweet toddy and Htan-Yei-Gar, the bitter one. There are two types of palm tree — male and female toddy palm, shown in Figures (1) and (2), (wikipedia.org/wiki/Borassus).

In Myanmar, Htan-Yei-Jo is either made into brown sugar called jaggery, or fermented into alcoholic Htan-Yei-Gar. In almost all the producing areas there are some places or localities which are noted for the manufacture of special quality jaggery. About 40 % of jaggery production was employed to produce palm sugar. The main aim of this research work is not only to show the private sector that improvement can be made in the production of better quality jaggery but also to indicate that quality sugar and sugar product can be made from palm juice and jaggery (Kyaa Nyo, 2000).

The fresh sap of palmyra palm, called “sweet toddy” or “Htan-Yei-Jo”, contains about 12 % of sucrose. While fresh sap, tapped from the palmyra tree, is transparent, pleasant-smelling and sweet. 100 liters of sap give 7–8 kg of sugar and 8 kg of molasses. Unless suitably treated, fermentation into toddy starts almost immediately after collection. Toddy is a pale frothy liquid with a characteristic aroma, and a slightly acid and pungent taste. Its nutritive value depends on small amounts of sugar and yeast in it (Council of Scientific & Industrial Research, 1948).

Htan-Nyet is a dark solid with a characteristic flavor. Sometimes it is also treacle, especially if sugar has suffered inversion. Different grades or types of palm jaggery are produced in Myanmar. The quality of each type varies according to color, hardness and the size of the balls (Director of Agriculture, Myanmar, 1951).

**Fig. (1)** Female toddy palm in TLT

**Fig. (2)** Male toddy palm in PMT

## Materials and Methods

### Sampling

The toddy fresh saps were collected from male and female toddy palm trees (Htabo and Htama) in Thanlyin Township, Yangon Region (TLT) and Pyinmana Township, Mandalay Region (PMT). In this research, the fresh saps from (TLT and PMT) were taken into 2 liters sterilized pots containing $5^{o}$ Be′ milk of lime in the early morning to prevent fermentation before measurements were performed.

### Processing of Palm Jaggery from Toddy Fresh Sap

1 liter of fresh sap (pH 7.5), leaving behind the sediment of lime by filtration, was transferred into a stainless steel boiling pan and boiled by using a vacuum of 660 mmHg at about 70 °C for nearly 30 minutes. After 15 – 20 minutes of boiling, a white scum rose to the surface which was skimmed off. The boiling was continued until the suitable condition for moulding of toddy palm syrup was obtained.

After that, toddy palm syrup was cooled to 35 – 40 °C and moulded into granules by hand. Then it was also dried at room temperature for about 30 minutes and processed palm jaggery was obtained.

### Processing of Palm Sugar from Toddy Fresh Sap

About 1 liter of toddy fresh sap was treated with 10 ml of 5°Be′ milk of lime and filtered with filter cloth. 750 g of filtered toddy palm sap was added into a 1.5 liters glass container, and heated to 70 – 75 °C in a water bath. The sterilized toddy palm sap was maintained at pH value of 8 – 8.6 by adding pre-calculated amount of milk of lime.

After liming, pH of toddy sap was maintained at pH 7.2 – 7.4 by passing 12 – 16 % of $SO_2$ gas into it. The sulphited toddy sap was again heated at 102 – 104 °C and kept at room temperature for 30 minutes to complete precipitation and settling. The clear portion was decanted and the rest of the solution (muddy juice) was filtered with filter cloth. The collected clear juice was evaporated up to 60 – 65 °Brix. Then, the evaporated syrup was again sulphited until its pH also decreased to 5.0 – 5.5 and boiled at 60 °C under vacuum of 660 mmHg in a vacuum pan, shown in Figure (3). When syrup reached to 92 – 94 °Brix, it was decolorized with 0.1 g of $Na_2S_2O_4$. After that, crystallization of sugar was conducted by seeding of 10 g of sugar (-48 mesh size sugar crystals) and then stirred at a speed of 0.5 rpm at 30 – 50 °C until sugar crystallization completed as shown in Figure (4).

The sugar crystals known as Grade A sugar in massecuites were separated from the mother liquor by centrifugation as shown in Figure (5). The molasses, leaving from Grade A sugar processing (A-Heavy Molasses), was boiled in the vacuum pan by using a vacuum of 660 mmHg at about 60 °C to produce Grade B sugar. The molasses, leaving from Grade B sugar (B-Heavy Molasses), was again boiled in the vacuum pan by using a vacuum of 660 mmHg at about 60 °C to produce Grade C sugar. The prepared sugar crystals (Grade A, Grade B and Grade C) were dried in an oven at 55 $\pm$ 5 °C for 15 minutes and then cooled and weighed respectively.

**Preparation of Palm Sugar from Processed Palm Jaggery**

Palm jaggery 500 g was diluted with warm water (50 – 55 °C) to reach the soluble solids content of 32 °Brix. The jaggery solution was added into a 1.5 liters glass container, and heated to 70 – 75 °C in a water bath. The sterilized jaggery solution was maintained at pH value of 8 – 8.6 by adding pre-calculated amount of milk of lime. After liming, the palm sugar was prepared by using the same procedure in processing of palm sugar from toddy palm sap.

**Fig. (3)** Vacuum pan evaporator for preparation of palm sugar

**Fig. (4)** Crystallization of palm sugar

**Fig. (5)** Basket centrifuge for separation of palm sugar from molasses

**Processing of Candy**

In candy production, 30 kg of processed palm sugar and 20 kg of maltose were boiled in a tank of 5 – 6 kg/cm$^2$ steam pressure and at 100 – 105 °C for 10 minutes. The syrup from the boiling tank was cooked in an automatic continuous vacuum cooker, shown in Figure (6), using 7.5 kg/cm$^2$ steam pressure at 135 – 140 °C for about 15 minutes. Then the syrup was mixed with other ingredients such as citric acid, malic acid, color and flavor and stirred for about one minute to complete mixing.

After that, the syrup mixture was cooled to rigid syrup on the cooling table for about 10 minutes and kneaded to improve its rigidity and consistency for about 10 minutes, shown in Figure (7). The rigid syrup was rolled in a batch roller and sized by using a rope sizer to get the desired dimension and then to the automatic molding machine. After that the sugar candies were cooled in a cooling tunnel at 38 – 43 °C for about 15 minutes. Finally, the processed palm candies were cooled and wrapped with pillow wrapping machine and also packaged with bench type automatic sealing machine; fifty candies per package.

**Fig. (6)** Vacuum cooker for cooking of palm sugar and maltose

**Fig. (7)** Kneader

## Results and Discussion

### Characterization of Toddy Fresh Saps

The physico-chemical characteristics of toddy fresh sap samples from (TLT and PMT) were determined immediately after collection and the results are shown in Tables (1) and (2) respectively.

Characteristics of male and female toddy fresh saps from (TLT and PMT) after liming with 10 ml, 20 ml and 30 ml each of 5° Be´ milk of lime were also determined. According to the results, pH, soluble solids and reducing sugars contents of toddy fresh saps were generally increased whereas sucrose contents of the saps were decreased with increase in dosage of lime. Figures (8) and (9) show variation of pH of toddy fresh saps from (TLT and PMT) (without and with liming) with respect to storage time.

### Influences of Operating Conditions on Yield and Quality of Palm Jaggery

#### *Effect of pH on Yield of Palm Jaggery*

Figure (10) indicates that the average yield of jaggeries with respect to pH value of fresh saps from male and female toddy palms of (PMT). These results indicated that a good flavor jaggery was obtained at the pH value of 7.5 of limed fresh sap (dosage: 1 mg/l of lime) with yield percent of about 17 %. Although a higher yield percents of jaggeries from limed fresh saps at pH 8.5 and 9.5 were observed, flavor of lime has influence on the flavor of these jaggeries due to the presence of excess amount of lime in them. As a result, the most suitable pH of toddy fresh sap for jaggery production was found to be 7.5.

#### *Effect of Temperature on Yield of Palm Jaggery*

Figure (11) shows the average yield percent of jaggeries at different cooking temperatures (50 $^{o}$C to 80 $^{o}$C) of palm sap from (PMT) at the most suitable pH of 7.5.The highest yield percent of jaggery was found at the boiling temperature of 70°C. At this temperature, the most favourable color and flavor of palm jaggeries were obtained according to the organoleptic properties as shown in Figure (12). The yield of jaggery was found to be the lowest at 80 °C and the color and flavour of processed jaggery were darker and a little bit bitter respectively.

### Characterization of Processed Jaggeries and Jaggeries from Different Sources

It was found that moisture, fat and ash contents of processed jaggeries from (TLT and PMT) were lower than those of jaggeries from different sources and Indian Standard. In contrast, protein, nitrogen and sucrose contents of processed jaggeries were relatively higher

than those of jaggeries from different sources whereas these values were slightly lower than Indian Standard. The invert sugar content in processed jaggeries was considerably lower than that of jaggeries from different sources. From these results, it was obvious that the quality of processed jaggeries was better than that of jaggeries in local market.

**Effect of Operating Conditions on the Characteristics and Yield Percent of Palm Sugar from Processed Jaggery of (PMT)**

***Effect of Temperature***

The effect of temperature on the properties and yield percent of palm sugar was conducted using processed jaggery at pH 6.5. Among the different boiling temperatures, 60 $^{o}$C is the most favorable condition since it gave the average highest total yield of sugar (Grade A, B and C) 46.61 % from jaggery of male toddy fresh sap and that of 46.16 % from jaggery of female toddy fresh sap. The average yield percent of prepared Grade A, B and C sugars from male and female palm jaggeries from (PMT) at various temperatures is shown in Figure (13). About 26.46 % and 25.5 % Grade A sugar, 12.13 % and 12.35 % Grade B sugar and 8.02 % and 8.31 % Grade C sugar from jaggeries of male and female toddy palm saps were obtained at the most suitable temperature 60 °C, respectively.

***Effect of pH***

About 29.22 % and 29.4 % Grade A sugar, 14.61 % and 14.7 % Grade B sugar and 9.75 % and 9.80 % Grade C sugar from jaggeries of male and female toddy palm saps of (PMT) were respectively obtained at the most suitable pH 5.5 and boiling temperature 60°C.

**Effect of Operating Conditions on the Characteristics and Yield Percent of Palm Sugar from Toddy Fresh Sap of (PMT and TLT)**

***Effect of Temperature***

The average yield percent of Grade A and B sugars from male and female toddy fresh saps from (PMT and TLT) were determined at various boiling temperatures as shown in Figure (14). It can be seen that the highest yield percent of both Grade A and B sugars were obtained at the most suitable temperature 60 °C.

***Effect of pH***

The average yield percent of Grade A and B sugars from male and female toddy fresh saps of (PMT and TLT) were determined at various pH of toddy fresh saps. It was found that the highest yield percent of both Grade A and B sugars were obtained at the most suitable pH 5.5 and the most suitable boiling temperature 60 °C.

**Characterization of Palm Sugar from Toddy Fresh Saps and Processed Jaggeries**

The physico-chemical characteristics of palm sugar from male and female toddy fresh saps (PMT and TLT) and processed jaggeries (PMT) were determined. It was interesting that relatively lower amounts of moisture, ash, color, reducing sugars and residual sulfur dioxide were observed for all studied samples as compared to those of standard value.

Percent of polarization and sucrose content of processed palm sugar were in accordance with literature value: ≥ 95 % for polarization and 95 % for sucrose. It was evident that a good quality palm sugar was obtained from both toddy fresh saps and processed jaggeries. The prepared Grade A, B and C palm sugars are illustrated in Figure (15).

**Physico-chemical Characteristics and Organoleptic Examinations of Processed Candy**

The Physico-chemical characteristics of processed candy from prepared Grade A and B palm sugars were compared with those of candy from cane sugar (local market). Moisture content of candy from Grade A palm sugar was less than that of candy from Grade B palm sugar and a slightly greater than candy from cane sugar. Ash contents of processed candies were nearly the same with each other. From the results of organoleptic examinations for candies, it was found that the color, texture, flavor and appearance of prepared candies were approximately the same as candy from cane sugar. The prepared candy from Grade B palm sugar was a little inferior to candies from Grade A palm sugar and from cane sugar. The quality of processed candy from Grade A palm sugar did not change within six months but color of candy from Grade B palm sugar changed a little bit from original or fresh candies. Processed candies with different flavors from Grade A palm sugar and Grade B palm sugar are shown in Figures (16) and (17) respectively.

## Conclusion

The present research work was mainly concerned with the examination of quality of toddy fresh sap and processed jaggeries from (PMT and TLT) and jaggeries from different sources, such as Mahlaing, Myingyan, Mawlamyaing and Kyaukpadaung.

The effective production technique of some palm products regarded as their quality and the improvement of present traditional jaggery production. The defecation process of toddy fresh saps can also be employed to improve the quality and yield of processed jaggery and palm sugar. The collection of toddy fresh sap could be made easier by using suitable collection methods.

**Table (1) Characteristics of Toddy Fresh Saps from (TLT)**

Sampling date : November, 2006 and November, 2007 (from Male Toddy Palm)

January, 2006 and January, 2007 (from Female Toddy Palm)

| Characteristics | Toddy Fresh Sap (Collected in 2006) | | Toddy Fresh Sap (Collected in 2007) | | Standard | |
|---|---|---|---|---|---|---|
| | Male Toddy Palm | Female Toddy Palm | Male Toddy Palm | Female Toddy Palm | FAO | India** |
| pH | 6.8 | 6.6 | 6.8 | 6.7 | 6.7-6.9 | - |
| Acidity, (%) | 0.032 | 0.050 | 0.035 | 0.041 | - | - |
| Specific Gravity | 1.16 | 1.27 | 1.22 | 1.26 | 1.07 | - |
| Ash, (%) | 0.26 | 0.37 | 0.31 | 0.35 | 0.54 | 0.29 |
| Soluble Solids, (Brix) | 12.4 | 12.6 | 12.2 | 12.4 | - | - |
| Reducing Sugars, (g/100 cc) | 0.33 | 0.26 | 0.45 | 0.14 | 0.96 | 0.4 |
| Sucrose, (g/100 cc) | 10.63 | 11.27 | 11.06 | 12.10 | - | 11.6 |
| Protein, (%) | 0.24 | 0.36 | 0.26 | 0.39 | 0.35 | 0.23 |
| Nitrogen, (%) | 0.038 | 0.058 | 0.042 | 0.062 | 0.056 | 0.037 |
| Bacteria, (SPC) | $4 \times 10^6$ | $5 \times 10^7$ | $5 \times 10^5$ | $3 \times 10^6$ | $1.5 \times 10^8$ | - |

**Note:** SPC = Special Plate Count

**Table (2) Characteristics of Toddy Fresh Saps from (PMT)**

Sampling date : April, 2006 and April, 2007 (from Male Toddy Palm)

July, 2006 and July, 2007 (from Female Toddy Palm)

| Characteristics | Toddy Fresh Sap (Collected in 2006) | | Toddy Fresh Sap (Collected in 2007) | | Standard | |
|---|---|---|---|---|---|---|
| | Male Toddy Palm | Female Toddy Palm | Male Toddy Palm | Female Toddy Palm | FAO | India** |
| pH | 6.5 | 6.9 | 6.6 | 6.9 | 6.7-6.9 | - |
| Acidity, (%) | 0.147 | 0.026 | 0.048 | 0.023 | - | - |
| Specific Gravity | 1.13 | 1.29 | 1.27 | 1.36 | 1.07 | - |
| Ash, (%) | 0.39 | 0.32 | 0.42 | 0.33 | 0.54 | 0.29 |
| Soluble Solids, (Brix) | 13.4 | 13.0 | 13.2 | 13.0 | - | - |
| Reducing Sugars, (g/100 cc) | 0.26 | 0.42 | 0.22 | 0.38 | 0.96 | 0.40 |
| Sucrose, (g/100 cc) | 12.3 | 11.05 | 12.6 | 11.2 | - | 11.6 |

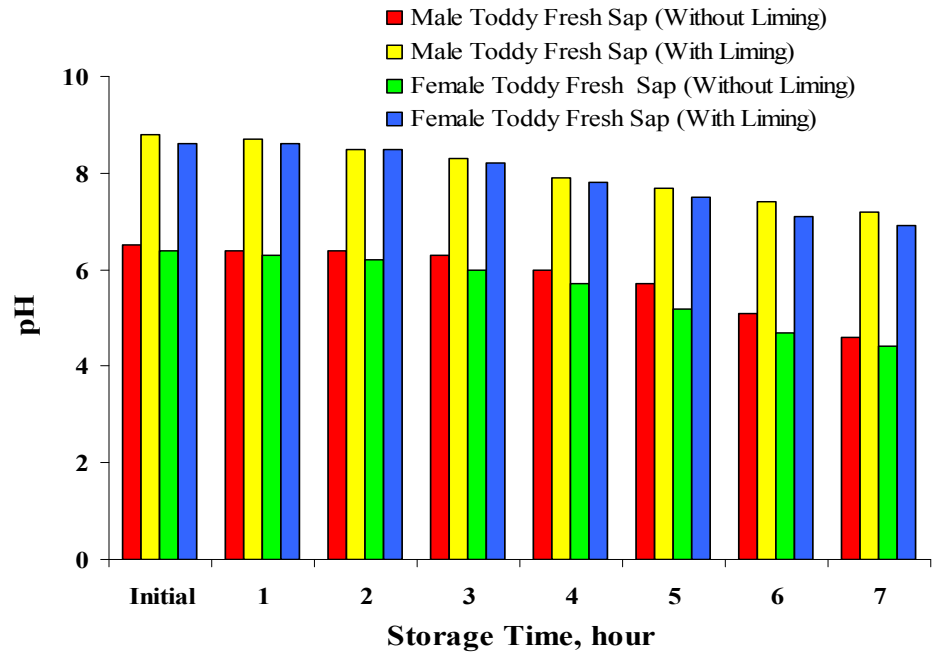


**Fig. (8)** Variation of pH of toddy fresh saps from TLT (Without & With Liming) with respect to Storage Time

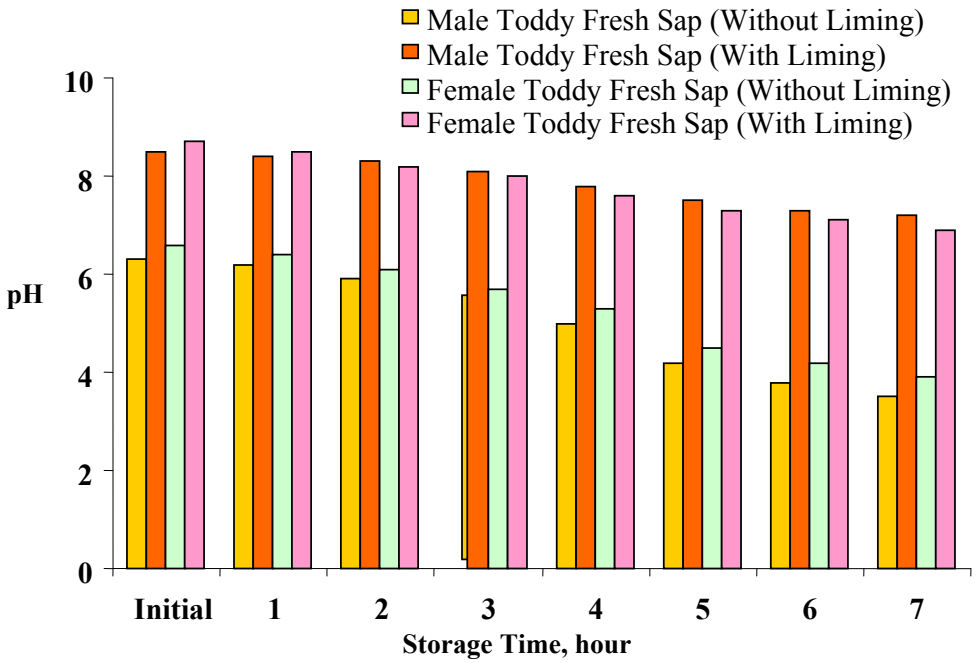


**Fig. (9)** Variation of pH of toddy fresh saps from PMT (Without & With Liming) with respect to Storage Time

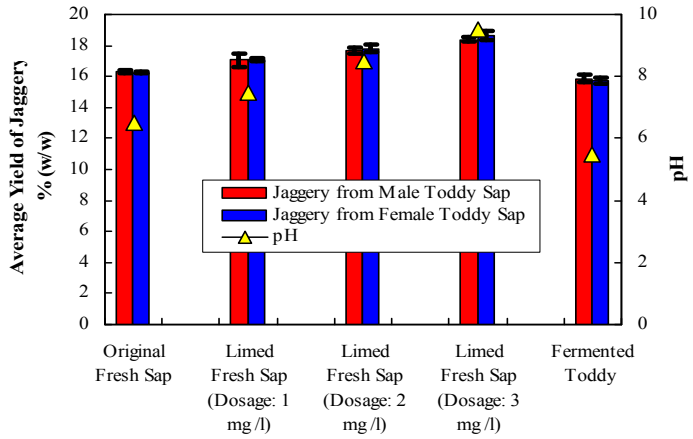


**Fig. (10)** Average yields of processed jaggeries with respect to pH value of fresh saps from male and female toddy of (PMT)

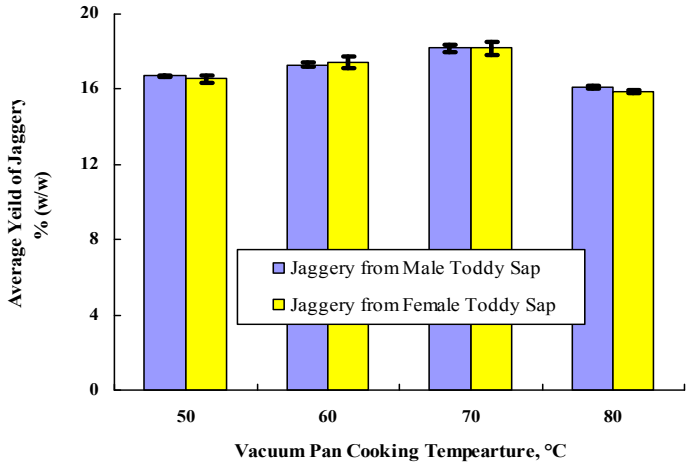


**Fig. (11)** Average yields of jaggeries at various vacuum pan cooking temperatures for toddy saps of (PMT)

Male toddy palm jaggery

Female toddy palm jaggery

**Fig. (12)** Processed palm jaggeries

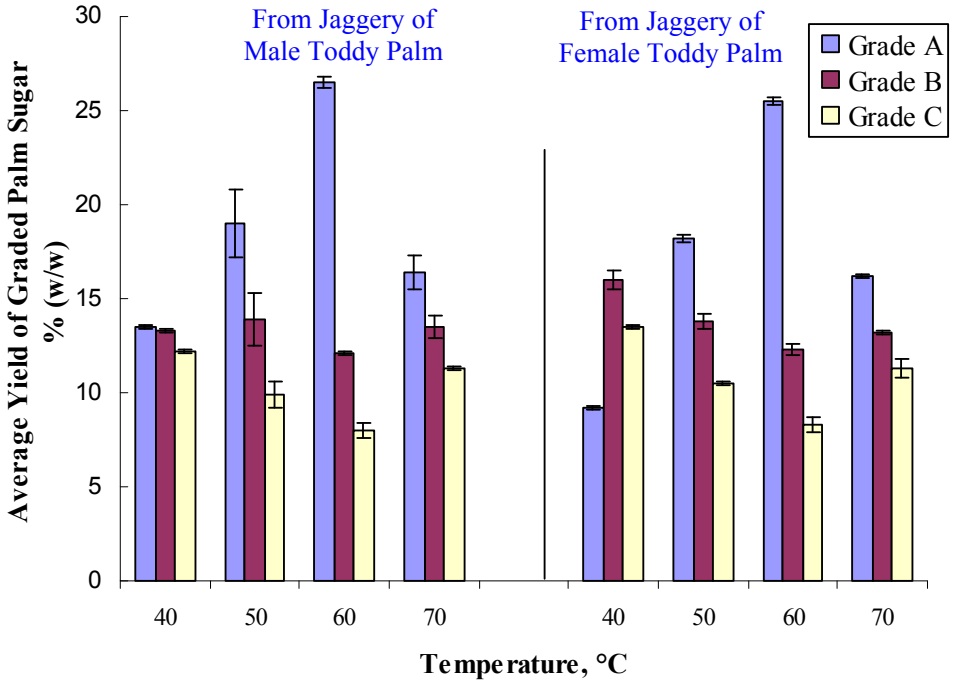


**Fig. (13)** Average yield of Grade A, B and C palm sugar from jaggery of male and female toddy fresh saps of (PMT) at different temperatures

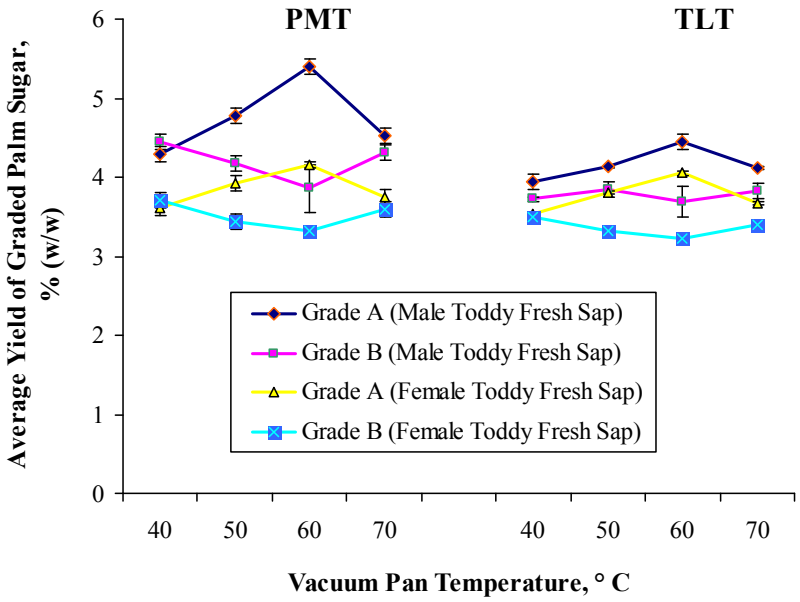


**Fig. (14)** Average yield of Grade A and B palm sugar from male and female toddy fresh saps of (PMT and TLT) at different temperatures


**Fig. (15)** Processed palm sugar: Grade A, B and C


**Fig. (16)** Processed candies made from Grade A palm sugar


**Fig. (17)** Processed candies made from Grade B palm sugar

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