PILOT COMMERCIALIZATION OF DEHYDRATED STRAWBERRY PRODUCTS

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ABSTRACT

Dehydrated strawberry products namely: Infused-dried strawberries, strawberry pinwheel, and strawberry champoy were pilot tested. Procedures were standardized and a cost and return analysis was done. Results show that the optimum temperature for drying is 70°C for 36 hours. In descending order, the recovery rates for the three products are the following: strawberry champoy (38%), infused-dried strawberries (33.75%), and strawberry pinwheel (29%). The Moisture contents after drying were: infused-dried strawberries (3.37%); strawberry pinwheel (3.70%); and strawberry champoy (4.87%).

Dehydrated strawberry products contain appreciable amounts of energy, calcium, phosphorus and minimal amounts of iron, proteins, and dietary fiber. Infused-dried strawberry and strawberry pinwheel were rated as "liked very much" while strawberry champoy was "liked moderately". All these dehydrated strawberry products show high market potential among tourists and local market.

KEYWORDS: Strawberry, Dehydrated products, Commercialization, La Trinidad, Benguet

INTRODUCTION

The trade liberalization policy of the Philippines posed a new challenge to the Benguet farmers. Good quality fruits and vegetables at reasonable prices from China and other countries flock the market, which affected the income of the Philippine fruit and vegetable farmers. To augment their income, increase utilization of their produce is an alternative solution. Processing, specially of seasonal fruits is often a means of value addition, providing variety and extending the availability of perishable fruits.

The Philippines has an abundant supply of seasonal fruits, which are mostly consumed in their fresh form. One of these is the strawberry, the number one and the most popular fruit grown in Baguio City and La Trinidad, Benguet. Generally, strawberries start bearing fruits in December and may last up to May depending on the weather conditions. The peak of harvest is during the months of February to April. As soon as the rain starts, the volume of harvest starts to decline. From November 2007 to April 2008 the total production consumption is 1,332 metric tons.

Strawberries are highly perishable due to their high moisture content. When left at room temperature for more than 24 hours, the fruit over-ripens, making them unpalatable for fresh consumption. Locally, strawberries are processed into jams, preserves, wines, and candies. However, preliminary studies conducted at BSU Food Processing Center showed that these could also be processed in other ways such as dehydration to produce products like dried whole strawberries, strawberry leather, and strawberry champoy. The positive result of the preliminary studies done led to the present study specifically on its commercial viability.

Dehydration is an old method of preservation that has been continuously modified and modernized to improve food quality, reduce costs, and increase production volumes needed for wider distribution to other parts of the country and the world. Dehydrated foods go well with the changing lifestyles where demand for convenience foods has dramatically increased. Moreover, consumers now look for foods that are ready-to-eat, ready-to-mix, natural foods and foods with new forms and tastes.

This project focused on pilot testing of the less

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explored strawberry products, namely: infused-dried strawberries, strawberry pinwheel and strawberry champoy. Infused-dried strawberries are fully ripened strawberries infused with sugar then dehydrated to a chewy product. It may be eaten as is or added to cakes, confections, cereals, and salads. Strawberry pinwheel, is strawberry leather rolled into pinwheel, with a pleasant blend of sweet and sour taste. It is an excellent fruit snacks for children and adults. Strawberry champoy is fully ripened strawberry cooked with spices to create a sweet-sour-salty taste. These make excellent nibbles.

The main aim of the project was to test the pilot commercialization of the dehydrated strawberry products. Specifically, this aims to: (1) Refine the procedures for infused-dried strawberries, strawberry pinwheel, and strawberry champoy; (2) Gather pertinent data such as: optimum-drying temperature, drying time, recovery rate, moisture content, and nutritional content for these products; (3) Compute for the cost of a pilot batch production for the different dehydrated strawberry products; and (4) Determine the market viability of dehydrated strawberry products.

MATERIALS AND METHODS

Refinement of Procedure and Quality Evaluation of Dehydrated Strawberry Products

Recipes for dehydrated strawberry products were standardized for pilot commercialization. These were: infused-dried strawberry, strawberry champoy, and strawberry pinwheel.

Freshly gathered strawberries from the BSU farm were used. The strawberries were sorted: large sizes were processed into infused-dried strawberry, medium sizes into strawberry champoy, and the small and mushy into strawberry pinwheel. The rest of the ingredients were bought from the market.

The main equipment used in processing the products was a fabricated cabinet dryer with temperature control that indicates the drying temperature. Other utensils and equipment used were weighing scale, knife, measuring spoons, large basins, measuring cup, wooden spoon, stove, blender, timer, utility trays, food tong, large strainer, horizontal band sealer, infrared moisture tester and sensory evaluation kits. The procedure followed is shown in Figure 1.

Pertinent data such as: drying temperature, drying time, recovery rate, moisture content, and nutrient contents were gathered during the process. Drying temperature was read directly from the dehydrator. Moisture content was obtained using the infrared moisture tester. Recovery rate was calculated based on the formula given below:

$$\% \text{ Recovery} = \frac{\text{weight after drying}}{\text{weight before drying}} \times 100\%$$

For nutrient evaluation, only macronutrients (carbohydrates and proteins), calcium, dietary fiber, phosphorus and iron were calculated. Water-soluble vitamins and carotene (provitamin) were not included in the calculation because these are heat-sensitive and easily destroyed by light. Protein, dietary fiber, calcium, phosphorus, and iron were calculated based on the formula given in the Food Composition Table by FNRI (1998), which is:

$$\frac{\text{Nutritive Value (FCT)} \times \text{edible weight of weighed sample}}{100}$$

where: FCT- Food Composition Table

Total carbohydrate was calculated "by difference." This method yields only an approximation of carbohydrate. On the other hand, energy in kilocalories (kcal) was calculated using the general Atwater factor 4-9-4 for protein, fat and carbohydrate respectively. The formula used in calculating the total carbohydrate and energy is as follows:

Carbohydrate =

100 – (%Water + %Protein+%Fat+%Ash)

Energy =

(4 x%Protein)+(9x%Fat)+(4x%Carbohydrate)

Market Potential Study of Dehydrated Strawberries

A questionnaire was prepared to obtain information regarding consumers' feelings, acceptability and willingness to buy the products in case it will be out in the market. A consumer-type panel was used to evaluate the product samples in terms of acceptability. No specific target groups were identified to test for its marketability. Three hundred panelists from the people present in the evaluation sites served as respondents. The product evaluation and market testing were done at the BSU Food Processing Center, Swamp Satellite Market, BSU Marketing Center, Session Road, and Burnham

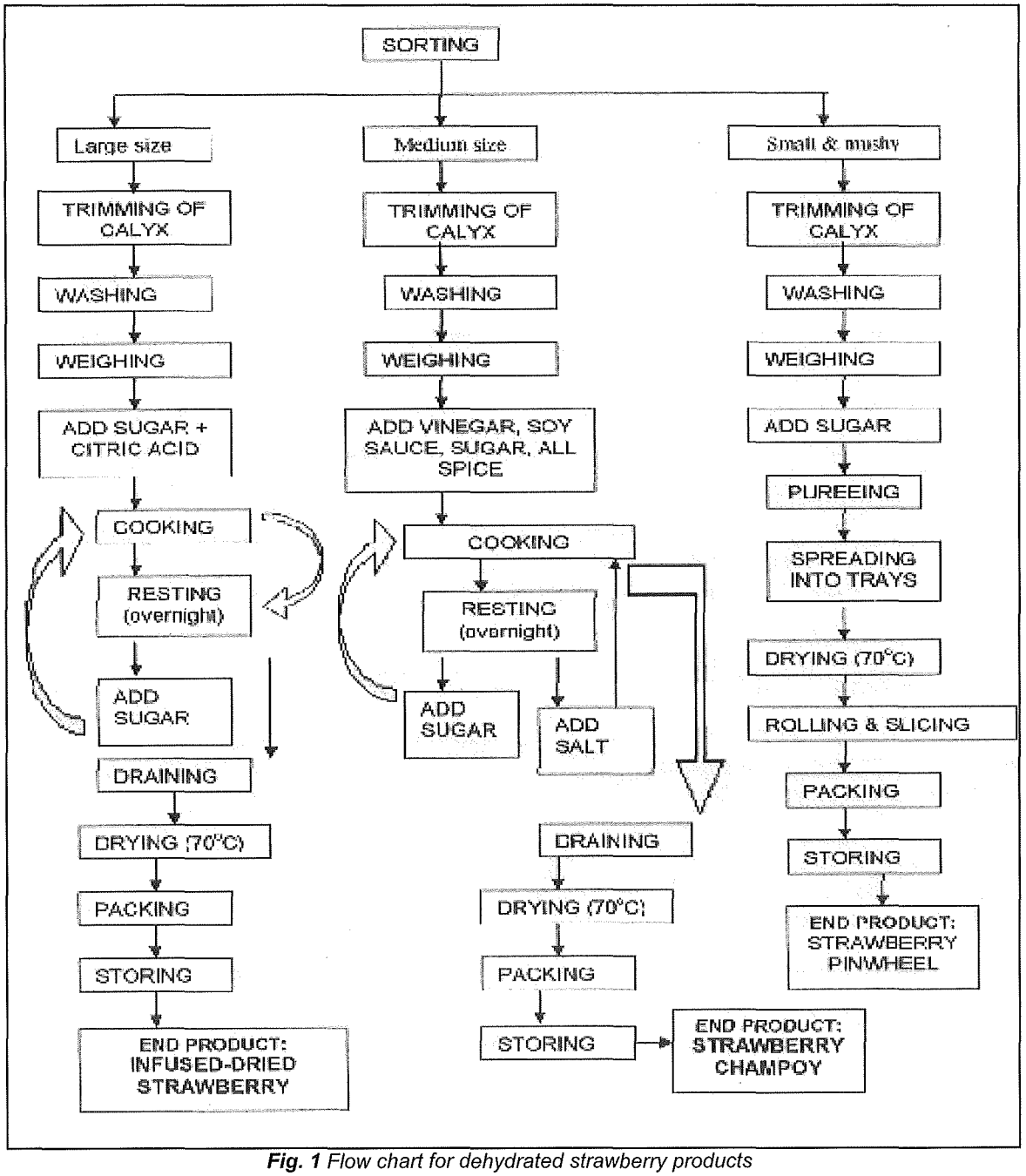

Fig. 1 *Flow chart for dehydrated strawberry products*

Park. These places were chosen because these are popular tourist destinations in La Trinidad and Baguio City.

In the estimation of the total operating expenses, 10% buffer was added to cover up the fluctuating prices of raw materials and packaging materials as well as the cost of processing utilities. Processing utilities such as power and fuel were measured by means of standard metering devices and weighing scales. Direct labor cost was computed by getting 10% of the total operating expenses. These data obtained were used in the estimation of production cost and selling price.

Results obtained from the product evaluation and market viability testing were statistically analyzed using the frequency and percentage distribution.

This tool used to analyze consumers' likes/dislikes, preference, willingness to purchase the product, and how frequent they will purchase the products if available in the market.

RESULTS AND DISCUSSION

Refinement of Procedure and Quality Evaluation of Dehydrated Strawberry Products

After several trials, the standardized procedures for the different products were established. These are shown in the following recipes.

A. Strawberry Pinwheel

Ingredients:

10 kg.	Strawberries
2-½ kg.	Sugar
	Corn oil

Procedure:

1. Sort the strawberries.
2. Trim the calyx, wash and weigh.
3. Add sugar and blend into puree.
4. Spread on greased trays about 2 mm thick (6 cups of puree per tray).
5. Dry at 70°C for 36 hours.
6. Roll into pinwheel and slice.
7. Wrap in individual wrapper, pack, label, and seal.

Drying time: 36 hours Drying Temperature: 70°C
Yield: 29 packs (100g/pack)

B. Infused-dried Strawberry

Ingredients:

10 kg.	Strawberries
10 kg.	Sugar
3-½ tbsp.	Citric acid
	Corn oil

Procedure:

1. Sort the strawberries.
2. Trim the calyx, wash and weigh.
3. Add one-half of the sugar and citric acid dissolved in water.
4. Heat and let boil for five minutes. Remove the scum.
5. Remove from heat, cover and rest overnight.
6. The following day, add the other half of the sugar.
7. Heat again and let boil for another five minutes. Remove the scum.
8. Remove from heat, cover and rest overnight.
9. The next day, drain the strawberries and place in tray. Spray some oil.
10. Dry at 70°C for 36 hours, turning from time to time.
11. Gather, sort and weigh the infused dried strawberries; pack, label and seal.

Drying time: 36 hours Drying Temperature: 70°C
Yield: 33 packs (100g/pack)

C. Strawberry Champoy

Ingredients:

10 kg.	Strawberries
6.1 kg.	Sugar
6 liters	Vinegar
2.5 liters	Soy Sauce
4 tsp.	All spice
5 tbsp.	Rock salt
	Corn oil

Procedure:

1. Sort the strawberries. Trim the calyx, wash and weigh.
2. Add soy sauce, vinegar, all spice and one-half of the sugar.
3. Heat and let boil for five minutes.
4. Remove from heat, cover and rest overnight.
5. The following day, add the other half of the sugar.
6. Boil again for another five minutes.
7. Remove from heat, cover and rest overnight.
8. The next day, add the rock salt and heat for another five minutes.
9. Remove from heat, cover and rest overnight.
10. The following day, drain and place in tray. Spray some oil.
11. Dry at 70°C for 36 hours.
12. Wrap in individual wrapper, pack, label and seal.

Drying time: 36 hours Drying Temperature: 70°C
Yield: 76 packs (50g/pack)

Recovery Rate, Optimum Drying Temperature, Drying Time and Moisture Content.

Table 1 shows pertinent data gathered such as recovery rate, optimum drying temperature, drying time, and moisture content of the products. The optimum drying temperature for the dehydrated strawberry products was 70°C and the drying time should not exceed 36 hours to avoid scorching of the

Table 1. *Pertinent data gathered during the processing of the dehydrated strawberry products (Based on 10 kilos per batch production)*

PERTINENT DATA	INFUSED-DRIED STRAWBERRY	STRAWBERRY PINWHEEL	STRAWBERRY CHAMPOY
Recovery Rate (%)	33.75	29.0	38.0
Optimum Drying Temperature (°C)	70	70	70
Drying Time (hours)	36	36	36
Moisture Content (%)	3.37	3.70	4.87

products. Standards dictate that dried fruits should not have moisture greater than 24-26%. Properly dried fruits have a moisture content ranging from 2% to 5% (De Leon, *et al.*, 1998). From the result of the moisture content test using the infrared moisture tester method, the moisture contents of infused dried strawberry; strawberry pinwheel; and strawberry champoy, which were 3.37%, 3.70% and 4.87% respectively, conformed to the standards.

Energy and Nutrient Contents of Dehydrated Strawberry. Since water-soluble vitamins and carotene (provitamin) are generally lost in dehydration, only energy, protein, carbohydrates, calcium, dietary fiber, phosphorous and iron contents were calculated. Calculated values are shown in Table 2.

Table 2. *Nutrient contents per 100 g of the dehydrated strawberry products*

NUTRIENT CONTENT	INFUSED-DRIED STRAWBERRY	STRAWBERRY PINWHEEL	STRAWBERRY CHAMPOY
Energy (kcal)	395.4	395.4	342.4
Protein (g)	2.4	2.8	4.4
Carbohydrates (g)	89.7	88.4	74.9
Dietary Fiber (g)	5.6	6.6	5.7
Calcium (mg)	101.5	118.2	170.2
Phosphorus (mg)	62.2	72.4	131.8
Iron (mg)	3.6	4.1	6.3

Product Evaluation. The results of the product acceptability test scale shows that the mean panel ratings on consumers' acceptability for Infused-dried Strawberry and Strawberry Pinwheel were 7.64 and 7.52 respectively, which by hedonic scale adjectival rating is "like very much". On the other hand, the mean panel rating on consumers' acceptability for Strawberry Champoy is 7.08, which by hedonic scale adjectival rating is "like moderately".

Market Potential Study of Dehydrated Strawberries

Cost and Return for Dehydrated Strawberry Products. Table 3 shows the cost and return for infused-dried strawberry production. Infused-dried strawberry has a net income of P 679.61, ROI of 41.68 and BCR of 1.42 per 10 kg fresh strawberries.

Table 4 shows the cost and return for strawberry pinwheel production. Strawberry pinwheel has net income of P 374.89, ROI of 27.46 and BCR of 1.27 per 10 kg fresh strawberries.

Table 3. *Cost and return for infused-dried strawberry production*

Gross Income		**2,310.00**
Production per batch: 33 packs at P 70/pack		
Production Cost		**1,630.39**
Materials per batch		
Strawberry (P 55/kg x 10kg)	550.00	
Sugar (P 34/kg x 5 kg)	170.00	
Citric acid (P 91/kg x 30g)	2.73	
Corn oil (P 103/L x 80ml)	8.24	
Plastic bags (P 0.16/pc x 33 pcs.)	5.28	
Labels (P2.30/pc x 33 pcs.)	75.90	
Gas (P 526/tank x 0.067 tank)	35.25	
Energy Cost	500.00	
Buffer	134.74	
Labor Cost	148.25	
Net Income		**679.61**
ROI		**41.68**
BCR		**1.42**

Table 4. Cost and return for strawberry pinwheel production

Gross Income		**1,740.00**
Production per batch: 29 packs at P 60/pack		
Production Cost		**1,365.11**
Materials per batch		
Strawberry (P 55/kg x 10kg)	550.00	
Sugar (P 34/kg x 2.5 kg)	85.00	
Plastic Wrap	10.50	
Cellophane (P6/sheet x 9 sheets)	54.00	
Plastic bags (P 0.26/pc x 29 pcs.)	7.54	
Labels (P3.35/pc x 29 pcs.)	97.15	
Energy Cost	324.00	
Buffer	112.82	
Labor Cost	124.10	
Net Income		**374.89**
ROI		**27.46**
BCR		**1.27**

Table 5 shows the cost and return for strawberry champoy production. Strawberry champoy has net income, ROI, and BCR of P 655.40, 59.33, 1.59 respectively per 10 kg strawberries.

Table 5. Cost and return for strawberry champoy production

Gross Income		**1,760.00**
Production per batch: 32 packs at P 55/pack		
Production Cost		**1,104.60**
Materials per batch		
Strawberry (P 55/kg x 10kg)	550.00	
Sugar (P 34/kg x 3 kg)	102.00	
Vinegar (P 18.06/L x 2.5 L)	45.15	
Soy sauce (P 21.10/L x 1 L)	21.10	
All spice (P 1.72/g x 4 g)	6.88	
Rock salt P 0.02/g x 90 g)	1.80	
Japanese paper (P 2.25/pc x 6 ¼ pcs)	14.06	
Glacine (P 1.70/pc x 6 ¼ pcs)	10.63	
Plastic Wrap	10.50	
Plastic bags (P 0.26/pc x 32 pcs.)	8.32	
Labels (P3.35/pc x 32 pcs.)	107.20	
Gas (P 526/tank x 0.067 tank)	35.25	
Energy Cost	324.00	
Buffer	91.29	
Labor Cost	100.42	
Net Income		**655.40**
ROI		**59.33**
BCR		**1.59**

Market Viability Testing. Results of market viability testing show that more tourists are willing to buy the products than the local residents. Consumers are willing to buy the products at the range of P 65.00 – P 70.00 per 100 g pack. Among the places where the consumers want to buy the products are: pasalubong center, supermarket, public market, school canteen, and sari-sari store in descending order.

SUMMARY, CONCLUSION, AND RECOMMENDATION

Summary

This study was conducted to refine the procedures for infused-dried strawberries, strawberry pinwheel and strawberry champoy; gather pertinent data such as: optimum-drying temperature, drying time, recovery rate, moisture content and nutritional content for these products; compute for the cost of a pilot batch production for the different dehydrated strawberry products; and determine the market viability of the dehydrated strawberry products.

Results show that the optimum temperature for drying is 70°C for 36 hours. In descending order, the recovery rates for the three products are the following: strawberry champoy (38%), infused-dried strawberries (33.75%), and strawberry pinwheel (29%). After drying, the moisture contents are: infused-dried strawberries (3.37%); strawberry pinwheel (3.70%); and strawberry champoy (4.87%). Dehydrated strawberry products contain appreciable amounts of energy, calcium, phosphorus, and minimal amounts of iron, proteins, and dietary fiber.

Infused-dried strawberry and strawberry pinwheel were rated as "liked very much" while strawberry champoy was "liked moderately". Results of market viability testing show that more tourists are willing to buy the products than the local residents. Consumers are willing to buy the products at the range of P 65.00 – P 70.00 per 100 g pack. Among the places where the consumers want to buy the products are: pasalubong center, supermarket, public market, school canteen, and sari-sari store in descending order.

Conclusions

Dehydrated strawberry products are acceptable and have good potential market not only among tourists but also local consumers. It has promising prospects for livelihood among farmers and local entrepreneurs.

Recommendations

1. Expand the land area devoted to strawberry production because dehydration of strawberry requires a large volume of fresh strawberries.

2. Encourage local fabricators of dryers suited for small-scale production.

3. Disseminate the technology for strawberry dehydration to local processors.

LITERATURE CITED

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