Appendix 1. Soil characteristics of the site where Cardaba was planted at varying distance, 1990-1993.

CHEMICAL PROPERTIES	CARMEN, PANABO, DAVAO DEL NORTE
pH	7.2
Organic Matter (OM) %	2.0
Nitrogen (%)	0.14
Phosphorous (P_2O_5) %	0.10
Potassium (K_2O) %	0.10
Soil Texture	clay loam

DEVELOPMENT OF PUREE FROM ACIDIC FRUITS (GUAVA, SANTOL AND MANGO) AND DETERMINATION OF THEIR PHYSICO-CHEMICAL PROPERTIES

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ABSTRACT

Puree was prepared from acidic fruits (santol, native guava, green 'Carabao' mango, and green 'pico' mango) which are used as condiments in cookery.

Pulp recovery from santol was an average of 48.14% while puree recovery was 80.76% after addition of water and passing through a blender. Pulp recovery from green carabao mango was 71.62% and 71.63% from green 'pico' mango. After addition of water and passing through a blender puree recovery was 107.61% for carabao and 110.81% from pico.

High percentage of recovery was obtained from unpeeled white guavas (88%) compared with the hand-peeled guavas (56.5%). Both the lye-peeled and unpeeled guavas had the same percentage of pulp recovery (50%).

There was no change in the color and appearance of the processed products during storage at root temperature.

Mango and guava puree were utilized as souring ingredients in "pork sinigang" and " bangus sinigang" and subjected to sensory evaluation using the Multiple Comparison Test. Results showed that the bottled guava and mango puree received higher scores than the control and found to be more acceptable. Statistical analysis of the results using ANOVA showed that there was no significant difference among the samples.

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INTRODUCTION

Acidic fruits have various uses. Their tartness make them excellent materials for food preparations like juices and beverages, leathers, butters, jams and jellies. Some are also important condiments used as sour ingredients in Filipino cookery. High acid fruits are those which have a pH of 3.9 or lower (Alabastro, 1987). The pH of mangoes has been reported to range from 3.9 to 4.4 (Nanjundaswany, *et al.*, 1973). According to de Leon (1971), the approximate pH values of mango range from 3.7-3.9; 3.4 for santol and 3.9 for guava. Although there are many ways of converting these fruits into non-perishable products, puree preparation offers a definite advantage because it can be used for remanufacture into other products like juices and beverages, jams, leathers and butters. Cull fruits or rejects can be utilized for puree purposes since raw materials quality is not as strict as those required for canning.

Purees are obtained from pulpy materials and prepared by comminuting the pulp into a homogenous mixture. Preparation is simple if materials are just fed into a pulping machine. Pre-treatments may vary, depending on the variety and maturity of the fruit used. Fully ripe guavas can be lye-peeled then dipped in citric acid solution before pulping (Ramteke,R.S.1990). Sieved apricots for baby foods are prepared by peeling and cooking thoroughly by live steam, passing through a pulper, then through finisher and finally through a homogenizer for smooth consistency (Cruess, 1952). Apple and pear purees for fruit butter are cooked until soft with a small amount of water without previous peeling or coring, passed through a tomato pulper-finisher to impart a smooth texture (Cruess,1952).

Guavas that are desirable for processing into puree are those with a thick outer flesh and small seed cavite since they yield more puree per unit weight than thin fleshed types. Those with few seeds and small quantities of stone cells are also preferred.

The main consideration in the selection of the acid fruits used in this study is their added usage as condiments in Filipino cookery. Aside

from tamarind and camias, the fruits commonly used are native guavas, native santol and green mangoes.

OBJECTIVES

General: To develop puree from some acidic fruits (green mangoes, santol, guava) and to determine their physico-chemical properties.

Specific:
1. To determine percent recovery of pulp and puree.
2. To observe shelf-life of the products stored under ambient condition.
3. To determine acceptability through sensory evaluation.

METHODOLOGY

Materials- The fruits used in the study were (1) ripe native guavas, (2) ripe santol, (3) mature green 'Carabao' mangoes and (4) mature green 'pico' mangoes. All these fruits were bought in nearby markets. Fresh samples were submitted for pH, total acidity, total soluble solids, and ascorbic acid content determinations.

Preparation of Materials and Processing- In the absence of a pulper-finisher, a blender was used for puree extraction. The schematic diagram for puree preparation from guavas, santol and green mangoes are shown in Fig. 1.

a. Ripe Guavas- The fruits were washed, crowns and ends trimmed off, halves and the seeds scooped out. To facilitate pulping extract from the boiled seeds were added to the raw guava pulp. Guava extract was obtained by adding varying amounts of water to the seeds and boiling. Different methods of puree extraction were tried on (1) hand-peeled, (2) lye-peeled, and (3) unpeeled guavas. In lye-peeling, guavas were immersed in two percent sodium hydroxide solution at 85-90 °C, washed,

dipped in dilute hydrochloric acid solution (1 ml/liter), washed again, scraping off the remaining peels. This was followed by blending, heating, bottling and processing.

b. Santol - The fruits were washed, blanched, peeled, deseeded and the pulp chopped. Seeds were boiled with a measured quantity of water to obtain extract which was added to the chopped pulp and passed into blender for smooth consistency, heated, bottled and processed. Puree was divided into three lots (plain as control, with salt and with salt and preservative).

c. Green Mango - Mangoes were washed, pared and stones removed. The chopped pulp was heated with water to soften it, passed into blender, heated again, bottled and processed. Puree were divided into three lots as in santol puree. The bottles products were stored at room temperature.

Chemical Analysis- Fresh and processed fruit puree samples of santol, pink and white guavas and green mangoes ('pico' and 'carabao') were submitted for pH, total soluble solids, total acidity (expressed as % citric acid) and Vitamin C content determinations. All determinations followed the procedures in the 1984 AOAC while pH value determination was done suing the Schott Gerate pH meter CG822. The total soluble solids content of the formulations were determined using a hand refractometer.

Bacteriological Analysis- At 0,3,6,9,12 months the processed puree products were subjected to microbial analysis to determine standard plate count, coliform colonies and mold and yeast count using the procedures in the 1076 Bacteriological Manual for Foods. Except for the pink and white mixture with salt all the guava puree samples were observed up to six months only due to insufficiency of samples.

Evaluation of Color and Appearance- Color and appearance of the product were evaluated through visual observation.

Pulp and Puree Recovery - Pulp recovery was obtained by weight

measurement after removing and or trimming off peels, seeds/stones, etc. Puree recovery was determined by volume measurement of the extracted pulp after blending and heating preparatory to bottling.

Sensory Evaluation-

a. Mango puree - After six days, mango puree was subjected to sensory evaluation using Multiple Comparison Test. Ten panelist were presented with three coded samples (processed carabao mango puree, processed pico mango puree and fresh tamarind) for comparison as to flavor with the control (fresh tamarind) marked R. Fresh tamarind was used as control since mangoes were out of season during the sensory evaluation. Scores ranged from 1 which means "extremely inferior to R" to 7 which means "extremely better than R".

b. Guava puree- Thirteen days after processing, guava puree was used in "bangus sinigang" and subjected to sensory evaluation using the Multiple Comparison Test. Ten panelists were presented with three (3) coded samples (fresh guava, commercial guava, and bottled guava puree) for comparison with the control (commercial) marked R.

The results of the sensory evaluation for the two products were statistically analyzed using ANOVA.

c. Santol puree- had not been subjected to sensory evaluation due to limited samples processed.

RESULTS AND DISCUSSIONS

Chemical Analysis

a. Fresh fruits - Santol, 'pico' mango and 'carabao' mango were found to have pH of 3.02,3.08 and 3.04, respectively as shown in Table 1. Guavas had lower pH - 4.07 for pink and 4.03 for white. For guavas, the more acid fruits (pH 3.3 to 3.5) are better for processing than the sweeter fruits (Luh, ***et al.***,1971). This is also true for the other fruits.

Table 1. Analysis of Fresh Fruits

FRUITS	pH	Total Acidity/ (%) Citric Acid	Total Soluble Solids (° Bx)	Ascorbic Acid (mg %)
Santol	3.02	1.39	10.00	1.40
Guava, pink	4.07	0.53	11.50	34.46
Guava, white	4.03	0.50	13.00	23.83
Mango, green pico	3.08	2.03	10.00	23.34
Mango, green carabao	3.04	2.53	9.50	12.28

Pink guavas had higher Vitamin C content (34.46 mg % than the white guavas (23.83) while carabao mango had 23.34; 'pico' mango and santol have minimal ascorbic acid contents of 12.28 and 1.40, respectively. Total soluble solids ranged from 9.50°Brix (green 'carabao' mango to 13.0° (white guava).

Total acidity expressed as % citric acid were as follows: 2.53 for green carabao mango; green 'pico' mango- 2.03; santol- 1.39; pink guava - 0.53 and white guava - 0.50.

b. Santol Puree- Table 2 presents the physico-chemical properties of processed santol puree at 0, 3, 10, 19 months storage. At 0 month, the pH for both the plain and the puree with salt and preservative was the same (3.4) while that of the puree with salt was 3.10. There were slight variations and changes in pH during storage. Acidity as citric acid for all the three samples was 0.72%. The total soluble solids of plain puree was

lower (8°) than the other two (12°) due to the addition of salt and preservative. Ascorbic acid content of the plain was slightly lower (1.20 mg %) than the puree with salt (1.14) and puree with salt and preservative (1.09). This indicates that addition of salt and preservative decreases the Vitamin C content. As expected Vitamin C content decreased with storage as in the case of plain santol puree which gradually decreased from 1.20 at 0 month, to 1.02 at 3 months, then 0.83 at 10 months and finally 0.30 at 19 months.

Table 2. Physico-Chemical Properties of Processed Santol Puree

Samples	pH	Total Acidity %: Citric Acid	Total Soluble: Solids (°Bx)	Ascorbic Acid: (mg %)	Total Solid (%)
I. Santol Puree (Plain)					
0	3.14	0.72	8.00	1.20	
3	3.19	0.83	8.50	1.20	
10	3.46	0.56	8.50	0.83	
19	3.41	1.00	8.00	0.30	10.06
II. Santol Puree + Salt					
0	3.10	0.72	12.00	1.14	
3	3.19	0.93	11.50	0.97	
10	3.40	0.72	11.50	0.40	
19	3.33	1.92	8.00	0.29	13.74
III. Santol Puree + Salt + Preservative					
0	3.14	0.72	12.00	1.09	
3	3.17	0.99	11.50	0.86	
10	3.43	0.81	12.50	0.40	
19	3.33	1.14	8.00	0.21	13.70

c. Guava Puree - Table 3 shows the physico-chemical properties of processed guava puree at 0 and 6 months storage. At 0 month storage slight differences in pH were noted for the first four samples while the mixture of unpeeled pink and white guavas were found to have a higher pH (4.68) due to the addition of salt. After 6 months, the pH of all the samples lowered down slightly. Total acidity expressed as % citric acid ranged from 0.36 (mixture of unpeeled pink and white guavas with added salt) to 0.44 (lye-peeled white guava) at 0 month storage with the same trend after 6 months. Total soluble solids (TSS) (in degree Brix) had slight differences also with the mixture of unpeeled pink and white guavas with added salt having the lowest (7°B).TSS of peeled pink and peeled white guava was the same (9.0) while lye-peeled was lower (8.0). For ascorbic acid content, peeled pink guavas had the highest (41.30 mg %). Lye-peeled white guava was found to have the lowest ascorbic acid (13.04) as compared to the unpeeled white guava (21.22) and peeled white guava (33.81). As expected the ascorbic acid content decreased after 6 months storage.

Table 3. Physico-Chemical Properties of Processed Guava Puree

Samples	pH : 0 Month	pH : 6 Months	Total Acidity (%) Citric Acid : 0 Month	Total Acidity (%) Citric Acid : 6 Months	Total Soluble Solid (° Bx) : 0 Month	Total Soluble Solid (° Bx) : 6 Months	Ascorbic Acid (mg % ml.) : 0 Month	Ascorbic Acid (mg % ml.) : 6 Months
White guava peeled	4.05	3.92	0.41	0.40	9.0	9.5	33.81	19.37
White guava unpeeled	4.10	3.92	0.42	0.41	8.5	8.0	21.22	13.15
Pink guava peeled	4.09	3.91	0.39	0.40	9.0	9.0	41.30	15.46
Mixture of unpeeled pink and white guavas, with added salt	4.68	4.55	0.36	0.36	7.0	7.0	31.66	14.12

d. Green mango puree - The physico-chemical properties of processed green mango puree from 'pico' and 'carabao' are shown in Table 4. At 0 month storage, the pH of the 'pico' puree samples were 3.04 for the plain puree; 3.0 for the puree with salt, and 3.05 for the puree with salt and preservative. Slight changes in pH were noted at 9 months storage. The pH of the carabao mango puree were 2.89 for the plain puree, 2,92 for puree with salt and 2.88 for puree with salt and preservative, slightly higher than 'pico'. Referring to the BPS-PNS Draft Standard on Specification for Mangoes the 'carabao' mangoes used were already on the "breaker stage" of ripeness wherein the peel color have traces of yellow green and the flesh color described as middle area and fruit outline yellowish, other areas are white to yellowish. The 'pico' mangoes used were on green stage of ripeness wherein the peel color is completely light green and flesh color is yellow green.

Talbe 4. Physico-Chemical Properties of Processed Green MangoPuree from "Pico" and "Carabao" at 0 and 9 months Storage.

Samples	pH		Total Acidity as Citrict Acids (%)		Total Solids (%)		Total Soluble Solids (°Bx)		Ascorbic Acid (mg %)	
	0 mo.	9 mos.	0 mo.	9 mos.	0 mo.	9 mos.	0 mo.	9 mos.	0 mo.	9 mos.
Pico										
- plain puree	3.04	3.29	1.06	1.29	12.03	11.68	10.0	10.0	22.83	20.78
- puree + salt	3.01	2.95	1.11	1.28	13.54	13.68	13.0	10.0	18.22	16.35
- puree + salt + preservative	3.05	3.01	1.05	1.24	14.35	13.59	12.5	10.0	16.44	11.35
Carabao										
- plain puree	2.89	2.86	1.66	2.47	14.31	13.54	10.0	11.0	11.05	11.66
- puree + salt	2.92	2.85	1.94	2.13	16.31	15.88	13.0	15.0	10.77	10.10
- puree + salt + preservative	2.88	2.67	1.63	2.22	16.25	15.44	12.0	15.0	10.78	9.50

Total acidity expressed as % citric acid of the 'pico' mango puree at 0 month storage was 1.06 for the plain puree, 1.11 for the puree with salt, and 1.05 for the puree with salt and preservative. This increase slightly after 9 months storage. Total solids at zero month storage were 12.03% for the plain, 13.54 for the puree with salt and 14.35 for the puree with salt and preservative. Ascorbic acid content of plain 'pico' puree was higher (22.83 mg%) than the other two samples - 18.22 for the puree with salt and 16.44 for the puree with salt and preservative. The ascorbic acid content of the 'carabao' mango puree was much lower as follows: 11.05 mg % for the plain puree, 10.77 for the puree with salt and 10.78 for the puree with salt and preservative.

Bacteriological Analysis

Samples were analyzed for standard plate count, yeast and mold count and coliform count. Results of microbial analysis of the processed puree from santol, guava, 'carabao' and 'pico' green mangoes are shown in Table 5. At 19 months storage, santol puree was still satisfactory, guava at 20 months were still satisfactory and mango at 12 months were still satisfactory.

Table 5. Results of Bacteriological Analysis

Sample	Storage Duration (Months)	Laboratory Results: Std. Plate count (cells/ml)	Yeast and Mold Count (cells/ml)	Coliform counts (cells/ml)	Inference
Santol puree					
- plain	19	(10 (ESPC)	(10 (ESPC)	(10 (ESPC)	Satisfactory
- with salt	19	- do -	- do -	- do -	- do -
- with salt +	19	- do -	- do -	- do -	- do -
Guava puree					
- white, peeled	6	- do -	- do -	- do -	- do -
- white, unpeeled	6	- do -	- do -	- do -	- do -
- white, lye-peeled	6	- do -	- do -	- do -	- do -
- pink, peeled	6	- do -	- do -	- do -	- do -
- mixture of pink and white with 2% salt	20	-do -	- do -	- do -	- do -
Green mango-pico					
- plain	12	- do -	- do -	- do -	- do -
- with salt	12	- do -	- do -	- do -	- do -
- with salt + preservative	12	- do -	- do -	- do -	- do -
Green mango-carabao					
- plain	12	- do -	- do -	- do -	- do -
- with salt	12	- do -	- do -	- do -	- do -
- with salt + preservative	12	- do -	- do -	- do -	- do -

Pulp and Puree Recovery

a. Santol fruits - Pulp recovery was an average of 48.14 % while puree recovery was 80.76%. Addition of santol extract (boiled seeds with water) to the chopped pulp to facilitate pulping led to increased puree production.

b. Mango - Pulp recovery from 'carabao' was an average of 71.555 while puree recovery was 107.61%. Increase in puree was due to the addition of measured quantity of water to the pulp to facilitate pulping. Pulp recovery from 'pico' was 71.62% while puree recovery was 110.81%. More water was added to pico due to its green stage of ripeness.

Table 6. Guava Pulp and Puree Recovery and Color (Appearance) of the Finished Product

Samples	Pulp Rocovery %	Method of Extraction	Puree Recovery %	Color (Appearance of Finished Product
Hand-peeled - white - pink	37.50 47.50	Water added was equal in volume to seeds	56.50 72.50	Cream-colored Pink
Lye-peeled - white	50.00	Water added was equal to weight of seeds	100	Cream-colored
Unpeeled - white	50.00	Water added was equal in volume to seeds	88	Cream-colored but darker (greenish tinge) than peeled
Unpeeled - pink and white	56.25	Water added was 170% of weight of seeds	118.75	Beige-colored

c. Guava - Table 6 shows the comparative pulp and puree recovery from hand peeled, lye-peeled and unpeeled guavas based on the method of extraction. Puree from lye-peeled and unpeeled white guava had the same percentage of recovery at 50%.

The 16% difference in puree recovery for hand-peeled pink and white guavas could be attributed to uncontrollable loss from peels, crowns, ends and seeds as several persons did the peeling. Lye-peeling seems to be the best method in terms of labor cost, time and efforts as well in improved yield.

Evaluation of Color and Appearance

Subjective method through visual observation was employed by the researchers to detect changes that occurred during storage.

The following initial observations were made on the processed puree : (1) color of santol puree was light brown; (2) color of green 'carabao' mango puree was light yellow; (3) green 'pico' mango puree was cream colored. Compared to the hand-peeled and lye-peeled which were cream colored, a wholesome pink colored puree was obtained from peeled pink guavas. Ideally, guava puree for nectar and juice blends should be a bright pink color that will not require the addition of artificial color.

There was no change in the color and appearance of the processed products during storage under ambient conditions.

Sensory Evaluation

a. Mango puree - The highest score was for the "pork sinigang" with processed 'carabao' mango puree (58), followed by processed 'pico' mango puree (50) and fresh tamarind (43). Six out of 10 panelists were able to discern which of the coded samples was the same as the control (tamarind). The ANOVA for mango puree shows that there was no significant differences among the three samples.

b. Guava puree- "Sinigang" with processed guava puree received the highest score (53) followed by fresh guava (46), and the commercial guava (42). However, the ANOVA show that there was no significant difference among the three samples. Six panelist were able to detect which of the coded samples was the same as the control.

CONCLUSION

Thermally-processed purees from acidic fruits like santol, guava and mango can be stored under ambient conditions without any change in color and appearance. Sensory evaluation results showed that bottled mango and guava purees were more acceptable compared with the fresh when used as ingredients in a traditional Filipino dish.

RECOMMENDATION

Since results are encouraging, sensory evaluation of the bottled puree could be conduced to determine acceptability up to at least 12 months storage period.

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