SCREENING FOR POTENTIAL UTILIZATION OF DIFFERENT BANANAS AND PLANTAINS FOR CHIPS PROCESSING

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ABSTRACT

Screening for the potential utilization of bananas and plantains for chips processing was conducted on January – December 2009 at the Bureau of Plant Industry – Davao National Crop Research and Development Center, Bago Oshiro, Davao City. Seven dessert and fourteen cooking varieties were evaluated. Through sensory evaluation, the acceptability of the different varieties of bananas and plantains for chips processing was determined.

Statistical analysis showed no significant differences among the varieties in terms of taste, color, crispiness and overall acceptability. But numerically, chips from FHIA 17 and FHIA 18 were the most acceptable among the dessert varieties and chips from “Inambak” were the most acceptable among the cooking varieties.

Among the dessert varieties, Kluai Namwa Khom gave the highest chips recovery rate of 40.0 percent per kilogram of raw unripe fruits and among the cooking varieties, “Tindok” gave the highest chips recovery rate of 61.6 percent.

Having bigger bunches and fruits, FHIA 17 gave the highest computed chips yield among the dessert varieties of 9.72 kgs per bunch. Among the cooking varieties the Check variety “Cardaba” gave the highest chips yield of 11.00 kgs per bunch. Small-bunched but big-fruited, “Tindok” also gave higher chips yield per bunch of 7.39 kgs.

Having a shorter planting to harvest period, higher chips yield per bunch, higher overall acceptability and consumers’ preference, the use of the cooking plantain “Tindok” for chips processing, early return on investment could be realized.

KEYWORDS: Banana Chips, Overall acceptability, Consumers’ preference, Crispiness, Banana varieties

INTRODUCTION

Bananas, the most popular fruit in the world are very important commodity for the developing countries.. They are at the same time a major staple commodity, together with rice, wheat and maize, and a fundamental export commodity. It is believed that there are almost 1000 varieties of bananas in the world wherein the most commonly known is the Cavendish variety which is largely produced for the export markets.

In the Philippines. banana is a common tropical fruit and considered as one of the major fruit commodities being grown. It remains to be the number one fruit in the country in both area and volume of production (BAS, 2000). Among the banana cultivars produced which are considered significant segments of the banana industry are "Cardaba" for banana chips as export, and "Lakatan" and "Latundan" largely for the local fresh fruit market. Banana chips, also known as banana crackers or dried bananas is the top dollar earner among processed fruit products. (Eusebio et. al., 2002).

Bananas are good sources of vitamin C, B6 and A and also rich in carbohydrates, fiber and potassium. Being a delicious and nutritious food item, it is consumed as snacks and desserts for many Filipinos. In some places of the country, these serve as substitute for staple food aside from rootcrops. However, the importance of this crop largely depends on its variety and quality.

There are wide varieties of bananas grown in the country today. In Davao City, particularly at BPI-DNCRDC, two hundred nineteen (219) different cultivars/varieties of bananas and plantains are being maintained in the field genebank which are either cooking and dessert types (DNCRDC, 2008) However, many of these cultivars/varieties are of lesser economic importance or have no value at all because of their unacceptable taste when cooked or eaten fresh.

Processing of these different banana and plantain cultivars into food product like banana chips will probably make them useful or have economic or commercial value, knowing that "Cardaba" is the only variety identified best for chip processing in the country at present.. The increasing demand of "Cardaba" for banana chips processing encourages farmers to grow more. However, production is not good enough to sustain the needs of a number of banana chips processing plants for consistent supply of raw "Cardaba", which affects the banana chip industry and the local markets. For further enhancement of the Philippine banana chips industry, identification and utilization of other banana and plantain varieties potential for chip processing was undertaken.

OBJECTIVES

General:

To utilize the different banana and plantain cultivars at DNCRDC banana gene bank for chip processing.

Specific:

1. To identify potential varieties of bananas and plantains for chip processing.

2. To determine the economic advantages of utilizing the identified potential varieties for banana chips processing.

MATERIALS AND METHOD

Selection of Fruit Samples

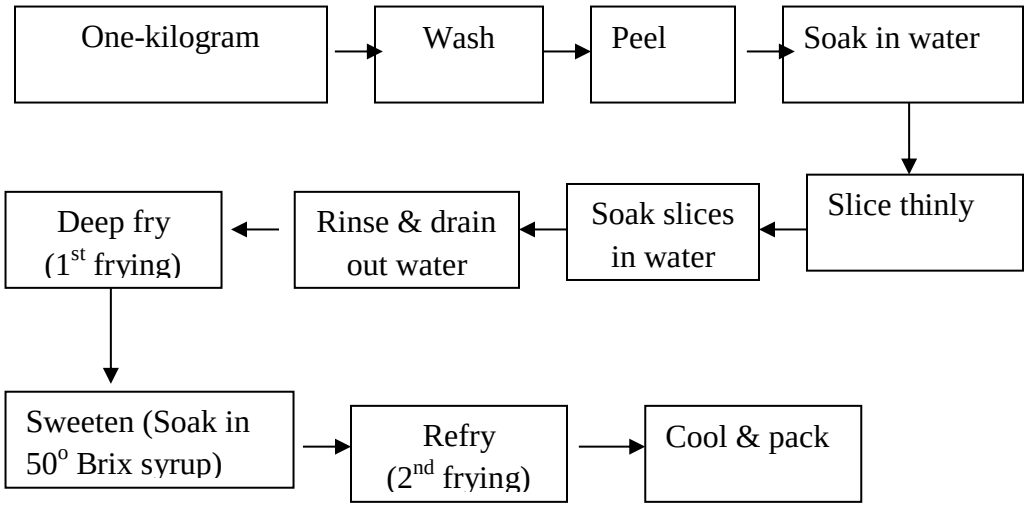
The BPI-DNCRDC banana field gene bank served as the source of fruit samples of different varieties of bananas and plantains used in the study.

The angularity or fullness of fingers was the visual indicator used in determining the maturity of the fruit. Selected bunches were harvested and one-kilogram samples of green or unripe fruits per variety were taken.

"Cardaba" being the identified popular variety for chips processing was included and served as Check or Control variety.

Processing of Fruit Samples

Using the following procedure, the one-kilogram unripe fruit samples for each variety were processed into chips.



Sensory Evaluation

A sensory evaluation of the banana chips processed out of the different banana and plantain varieties was conducted involving fourteen (14) trained panelists. Using the following Hedonic scoring scale of 1-5, consumers' acceptability were assessed.

Sensory quality parameters / Hedonic scoring scale.

Scale	Taste	Color	Crispiness	Overall Acceptability
5	excellent	excellent	Very crispy	excellent
4	Very acceptable	Like very much	Crispy	Very good
3	Good	Good	Slightly crispy	good
2	Fair	Fair	Soft	fair
1	poor	poor	Very soft	poor

Sensory data were statistically analyzed using the descriptive crosstab analysis.

Assessment of Recovery Rates and Economic Advantages

Other parameters that served as basis in determining the recovery rates per kilogram of each variety were also taken.

1. Number of fruits per kg.
2. Percent peel weight - Peels of one-kg raw unripe bananas were weighed right after peeling and Percent Peel Weight was computed as follows:

$$\text{Percent Peel Weight} = \frac{\text{Peel Weight}}{1000\ g} \times 100$$

3. $$\text{Percent Pulp weight} = \frac{1000\ g - \text{Peel weight}}{1000\ g} \times 100$$

4. $$\text{Percent Recovery} = \frac{\text{Weight of Processed Chips}}{1000\ g} \times 100$$

4. Percent Weight Lost in Cooking =

$$\frac{\text{Pulp Weight} - \text{Weight of Processed Chips}}{1000\ g} \times 100$$

The economic advantages of identified potential varieties for chips processing was determined with the following parameters involved: percent recovery per kilogram, bunch weight, fruit size and number of days from planting to harvest.

RESULTS AND DISCUSSION

Sensory Evaluation

A total of twenty-one (21) banana and plantain varieties were evaluated for chips processing through sensory evaluation. Among the twenty-one (21) varieties, seven (7) were dessert types and fourteen (14) were cooking types wherein one variety belonged to the plantain group.

Statistical analysis showed no significant differences among the varieties in terms of taste, color, crispiness and overall acceptability (Table 1). This implies that all varieties were acceptable for chips processing. But numerically, differences in chips characteristics among the varieties were observed.

Table 1. Acceptability ratings of twenty-one banana and plantain varietie evaluated for potential utilization for chips processing, BPI-DNCRDC, December 2009.

VARIETIES **Dessert Types**	TASTE	COLOR	CRISPINESS	OVER ALL ACCEPTABILITY
FHIA 2	3.55	3.46	3.36	3.48
FHIA 5	3.36	3.46	3.27	3.39
FHIA 17	2.91	3.73	4.00	3.61
FHIA 18	4.00	3.91	3.64	3.91
K. Namwa Khom	2.91	2.64	3.00	2.81
K.Nang Nuan	3.00	2.73	3.36	3.03
Ragus Burong	3.18	3.09	3.64	3.30

Cooking Types				
Binato	3.18	3.55	3.36	3.36
Cachaco	3.55	3.46	3.91	3.61
Cardaba	3.55	3.73	3.5	3.67
Duhoy	3.18	2.73	3.09	3.15
FHIA 3	3.55	2.91	3.64	3.45
Inambak	3.73	4.09	4.55	4
Paa Dalaga	3.55	3.18	3.27	3.36
Pisang Rasa	3.18	3.46	3.64	3.42
Saba 1138	3.55	3.82	4.09	3.85
Sabra	3.46	3.27	3.64	3.45
Tindok	3.73	3.64	3.55	3.79
TMB x 1378	3.18	3.18	2.82	3.06
Tiparot	2.82	2.82	3.73	3.21
Waggie	3.55	3.09	3.82	3.44

*Not significant

Taste

Among the dessert varieties, chips from FHIA 18 was numerically the most acceptable in terms of taste with average rating of 4.0 followed by chips from FHIA 2 which was rated good to very acceptable. The rest were rated good and fair to good (Figure 1a).

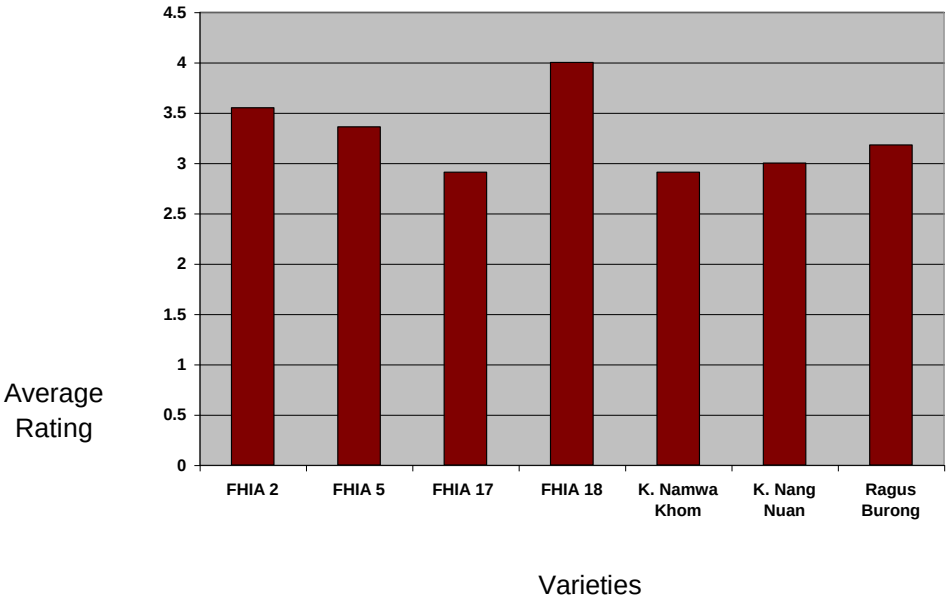


Figure 1a. Taste acceptability ratings of chips made from 7 dessert banana varieties.

Among the cooking varieties, chips from eight (8) varieties were rated good to very acceptable. But numerically, chips from "Inambak" and "Tindok" were the most acceptable with both having the average rating of 3.73 followed by "Cachaco", FHIA 3, "Saba 1138", "Waggie" and the Check variety "Cardaba" with the same average rating of 3.55 (Figure 1b).

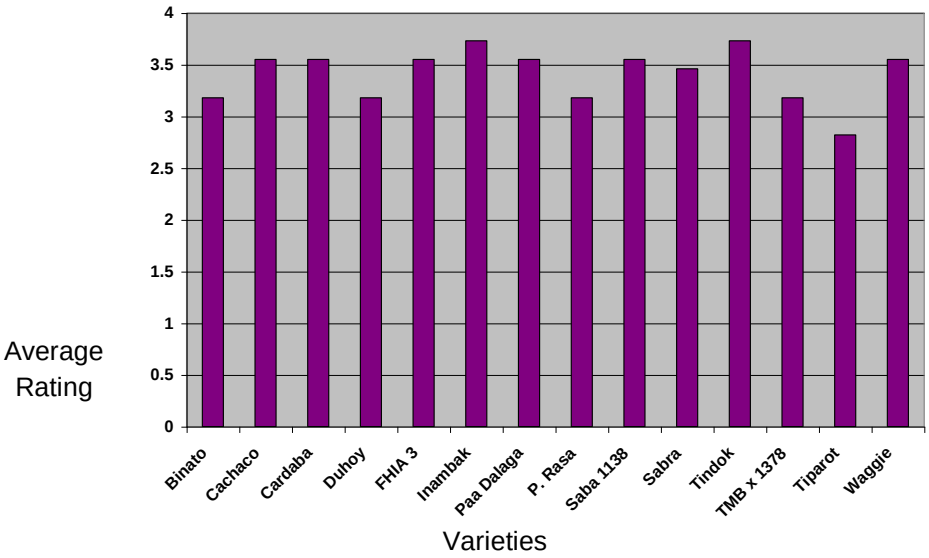


Figure 1b Taste acceptability ratings of chips made from 14 cooking

Color

Color on chips made from the varieties evaluated which were visually observed ranged from pale yellow to yellow-orange. Among the dessert varieties, pale yellow colored chips from FHIA 18 and FHIA 17 were the most preferred in terms of color having the average ratings of 3.91 and 3.73, respectively, followed by FHIA 2 (3.46), FHIA 5 (3.46) and “Ragus Burong” (3.09) (Figure 2a).

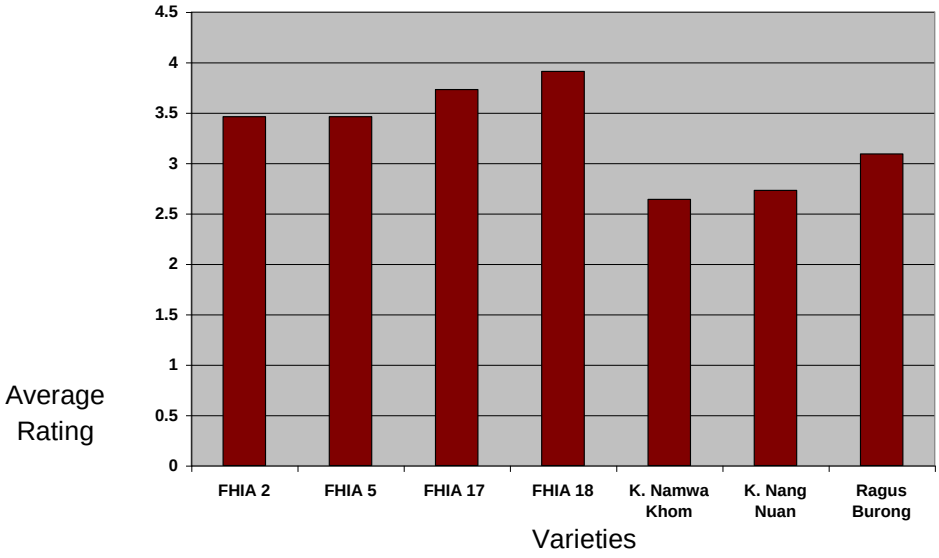
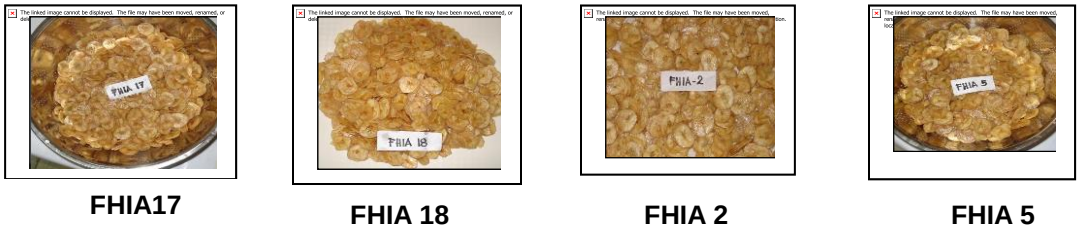


Figure 2a. Color acceptability ratings of chips made from 7 dessert



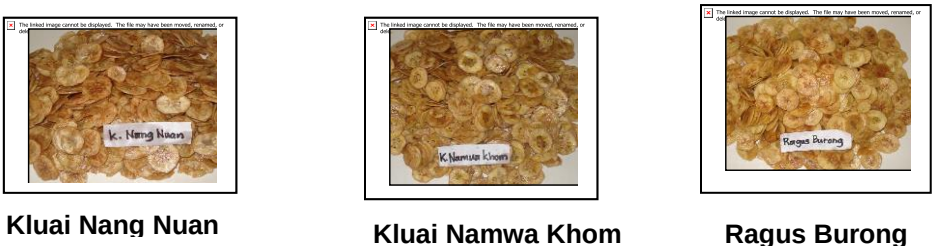


Figure 2a.1. Color differences of chips made from 7 dessert banana varieties.

Chips from the yellow-orange colored “Inambak” was numerically the most preferred among the cooking varieties with the highest average rating of 4.09 followed by the pale yellow colored “Saba 1138” and “Cardaba” (Check variety), “Tindok” (yellow-orange) and “Binato” (pale yellow) with average ratings of 3.82, 3.73, 3.64 and 3.55, respectively (Figure 2b)

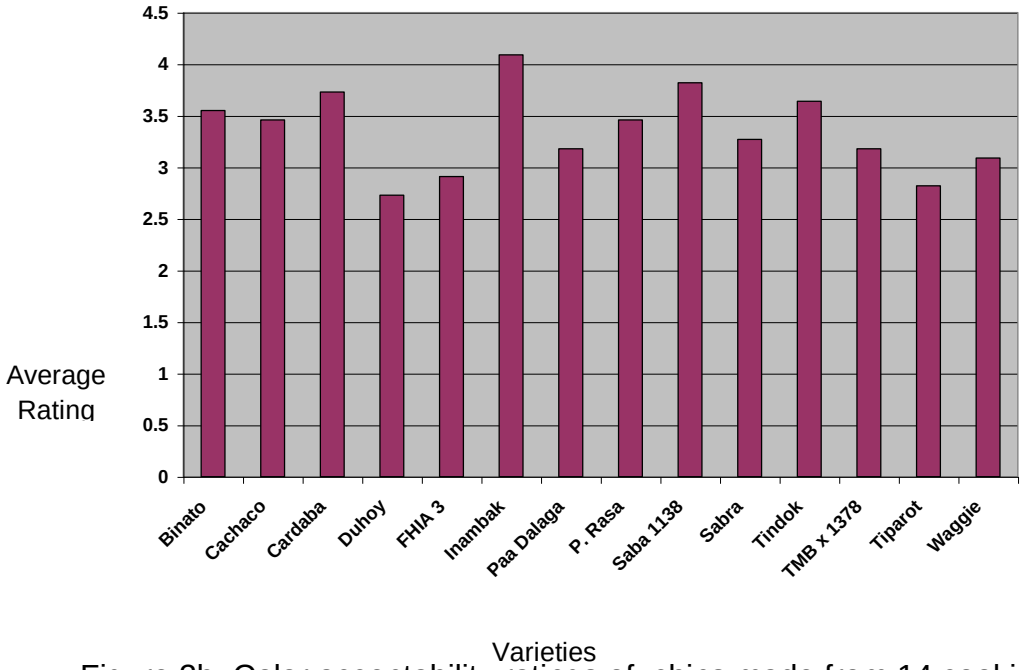
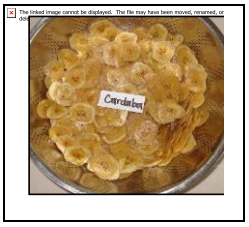


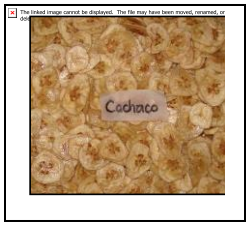
Figure 2b Color acceptability ratings of chips made from 14 cooking

Inambak

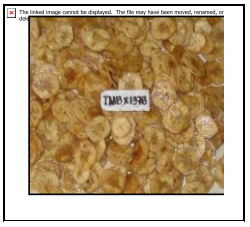


Cardaba (Check()

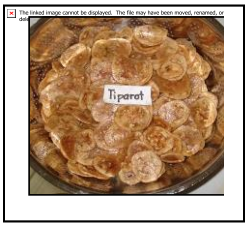
Tindok



Cachaco



TMB x 1738

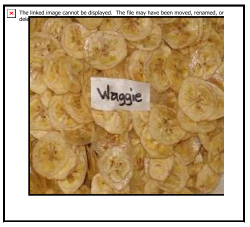


Tiparot

Duhoy

FHIA3

Sabra



Waggie

Pisang Rasa **Paa Dalaga** **Binato** **Saba 1138**

Figure 2b.1 Color differences of chips made from 9 cooking banana varieties.

Crispiness

In terms of crispiness, chips from FHIA 17 were the most preferred among the dessert varieties having the highest average rating of 4.0 followed by chips from FHIA 18 and "Ragus Burong" both having the average rating of 3.64 (Figure 3a).

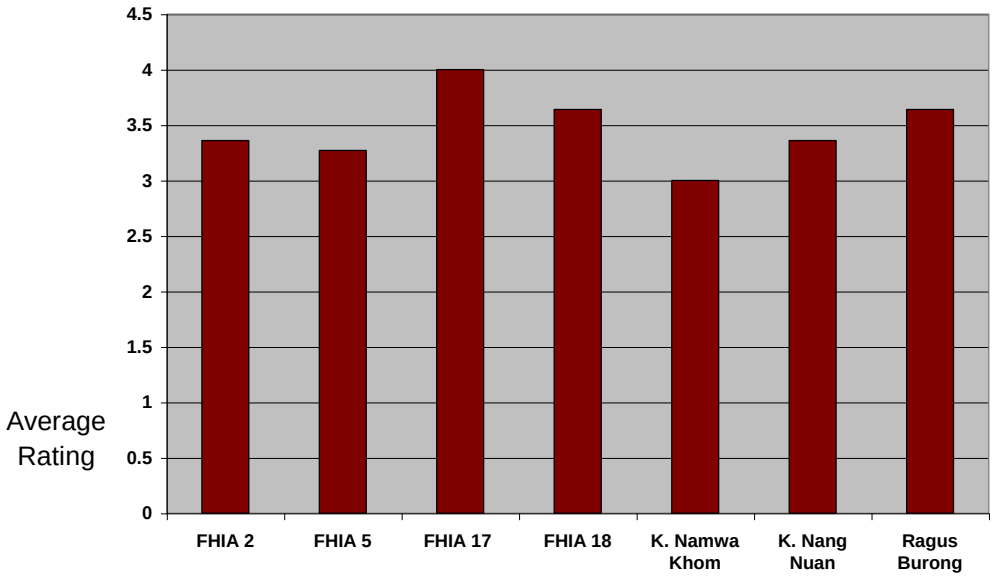


Figure 3a. Crispiness acceptability ratings of chips made from 7 dessert banana varieties.

Chips from all of the cooking varieties evaluated were rated as slightly crispy to very crispy except for TMB x 1378 which was rated as soft to slightly crispy. But numerically, “Inambak” were the most preferred in terms of crispiness among the cooking types having the highest average rating of 4.55 followed by “Saba 1138” (4.09) (Figure 3b). The chips from the Check variety “Cardaba” obtained lower average rating of 3.5 compared to the abovementioned varieties. But rated as slightly crispy to crispy, apparently, it is still comparable to chips from other cooking varieties.

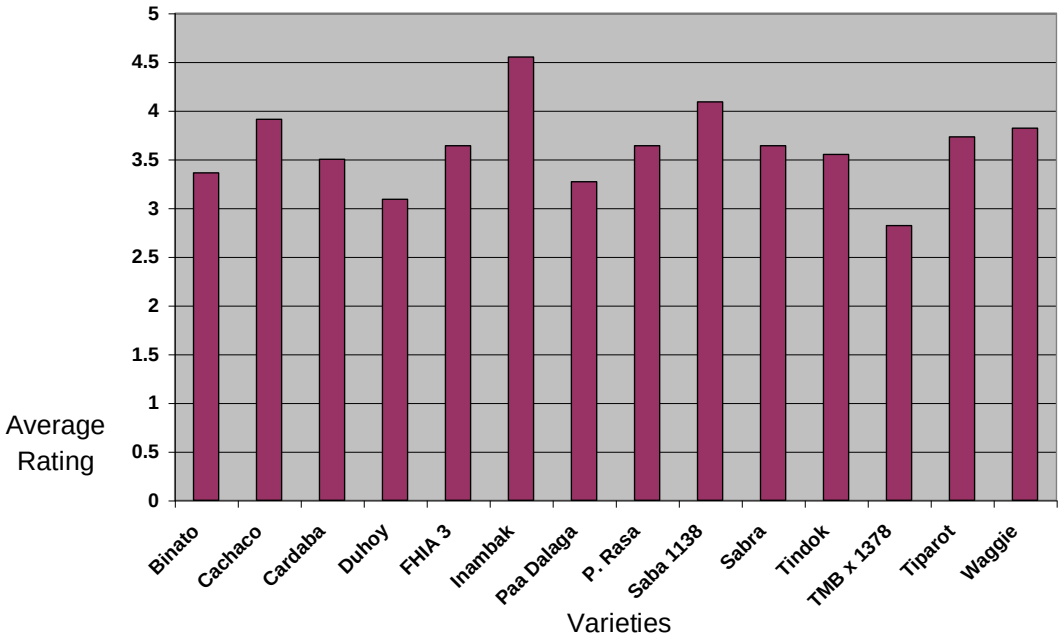


Figure 3b Crispiness acceptability ratings of chips made from 14 cooking banana varieties.

Overall Acceptability

In terms of overall acceptability, chips from FHIA 18 and FHIA 17 were numerically the most acceptable among the dessert varieties which were rated as good to very good and having the highest average score of 3.91 and 3.61, respectively (Figure 4a). Chips from the rest of the dessert varieties were rated good except for chips from Kluai Namwa Khom which obtained fair to good rating.

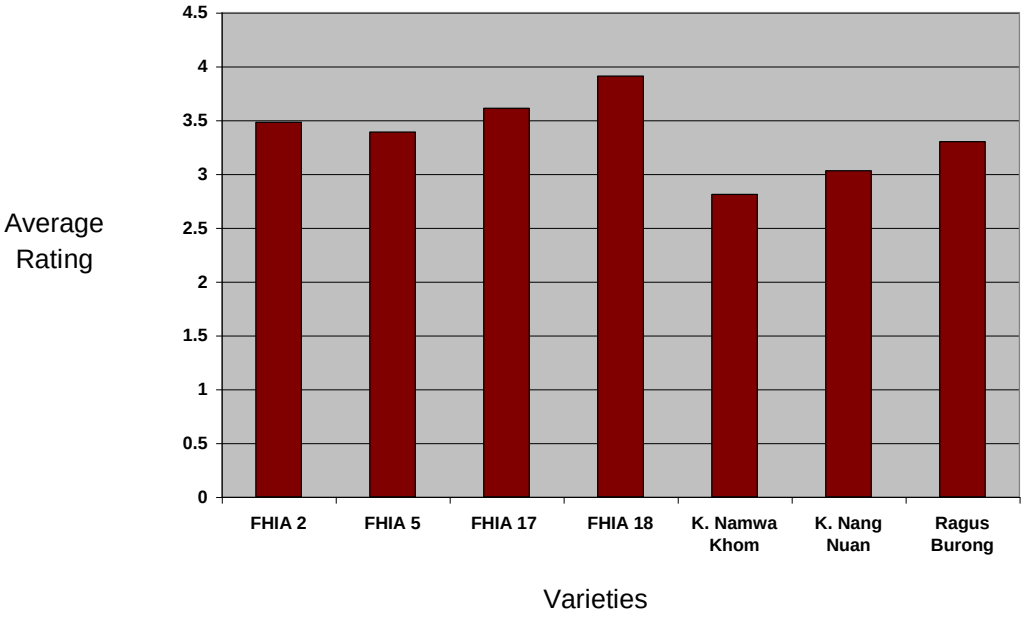


Figure 4a. Overall acceptability ratings of chips made from 7 dessert

Among the cooking varieties, chips from “Inambak” were the most acceptable which had a rating of 4.0 (Figure 4b). Chips from “Saba 1138”, “Tindo”, “Cardaba” (Check) and “Cachaco” were rated good to very good with average scores of 3.85, 3.79, 3.67 and 3.61, respectively. The rest of the cooking varieties were all rated good.

This implies that chips made from all of the dessert and cooking varieties that were sensory evaluated were acceptable.

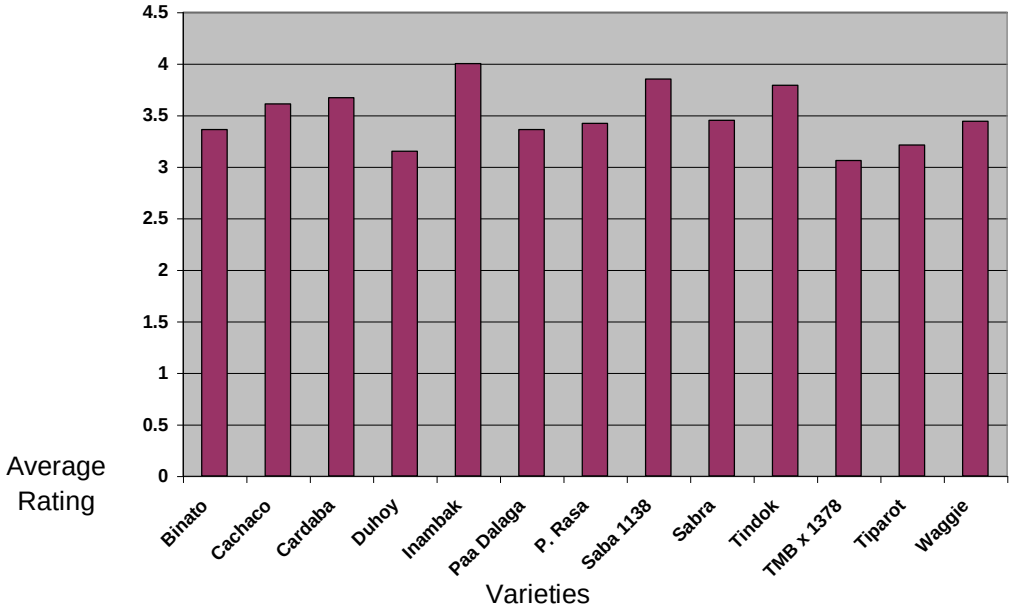


Figure 4b Overall acceptability ratings of chips made from 14 cooking banana varieties.

Consumers' Preference

Out of the 21 varieties evaluated, chips made from fourteen varieties (5 dessert and 9 cooking types) qualified to the preference of the panelists (Table 3). Of the five dessert types, chips from FHIA 18 were most preferred by 43 percent of the panelist followed by FHIA 17 (21%) (Table 2).

Among the nine most preferred cooking varieties, chips from "Inambak" were highly preferred by sixty-four percent (64%) of the panelists followed by "Cardaba" (57%) and "Tindok" (36%).

Table 2. Consumers' preferences on sampled chips from different dessert and cooking types of bananas.

Variety	% of Panelists	Variety	% of Panelists
Dessert Types		**Cooking Types**	
FHIA 2	14	Binato	0
FHIA 5	7	Cachaco	0
FHIA 17	21	Cardaba	57
FHIA 18	43	Duhoy	0
K. Namwa Khom	0	FHIA 3	14
K.Nang Nuan	0	Inambak	64
Ragus Burong	7	Paa Dalaga	14
		Pisang Rasa	7
		Saba 1138	14
		Sabra	7
		Tindok	36
		TMB x 1378	0
		Tiparot	0
		Waggie	14

Percent Recovery

Among the dessert varieties, Kluai Namwa Khom gave the highest chips recovery rate of 40.0 percent per kilogram of raw unripe fruits followed by Kluai Nang Nuan (37%), FHIA 5 (36.8%), FHIA 17 (36%), FHIA 2 (35%) and FHIA 18 (33.53%). "Ragus Burong" obtained the lowest chips recovery rate of 28.70 percent (Figure 5a and Appendix 1).

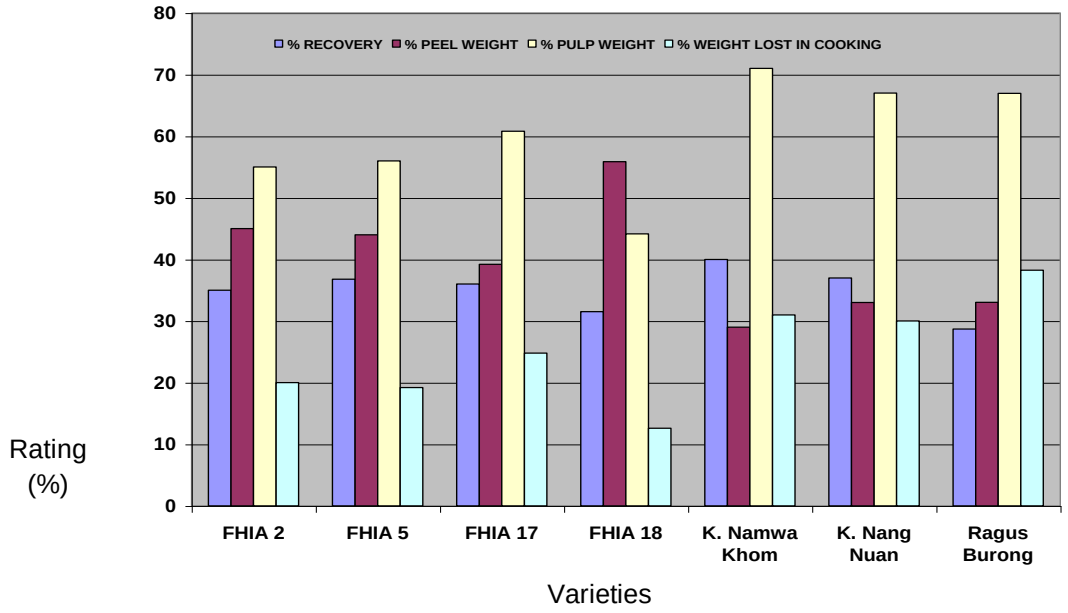


Figure 5a. Recovery ratings per kilogram of raw unripe bananas (Dessert types).

The high chips recovery rates of Kluai Namwa Khom and Kluai Nang Nuan were attributed to low percent peel and high pulp weights per kilogram of raw unripe fruits. The high chips recovery rates of FHIA 5 and FHIA 17 were attributed to high percentage of pulp weights and low percentage of weight lost in cooking.

Among the cooking cultivars, "Tindok" gave the highest chips recovery rate of 61.6 percent followed by TMB x 1738 (57.4%), while the lowest chips recovery rate of 21.0 percent was from "Cachaco" (Figure 5b and Appendix 1). The rest of the varieties including the Check variety "Cardaba" obtained the average recovery rates ranging from 27.70 to 39.0 percent.

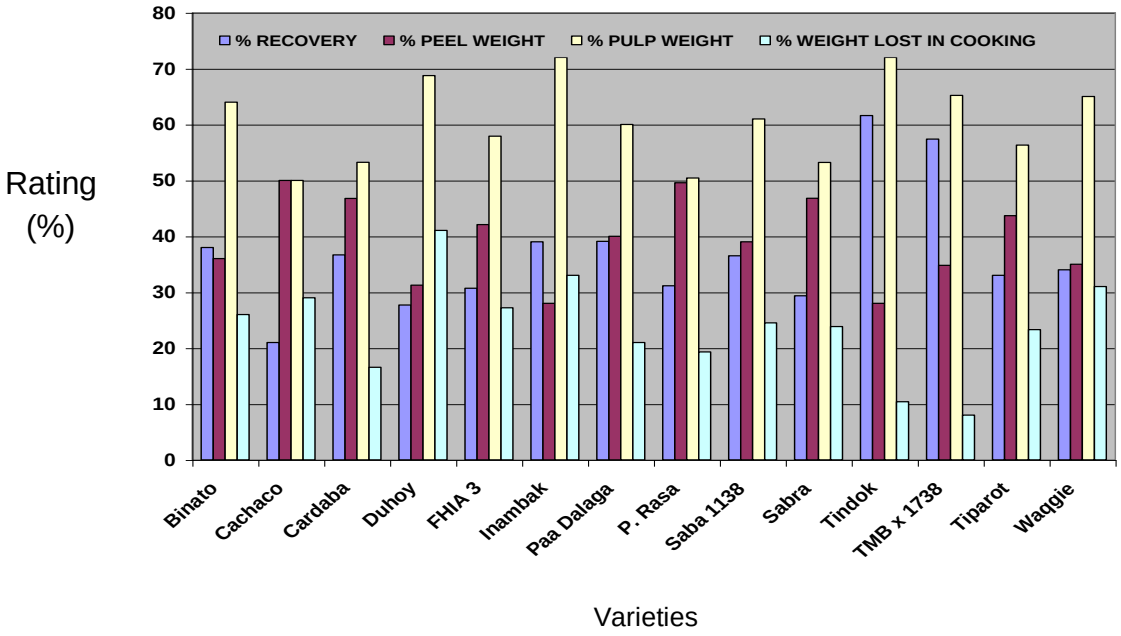


Figure 5b. Recovery ratings per kilogram of raw unripe bananas (Cooking types).

The very high chips recovery rates of “Tindok” and TMB x 1738 were influenced by low percentage of peel weight, high percentage of pulp weight per kilogram and low percentage of weight lost in cooking. The low percentage of peel and high percentage of pulp weights influenced the higher recovery rates of “Inambak”. The low percentage of weight lost in cooking and high percentage of pulp weight influenced the higher recovery rates of “Paa Dalaga”. While “Cardaba” and Pisang Rasa obtained higher chips recovery rates by having high percentage weight of pulp and low percentage of weight lost in cooking.

Economic Advantages

The economic advantages of utilizing the five dessert and nine cooking varieties most preferred for chips processing was determined.

Among the five dessert varieties, FHIA 17 gave the highest computed chips yield of 9.72 kgs per bunch followed by FHIA 5 (6.26 kgs), FHIA 2 (5.95 kgs) and FHIA 18 (5.18 kgs) (Figure 6a & Appendix 2). While “Ragus Burong” gave the lowest chips yield of 2.58 kgs per bunch. Having bigger bunch and fruits influenced the higher chips yield of FHIA 17.

Among the nine cooking varieties, the Check variety “Cardaba” gave the highest computed chips yield of 11.00 kgs followed by “Paa Dalaga” (8.602 kgs), “Saba 1138” (7.665 kgs), “Tindok” (7.392 kgs, “Sabra” (6.166 kgs) (, FHIA 3 (6.14 kgs) (Figure 6b & Appendix 2). While the lowest chips yield were from Pisang Rasa (3,74 kgs), “Inambak” (4.29 kgs) and “Waggie” (4.76 lgs). Having bigger bunch and fruits influenced the higher chips yield of “Cardaba”. Although small-bunched, “Tindok” gave higher chips yield per bunch because of its very big fruits (405 g/fruit). Bunch and fruit size were the factors that influenced the yield of chips per bunch.

Based on overall acceptability, consumers’ preference, chips from FHIA 18 and FHIA 17 for dessert types and “Inambak”, “Tindok”, “Cardaba” (Check) and “Saba 1138” for the cooking types were the most acceptable. But considering the yield of chips per bunch, FHIA 17 for the dessert types and “Cardaba” (Check) and “Tindok” for the cooking types were the most acceptable for chips processing. However, utilization of varieties that have shorter planting to harvest period is advantageous.

Among the dessert varieties, “Ragus Burong” has the shortest planting to harvest period of 247days which implies that using this variety for chips processing, earlier return on investment could be realized. However, this variety is less preferred and acceptable and gave the least chips yield per bunch.

Among the cooking types, “Waggie”, “Tindok” and Pisang Rasa had the shortest planting to harvest periods of 306, 368 and 395 days. However, “Waggie” and Pisang Rasa gave least chips yield and were lesser acceptable than “Tindok”. Having shorter planting to harvest period, higher chips yield/bunch, higher overall acceptability and consumers’ preference, using “Tindok” for chips processing, an early return on investment could be realized.

CONCLUSION AND RECOMMENDATION

Based on sensory evaluation, all of the bananas and plantain varieties evaluated either dessert or cooking types can be considered acceptable for chips processing. But chips from FHIA 17 and FHIA 18 were the most acceptable among the dessert varieties and chips from “Inambak” were the most acceptable among the cooking varieties. In terms of consumers’ preference, chips from FHIA 18 followed by chips from FHIA 17 were highly preferred among the dessert varieties and chips from “Inambak” followed by chips from “Cardaba” and “Tindok” were the highly preferred among the cooking varieties. Therefore, based on consumers’ acceptability, FHIA 17, FHIA 18,” Inambak”, “Cardaba” (Check) and “Tindok” are best for chips processing.

Varieties with low percentage of peel weight, high percentage of pulp weight and low percentage of weight lost in cooking, basically obtained the highest recovery of processed chips.

Bunch weight and fruit size influenced the chips yield per bunch. Thus, varieties that have bigger bunches and fruit size like FHIA 17 (dessert) and “Cardaba”

(cooking)give higher chips yield per bunch. Although a variety is small-bunched but if it is big-fruited like “Tindok” (405 g/fruit), higher chips yield per bunch could be realized.

Varieties that have shorter planting to harvesting period will give earlier return on investment to banana growers and chips processors. However, selection of varieties should consider other characteristics like bigger bunches and fruits, higher chips yield per bunch and higher consumers’ preference and acceptability.

Not considering the planting to harvesting period, aside from the Check variety “Cardaba”, FHIA 17 can be recommended for commercial chips processing. But if earlier return on investment is of economic importance, planting of a variety that has shorter planting to harvesting period like “Tindok” is best.

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Appendix 1. Percent recovery per kilogram or raw unripe bananas and plantain.

VARIETY	% RECOVERY	% PEEL WEIGHT	% PULP WEIGHT	% WEIGHT LOST IN COOKING
Dessert Types				
FHIA 2	35.00	45.00	55.00	20.00
FHIA 5	36.80	44.00	56.00	19.20
Fhia 17	36.00	39.20	60.80	24.80
FHIA 18	31.53	55.86	44.14	12.61
K. Namwa Khom	40.00	29.00	71.00	31.00
K. Nang Nuan	37.00	33.00	67.00	30.00
Ragus Burong	28.70	33.04	66.96	38.26
Cooking Types				
Cachaco	21.00	50.00	50.00	29.00
Waqgie	34.00	35.00	65.00	31.00
Tindok (Plantain)	61.60	28.00	72.00	10.40
TMB x 1738	57.40	34.80	65.20	8.00
Binato	38.00	36.00	64.00	26.00
Tiparot	33.00	43.70	56.30	23.30
Paa Dalaga	39.10	40.00	60.00	21.00
Inambak	39.0	28.00	72.00	33.00
Duhoy	27.70	31.25	68.75	41.05
FHIA 3	30.70	42.10	57.90	27.20
Sabra	29.36	46.80	53.20	23.84
P. Rasa	31.14	49.56	50.44	19.30

Cardaba (Check)	36.67	46.76	53.24	16.57
Saba 1138	36.50	39.00	61.00	24.50

Appendix 2. Factors considered in determining the economic advantages of 14 varieties of bananas and plantains.

Variety	% Consumers' Preference	Overall Acceptability	% Recovery per kg.	Bunch wt. (kg)	No. of Fruits/ Bunch	Fruit Size (g)	Days from planting to harvesting	Net Yield of Chips per Bunch (kg)
Dessert Types								
FHIA 2	14	3.4	35	17	113	148	369	5.95
FHIA 5	7	3.45	36.8	17	114	125	357	6.256
FHIA 17	21	3.66	36	27	184	143	465	9.72
FHIA 18	43	3.55	31.53	17	132	116	420	5.36
Ragus Burong	7	3.25	28.7	9	62	120	247	2.583
Cooking Types								
Tindok (Plantain)	36	3.83	61.6	12	18	405	368	7.392
Waqgie	14	3.35	34	14	83	163	306	4.76
Cardaba	57	3.72	36.67	30	198	146	654	11.00
Paa Dalaga	14	3.36	39.1	22	189	110	448	8.602

Saba 1138	14	3.55	36.5	21	113	177	433	7.665
Sabra	7	3.22	29.36	21	74	145	453	6.166
FHIA 3	14	3.42	30.7	20	146	129	489	6.14
P. Rasa	7	3.2	31.14	12	118	98	395	3.737
Inambak	64	3.99	39	11	128	83	508	4.29