Development of Processed Products from Guapple

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ABSTRACT

The study aimed to develop processed products from guapple. Characterization of the guapple fruit was intially conducted before proceeding to formulation studies.

The following characteristics of the guapple fruit were observed: color of outer skin - yellow green with Munsell notation of 10 Y7/6, color of inner flesh - off white with Munsell notation of 7.5Y 8/2; texture, 20.4-37.1 mm; average weight per piece, from 219 to 420 gms; ph, 3.7; titrable acidity (citric acid), 0.34%, and soluble solids, 2.6° Brix.

The identified processed products from guapple were puree, pickles, and preserves. Standardized processes and formulations for each of these products were developed in semi-pilot scale. Removal of the skin for the guapple preserves and pickles was facilitated using 5% brine-1% $CaCl_2$.

Suitable packaging materials were also identified. Flexible films were used for guapple puree while glass jars and flexible films were found to be satisfactory both for guapple pickles and preserves.

Physico-chemical, microbiological, and sensory evaluation were done after two months of storage. Based on these tests, the pasteurization process of 180° F for 20 minutes for puree and 10 minutes for preserves and pickles, was found to make the products commercially sterile.

INTRODUCTION

Since 1988, Negros and other provinces in the Visayas and Mindanao have grown numerous guapple trees. After the downfall of the sugar industry, most of the sugar cane areas were converted to orchards of guapple. The volume of guapple production increased from 1,072,988 kg in 1989 to 2,091,161 kg in 1993 (BAS, 1994). Agricultural production of guapple on a commercial scale in the South resulted in a surplus of guapple in the local market. This brought on losses due to spoilage. With the availability of good quality cultivars and continuity of supply, the prospect of marketing guapple in both fresh and processed forms is very promising.

Guapple is primarily consumed in its fresh form. The marketable potential of the fruit can be maximized through its development into processed products. Losses and wastage can be prevented by increasing the utilization of the fruit. Commercial processing of guapple is favored because of its high pulp recovery & high ascorbic acid content.

The processing of guapple requires simple and inexpensive technologies. Therefore, the possibility of industrial assimilation is very high. The technological adaptability of the process encourages growers and consumers to engage in the manufacture of processed guapple on a small scale.

The study aims to develop three products from guapple: puree, pickles, preserves.

MATERIALS AND METHODS

The study was divided into four phases. The first phase dealt with the raw materials characterization of guapple.

Key words: puree, pickles, preserves, guapple, standardization, pasteurization

Guapples of proper stage of maturity were selected and recommended for each product through physico-chemical evaluation. Phase II involved the standardization of formulations and processes for the three products. Phase III involved the identification of suitable packaging material for puree, pickles, and preserve. Phase IV was concerned with the determination of storage characteristics for each product.

Phase I. Raw Material Characterization

To control the uniformity of raw materials, only one supplier was identified as the source of the guapples. The purchase was done promptly on the day of arrival of the guapples from General Santos City in Mindanao. The fruits were inspected and sorted according to size. A uniform degree of ripeness was sought in the contents of the crate.

Raw material evaluation

Immediately after the purchase of the guapples, samples were subjected to physico-chemical analysis. Instrumental tests on the fruit for an assessment of maturity were as follows: color of the outer skin and inner flesh, texture, pH, soluble solids, titrable acidity, weight per piece, and diameter of the fruit. Color was measured using the Munsell book of colors.Texture was determined using a Humboldt Penetrometer 6438. Penetrometer readings were taken along the fruit at three points (head, center, and bottom). The fruit was positioned horizontally at the penetrometer base such that the stem end was at the side and the instrument portion was directly focused on the middle portion having the largest diameter. The diameter of the the fruit was determined using a vernier caliper. Actual weight per piece was taken to classify the fruits as large, medium, or small.

Small sized guapples have a weight of 180–330 grams, medium sized guapples, 331-480 grams, and large guapples, 481 to 630 grams. The average weight of one guapple 219 to 420 grams.

The soluble solids content was determined using a hand refractometer. The acidity was measured by titrating with 0.1N NaOH up to the phenolphthalein end point and expressed as per cent citric acid. The pH was obtained using Suntex digital pH center model SP-7.

To maximize the utilization of the guapple in each crate, m grading in terms of size was made. Small-sized guapples were made into puree while large and medium-sized guapples were made into preserves and pickles.

Phase II. Standardization of Formulations and Processes for the Three Guapple Products

Puree

Large mature guapples were utilized in the preparation of guapple puree. The guapple fruits were washed in 20 ppm chlorinated water, then cut into wedges using a fruit slicer. The seeds were removed and placed in a separate container. An equal amount of water was added and the seeds were boiled until tender enough to pass through the pulper.

The fruits were washed again and cut further using the fruit slicer. After weighing, the sliced fruits were allowed to pass through the colloid mill for homogenization. An equal amount of water was simultaneously trickled down while milling. One part water to one part fruit was utilized (w/w). Guapple seeds and meat were passed through the pulper finisher twice. The titrable acidity was adjusted to 0.7%. The resulting puree was heated to 180° F for 20 mins. using a steam jacketed kettle. The product was hot-filled in aluminum-lined bags and sealed immediately using a vacuum sealer. It was then cooled in water bath and stored inside the freezer at a temperature of -18°C. Several production runs on guapple puree were done in order to standardize the process parameters and identify critical control points. Physico-chemical results were compared to determine the significant changes that occur during processing.

Guapple Pickles

The guapple fruits were sorted and inspected for defects and bruises. Large, fresh, mature guapples were thoroughly washed in 20 ppm chlorinated water to remove dirt and other accumulated debris, then cut into wedges using a fruit slicer. Seeds were removed and the cut fruits were cured overnight in 5% brine and 1% $CaCl_2$. The washed with tap water, weighed, and the packed in glass jars.

The syrup was prepared by pre-mixing all the spices and adding sugar as base. The sugar-spice mix was dissolved in vinegar and water and was boiled for 15 mins. The pickling solution was poured into the glass jars which were then tightly covered, heated at 180°F for 10 minutes, cooled in water bath before being stored at ambient temperature.

Calcium chloride was used as firming agent on pickled guapples. Salt, sugar, vinegar, and spices were combined with the pickling solution. The level of calcium chloride used as firming agent was established based on sensory evaluation. The results of the sensory evaluation were

statistically analyzed using Kramer's Rank Sum Test and Analysis of Variance (ANOVA). Duncan's Multiple Range Test (DMRT) was applied when significant differences between samples were obtained.

Guapple Preserves

Sound guapple fruits were washed in 20 ppm chlorinated water, then peeled by immersing in almost boiling 2% lye solution the skin was scrubbed with abrasive pads. The fruits were washed thoroughly with tap water, and cut into wedges using a fruit slicer. The seeds were removed by scraping them off with a knife. The fruits were rinsed thoroughly in running water and cured overnight in 5% brine and 1% $CaCl_2$. The cured guapple slices were rinsed in running water and packed in glass jars. Twenty five (25) Bx syrup was heated and poured into the glass jars. They were pasteurized at 180°F for 10 minutes, then cooled in water bath and stored at room temperature.

Phase III. Determination of Packaging Materials for Guapple Puree, Pickles, and Preserve.

Different packaging materials were tested for the guapple products; 2T cans, glass jars, and flexible films. For pickles, glass jars and transparent pouches were utilized. Clear, medium-sized glass jars with self-sealing caps were used Transparent and aluminum retortable pouches were used for puree and preserves.

Phase IV. Determination of Storage Characteristics of Guapple Products

The three guapple products in different packaging materials were stored for two months at freezing temperature for puree and at room temperature for pickles and preserves.

Immediately after the production of the puree, samples were obtained for physico-chemical analysis. Evaluation was conducted during its two month storage to determine sensory attributes and acceptability of the product. The initial microbiological profile of the finished product was determined.

Guapple preserves and pickles were stored at room temperature and their physico-chemical and microbiological characteristics were observed after two-months of storage. The sensory attributes and acceptability of these products were also evaluated.

RESULTS AND DISCUSSION

Phase I. Raw Material Characterization

The characteristics of guapples were established before proceeding to formulation studies. Physico-chemical characterization of raw material provides quality specifications in the development of new products. According to Boyle (1957), guava fruits ideal for processing are those with strong acidity, colored flesh (cream, red, or pink), high flesh recovery (greater than 75%), high soluble solids, and ascorbic acid content. The utilization of guapple for processing into puree was based on these attributes.

Raw Materials Specifications

Color. Raw materials control is necessary to predetermine the color of the finished product. Table 1 shows that the guapple fruit has a Munsell color notation of 10Y 7/6 for the outer skin, with a characteristic yellow green color. The inner flesh was characterized as off-white in color with Munsell notation 7.5Y 8/2.

Table 1. Recommended raw material specifications for the manufacture of guapple products

Attributes	Specifications
color	
outer skin	10Y7/6
inner flesh	7.5Y/8.2
texture (mm)	20.4-37.1
weight per piece (g)	219-410
yield of fruit	87.8%
pH	3.7
% TA (as % citric acid)	0.34%
soluble solids (Bx)	2.6
moisture	54.8%

Texture. Table 2 shows the range of penetrometer readings for a sample consisting of three pieces per trial. Penetrometer reading translates the depth to which needle sinks into the fruit within the duration of 20 seconds. Thus, a high reading indicates a soft texture while a low reading indicates a firm texture.

Guapples with soft texture has high juice yield. Guapples with low penetrometer readings (9.8-27 mm) are good for

Table 2. Texture penetrometer readings of guapple fruit

Penetrometer reading	Skin (mm)	Pulp (mm)	Core (seeded portion) (mm)
unripe	1.0-16.7	9.8-27.0	2.8-23.6
mature	33.0-44.0	20.4-37.1	26.3-32.2
overripe	38.5-46.2	28.9-42.4	--
cooked	56.4	60.0	34.8

the manufacture of pickles and preserve, but not for the production of puree. The firm texture of the fruit is good for pickles and preserves, but makes extraction of the pulp difficult.

Diameter of fruit. The average diameter of guapple is 7.9 cm. A large portion of the fruit is made up of a thick outer pulp; at the center is a smaller mass of softer material. The thick outer pulp explains the firm texture of guapple. Large guapples are suitable for processing because these have large pulp. And a large pulp has a high puree yield.

Guapple has a 72% pulp recovery. It is lower than the set requirement of 75% for good pulp recovery.

Objective tests on pulp

pH. Results showed that guapple belongs to the high-acid food category, with an average pH value of 3.7. Guapple is not appropriate for processing from the standpoint of acidity. An overripe guapple has a pH of 3.62.

Titrable acidity. The titrable acidity (expressed as citric acid) of guapple was found to be 0.34%. The high acidity of the fruit will render it self-stable because some microorganisms will be inhibited by the high acidity of guapple.

Soluble solids. Guapple was found to contain low soluble solids (2.6 Bx). This value is low for processing types of guava fruits as reported by Boyle (1957).

Phase II. Standardization of Formulations and Processes For Guapple Products

Guapple Puree

In the formulation studies for the optimum soluble solids and titrable acidity levels, results of the sensory evaluation of guapple puree revealed that 13° Bx and 0.78% titrable acidity gave the right brix:acid ratio for the puree. Increasing the soluble solids content of guapple to 13°Bx intensified the browning reaction. In the succeeding production runs, the soluble solids of the puree was, therefore left unadjusted to lessen the browning.

The pH reading of the product before and after processing remained between 3.8 and 4.1.

Guapple Pickles

Results of the sensory evaluation is presented as shown in Table 3. Based on the results, 37 per cent of the panelists preferred the product with 1.0% $CaCl_2$ which had a mean score of 3.63 and was described to have a crunchy texture. Results of DMRT showed that there is no significant difference between the level of $CaCl_2$, 0.5 and 3.0%.

Table 3. Sensory Evaluation of guapple pickles at different levels of CaC12

% of CaC12	Mean score for crunchiness	% of panelists that considered the product best
0.3	2.94	27
0.5	4.37b	23
1	3.63	37
3	4.79b	13

a score close to 1, soft; 4, crunchy; 7, tough
b, not significantly different at 5% level of significance

Guapple Preserve

Peeling the guapple manually increases peeling time, thus, recovery was further reduced by about 10%. Results of the experimental matrix for lye peeling are shown in Table 4.

Lye treatment of guapple using 2% solution at near boiling temperature was selected since immersion time was

Table 4. Effect of different lye concentration on peeling of guapple fruit

Lye solution at 70°	Immersion time in order to peel
1%	begins to flake at 15 minutes; takes 20 minutes of soaking to be able to scrub off some parts
2%	2-3 minutes
3%	under 1 minute

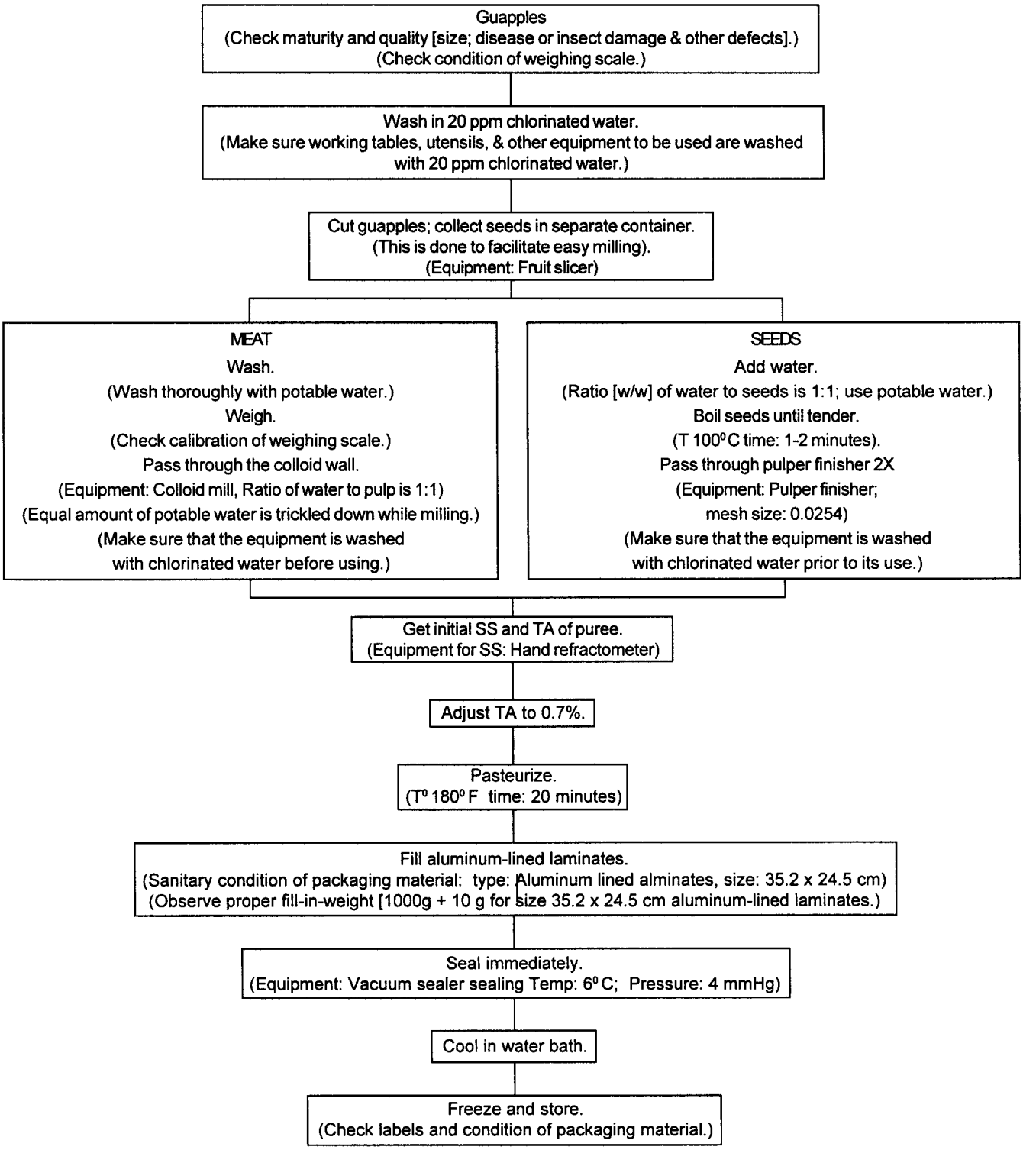

Fig. 1. Process flow and control points for the production of guapple puree

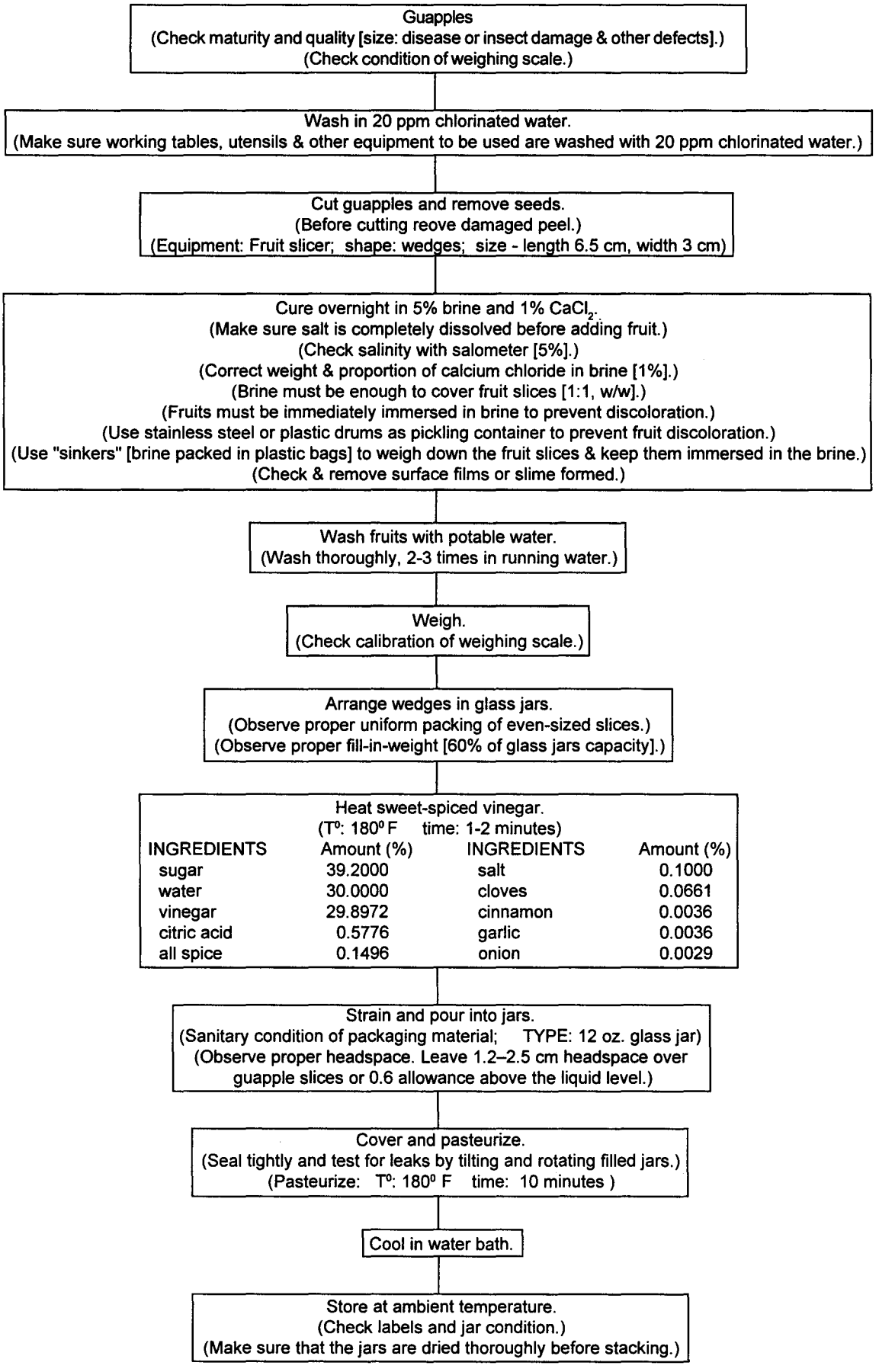

Fig. 2. Process flow and control points for the production of pickled guapple

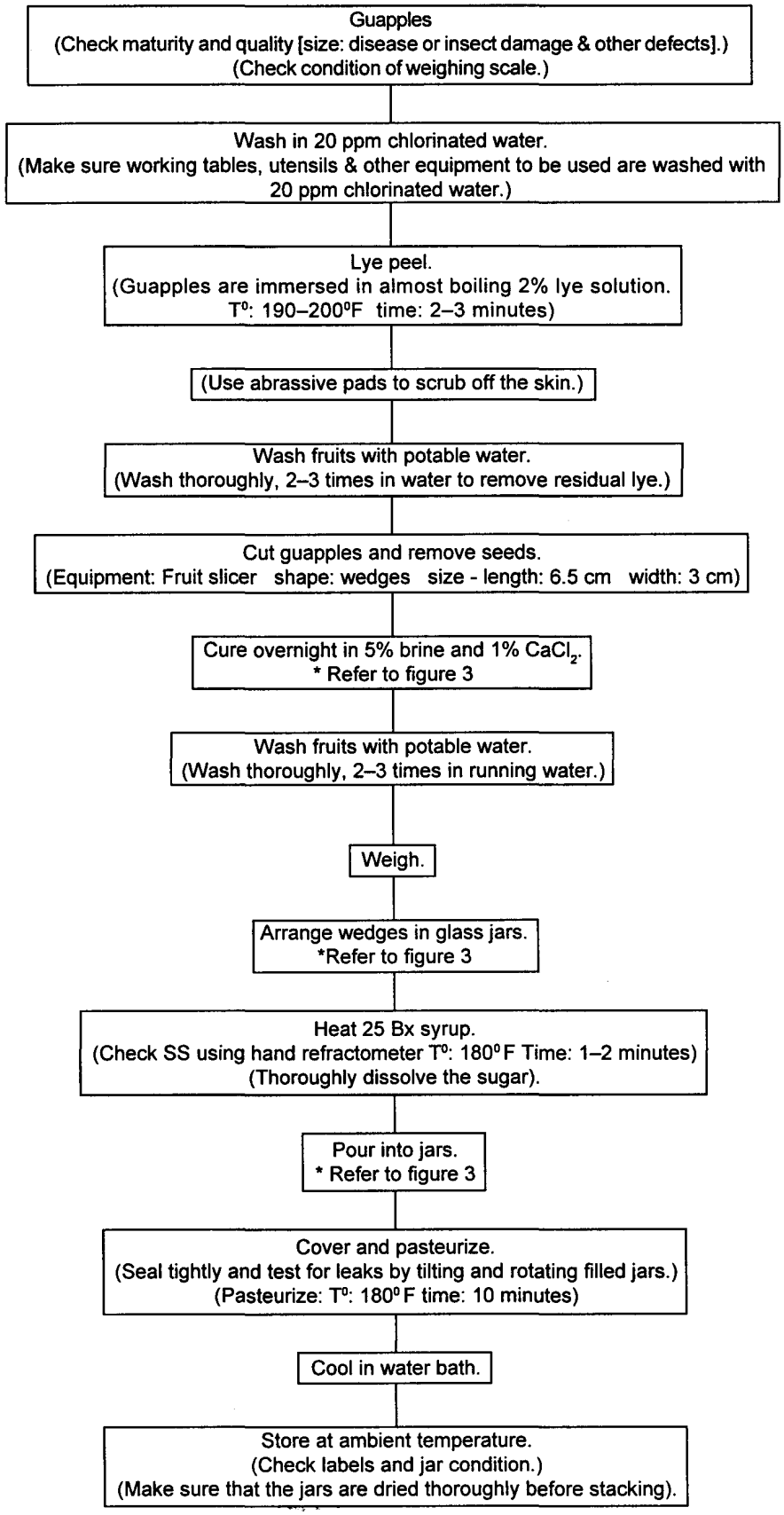

Fig. 3. Process flow and control points for the production of guapple preserve

adequate for peeling. It was observed that some parts of the guapple fruit were difficult to peel, resulting in uneven peeling.

Sensory inspection of the treated guapple revealed no off taste as a result of the treatment. The fruit was thoroughly rinsed with tap water. A 1% level of calcium chloride was used as a firming agent.

Phase III. Determination of Packaging Materials for Identified Guapple Products

Puree

Tin cans were utilized as packaging material for puree. However, after processing, it was noted that the product turned pink and upon storage the puree corroded the cans. Scratches on the coating of the can walls were observed. Bottles were tried next as containers but evident discoloration on the puree was noted upon storage. Flexible films were then utilized as packaging material for puree.

Pickles

Glass jars and flexible films were used as packaging materials for guapple pickles. Both packaging materials were satisfactory.

Preserves

Preserves were packed in flexible films and glass jars. Both packaging materials were also satisfactory.

Phase IV. Determination of Storage Characteristics of Guapple Products

Representative samples for pureed, pickled, and preserved guapple products were subjected to microbiological examination and physico-chemical analysis after two months of frozen storage for puree and at room temperature for pickled and preserved guapple. Results of these tests are presented in Table 5.

Total plate count, yeast, and molds were examined. The results of the yeast and mold count for the three guapple products were negative.

After two months of storage, slight changes were observed in the physico-chemical characteristics of the guapple products. The acidic nature of the guapple products remained constant as shown by the relatively uniform pH values. No major changes were observed in the titrable acidity values.

Table 5. Results of physico-chemical and microbiological tests for guapple puree, pickles, and preserve after two months of storage.

	PUREE		PICKLES		PRESERVE	
	2 wks	2 mos	2 wks	2 mos	2 wks	2 mos
pH	3.6	3.55	2.6	2.33	3.6	3.68
Soluble solids	12	8.6	22.7	24.1	21	17.64
Titrable acidity (%)	0.66a	0.83a	0.91b	1.04b	0.20a	0.18a
Microbiological analysis						
Total plate count	10cfu/g		10cfu/g		10cfu/g	
Yeasts and molds	negative		negative		negative	

The changes in the % soluble solids of preserves and pickles indicated that equilibration took place between the packing medium and the fruit slices.

In the sensory evaluation, a majority of the panelists described the pickled guapple as be greenish in color, moderately tender in texture, with the right blend of sweetness and sourness, and a general acceptability of "liked very much."

The guapple preserve gained a general acceptabilty of "liked moderately." It has a greenish yellow color, a slightly tender texture, and sweet flavor.

The guapple puree was presented in its original puree form to the panelists. It was described as greenish to yellow in color, slightly gritty in texture, and moderately sour in flavor. The general acceptability was described to be "liked slightly."

Among the three guapple products evaluated, the puree was the least preferred. This can be attributed to the manner by which the product was presented to the panelists.

SUMMARY AND RECOMMENDATIONS

The study was conducted to develop processed products from guapple. Characterization of the guapple fruit was initially conducted before proceeding to formulation studies. The following characteristics of the guapple fruit were observed: color of outer skin-yellow green with Munsell notation of 10Y 7/6, color of inner flesh - off white with

Munsell notation of 7.5 y8/2; texture 20.4-37.1 mm; average weight per piece, 60 grams; pH, 3.7; titrable acidity (% citric acid), 0.34, and soluble solids, 2.6 Bx.

The identified processed products from guapple were preserves, pickles, and puree. The formulations and processes of these products were developed and standardized. To facilitate the removal of the skin for guapple preserve, a 2% lye treatment was used. A 1% $CaCl_2$ was used to improve the texture of guapple preserve and pickles.

Guapple puree was made by passing the flesh of the fruit through a colloid mill and pulper for extraction and homogenization. One part water and one part fruit was utilized. The product was pasteurized at 180° F for 20 minutes, poured in aluminum laminates, vacuum-sealed, cooled, and frozen.

Pickled guapple was processed by cooking guapple wedges in sweet-spiced vinegar solution. The guapple wedges and pickling solution were packed in glass jars, pasteurized at 180°F for 10 minutes, cooled, and stored at room temperature.

Guapple preserve was prepared by cooking peeled guapple slices in syrup, packed in covered glass jars, and pasteurized at 180° F for 10 minutes. The glass jars constaining the preserves were then cooled in water bath and stored at room temperature.

Representative samples for pureed, pickled, and preserved guapple products were subjected to microbiological examination and physico-chemical analysis after two months of frozen storage for puree and at room temperature for pickled and preserved guapple.

After two months of storage, slight changes were observed in the physico-chemical characteristics and sensory attributes of the products. Results of microbiological analysis were negative for all the guapple products.

After developing processed products from guapple, commercial utilization is recommended. The technology of producing these guapple products can be transferred to guapple growers to enhance the economic potential of this produce.

The food products developed are stable and easy to store, convenient for end-users, and can serve as base materials for the manufacture of nectars and fruit juice blends, jams, jellies, pastries, dairy, and other bakery products. Guapple preserve is ideal for commercial use as pie fillings, bread or cake toppings, and as an ingredient for other dessert preparations. Pickled guapple, in a mix of seasonings and spices, can be made into a product similar to *atchara* or mango chutney and other similar specialty products.

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