

DEVELOPMENT OF SWEETPOTATO-BASED CANDY PROCESSING TECHNOLOGY FOR COMMERCIALIZATION

Esther T. Botangen¹ and Hilda L. Quindara¹

ABSTRACT

Product development involving consumers is important in developing quality attributes. It ensures that the products developed and marketed satisfy the needs and preferences of the consumers which is important in commercialization.

The sweet potato-based tamarind (camarind) and strawberry (camberry) candies have a sweet-sour taste. Specifically, camarind has soft leathery texture and is seedless. Camberry has soft textural moistness.

The quality of camberry was observed to change at three months after processing. For camarind, the quality started to deteriorate at eight months after processing. Camango has the shortest shelf life of two to four weeks after processing.

At a selling price of P18.50/pack and production costs of P13.55/pack and P14.25/pack for camberry and camarind, respectively, estimated return in Returns on Capital Employed (ROCE) of 36.51% and 29.82% can be derived.

KEYWORDS: sweetpotato, development of sweetpotato, candy processing technology, commercialization, sweetpotato products

INTRODUCTION

Sweetpotato is one of the most versatile nutritious crops available year round in the country. It is rich in vitamin A, vitamin C, fibers, and calcium. Consumption of sweetpotato can provide 6–15% of the total RDA requirement for vitamin C; 3-5% vitamin A; 2-3% calcium; 1-3% iron; 1-2% energy; and less than 1% of protein (Gayao *et al.*, 2004)

Promoting its commercialization is one strategy in helping reduce the incidence of micro-nutrient deficiency. In Mozambique, children intake of vitamin A increased with

enhanced commercialization of orange-fleshed sweetpotatoes. Commercialization of sweetpotato-based products such as candies could be a potential approach to help promote consumption and spread its nutritional benefits to a wider population.

The success of commercialization depends however, on the market quality of the product. Market quality depends on the preferences and needs of the consumers and on the processing technique employed. In addition to market quality, the storability, the saleability and potential income derived are important in packaging a technology intended for commercialization.

¹Researchers, Northern Philippines Root Crops Research and Training Center (NPRCRTC), Benguet State University (BSU)

Such information has to be established before promoting a processing technology for commercialization. The objective of this project is to package sweetpotato - based candy processing technology for commercialization.

MATERIALS AND METHODS

Phase 1. Preliminary evaluation of different formulations of sweetpotato (SP) - strawberry (camberry), - tamarind (camarind), and mango (camango) candies

'Bengueta,' 'Inmitlog' and 'Haponita' varieties of sweetpotato are good for sweetpotato-based candy processing. Any variety with yellow, orange, and violet flesh color can do.

Preliminary evaluation of different formulations of SP-based candies was done. For the SP-strawberry and the SP-tamarind candies, formulations with different ratio of SP:strawberry, tamarind: sugar were tested. For the SP-mango candy, the use of ripe and unripe mango was tried. The different formulations were evaluated based on the qualities such as textural moistness, sweetness/sourness, and the general acceptability. Shelf life and cooking time were also monitored.

The dry matter content is not a strict criteria for processing as long as the processor gets the right consistency of the mixture to prolong the shelf life of the product. Cooking time is important.

The implementation procedure is summarized in Fig. 1 and Fig. 2.

Sensory Evaluation

Sensory evaluation involved the quality rating scale of 1 – 5. Sweetness was rated from very sweet (5) to bland (1). Similar numerical scale was used for sourness and texture. For acceptability, the scale of 1 (not acceptable) – 7 (highly acceptable) was employed.

The mean ratings were estimated and the respective quality attributes of the different formulations were compared.

The formulation with the highest acceptability ratings was considered as potential formulation and was used in the market testing activity of Phase 2.

Phase 2. Market testing and modification of the potential product formulation

The potential formulation was processed at a semi-commercial scale and delivered to the BSU Marketing Center to gather consumers' comments or responses that served as basis for further improvement of the formulation.

Based on the result of the informal market testing activity, the formulation was modified to suit consumers' needs and preferences. The final/ acceptable product formulation was the basis for cost and return analysis, nutrient analysis, product costing and market testing.

Phase 3. The storability of sweetpotato-strawberry/tamarind candies

The study was undertaken to estimate the shelflife of the candies as basis for declaring the expiration date of the processed product.

Since relative humidity can influence shelflife, there were two storage trials conducted: one trial started in January for low relative humidity and the other trial started in July for high relative humidity.

Sampling of the product was done weekly. Sensory evaluation was done to monitor quality changes during storage. Visual observation for the presence of molds was also monitored.

A similar commercial product was included as control in the study. The commercial product was bought at the Swamp satellite market which was processed on the same period as the SP-based camberry.



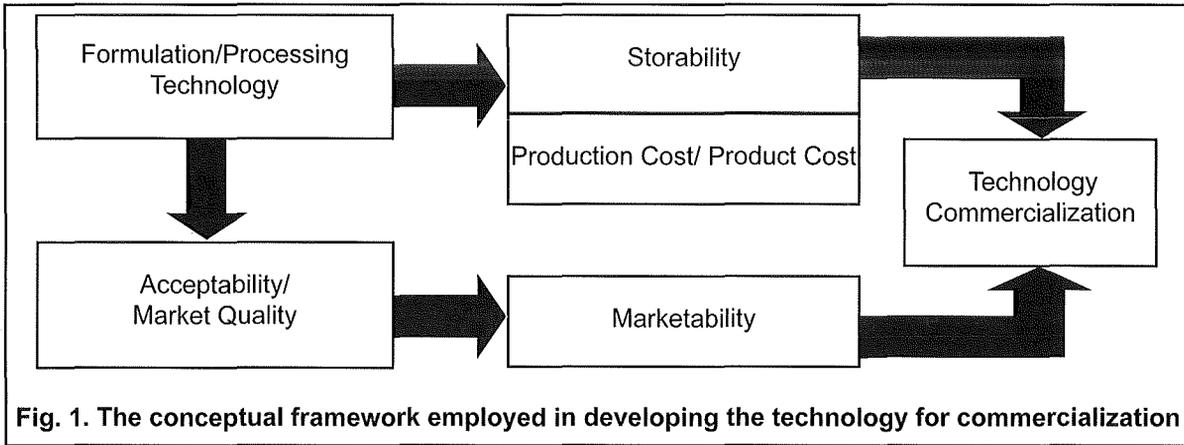


Fig. 1. The conceptual framework employed in developing the technology for commercialization

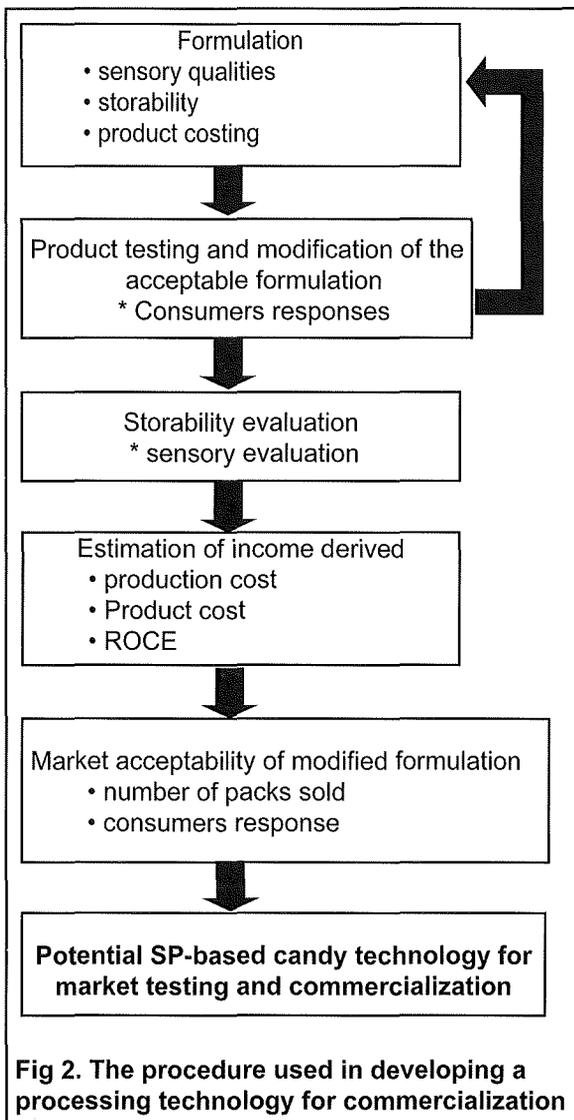


Fig 2. The procedure used in developing a processing technology for commercialization

No agreement was done between the processor of the commercial strawberry candy because this product is already available before this study was conducted.

Phase 4. Production cost and income derived from SP-based candies

Product costing and the income derived from the potential formulation were estimated. Estimates were based on the cost of ingredients, labor from preparation, cooking time, packaging, fuel, and overhead cost (depreciation cost and other costs).

Phase 5. Marketing of camberry and camarind candies

To determine the marketability of the product, processing at a semi-commercial scale was done. Products were delivered to the marketing center. Afterwhich, the number of packs sold monthly were monitored.

RESULTS AND DISCUSSION

SP-Tamarind (camarind) Candy

Phase 1. Preliminary evaluation of different formulations of sweetpotato-based (SP) - strawberry, tamarind and mango candies

SP-Strawberry (camberry) Candy

Acceptability and cooking time were compared among the treatments in terms of texture and sweetness of the product. Results showed that cooking time ranged from 2–3 hours for SP-strawberry and tamarind candies and acceptability ranged from slightly acceptable to acceptable. Acceptable rating was observed from the homemade strawberry candy and SP-strawberry candy with a ratio of 1:1.5:1.5 sweetpotato:strawberry:sugar. This is due to the soft and 'makunat' texture as well as the sweet taste of the candy. The slight acceptability observed from the ratio of 1:1:1 sweetpotato:strawberry:sugar was due to its hard texture and very sweet taste.

Sweetpotato-tamarind candy with a ratio of 1:1:1 SP:tamarind:sugar was preferred by the panelists while the formulation with a ratio of 2:1:1.5 SP:tamarind:sugar was slightly preferred. Result implies that generally, the panelists prefer tamarind candy with 'makunat' (leathery) texture and a sweet-sour taste.

Sweetpotato-tamarind candy with a ratio of 1:1:1 (SP-strawberry:tamarind:sugar) was observed to have a shorter cooking time of 2 hours while a longer cooking time of 3 hours was observed in formulation 2. This is due to an increase in mixture from 3 kg to 3.8 kg and 4.5 kg sweetpotato:tamarind:sugar mixture.

SP- Mango (camango) Candy

The cv. Carabao mango was used in the study. The unripe mango was more acceptable than the ripe mango. The use of unripe mango was evaluated as soft with sweet and sour taste.

Table 1. The qualities, acceptability and cooking time of the different SP-based candies formulations

FORMULATIONS	TEXTURE	SWEETNESS	GEN. ACCEPTABILITY	COOKING TIME
SP -Strawberry (camberry) candy				
Homemade strawberry candy	Soft	Sweet	Acceptable	
1:1:1 Sweetpotato -strawberry - sugar	Hard	Very sweet	Slightly acceptable	2 hours
1:1.5:1.5 Sweetpotato-strawberry-sugar	'makunat' (leathery)	Sweet	Acceptable	3 hours
SP –Tamarind (camarind) candy				
Commercial tamarind candy	Soft	Sweet/sour	Slightly acceptable	
1:1:1 Sweetpotato-tamarind-sugar	Makunat	Sweet/sour	Acceptable	2 hours
2:1:1.5 Sweetpotato-tamarind-sugar	Slightly makunat	Sweet/ slightly sour	Slightly acceptable	3 hours
SP- Mango (camango) candy				
Ripe -1:1:1 Sweetpotato-mang-sugar	Soft	Sweet/ slightly sour	Slightly acceptable	4 hours
Unripe- 0.75:1:1 Sweetpotato-mango-sugar	Soft	Sour/ sweet	Acceptable	3 hours

Table 2. Storability of sweetpotato-based strawberry, tamarind and mango candies

FORMULATION	STORABILITY (JAN) RH- 76 – 82 %	STORABILITY (JUNE) RH – 82 – 86%
SP - Strawberry (camberry) Candy		
Homemade strawberry candy	1 month	No available
1:1:1 Sweetpotato-strawberry-sugar	3 months	2 months and 2 weeks
1:1.5:1.5 Sweetpotato-strawberry-sugar	3 months	2 months and 2 weeks
SP-Tamarind (camarind) Candy		
Commercial tamarind candy	8 months	7.5 months
1:1:1 SP-tamarind-sugar	1 year	8 months
2:1:1.5 SP-tamarind-sugar	6 months	5 months
SP - Mango (camango) Candy		
Ripe	3 weeks	2 weeks
Unripe	1 month	3 weeks

Shelf-life of sweetpotato-strawberry/tamarind/mangos candy

Visual observation and sensory tasting were done weekly through destructive sampling to observe the presence of molds as well as the taste of the various candy formulations. Sweetpotato-strawberry candy maintained a good quality up to 3 months. After 3 months, the quality started to change. For SP-tamarind candy, formulation with 1:1:1 ratio maintained its good quality for 1 year while formulation with 2:1:1.5 ratio reached only 6 months. Camango has good quality for only two to four weeks.

Phase 2. Market testing and modification of the processing techniques

Candies from the acceptable formulations were delivered to the BSU marketing center to observe its market potentials and to gather consumer's response. Accordingly, the candies taste good. Sweetpotato-strawberry has a good texture but has a sweet taste.

Sweetpotato-tamarind has a good blending of sweet and sour taste but seeds should be

removed because it serve as disturbance during eating. Hence, consumers suggested that sugar should be lessened for SP-strawberry candy and seeds be removed for SP-tamarind candy.

Table 3. Consumer responses on the modified formulation

MODIFIED FORMULATIONS	COMMENTS
Camberry candy (1:1.5:1.3) SP-strawberry-sugar	Good and acceptable but try to lessen the sugar
Camarind candy (1:1:1) SP-tamarind-sugar	Good and acceptable but try to remove the seeds
Camango (unripe)	No comments gathered

Based on comments gathered, the initial formulation was modified. The amount of sweetpotato remained while the amount of sugar was decreased from 1.5kg to 1.3 kg and the amount of strawberry was increased by 0.5kg. The tamarind seeds were removed.

After modification, the reformulated products were delivered to the BSU marketing center to gather responses. Based on interviews and observations, it showed that the formulations have satisfied the quality needed by the consumers. Accordingly, the camberry has good taste, good texture, not so hard and the level of sweetness is just right. For camarind, it has good texture (leathery), not so hard and seedless. The presence of



Table 4. Consumer responses towards the modified formulations

CANDY STANDARD FORMULATION	RESPONSE	COOKING TIME
Camberry (1:3:1.3) SP-strawberry: fresh sugar	Good taste, less sugar, not too sweet with good texture, not so hard	3 hours
Camarind (1:1:1L:1.3) SP-tamarind-water-sugar	Good texture, not so hard and good blending of sweet-sour taste, at least seeds were removed	3 hours

Table 5. Shelflife of modified camberry and camarind candy

CANDY STANDARD FORMULATION	SHELF-LIFE	EXPIRATION DATE
Camberry (1:3:1.3) SP-Strawberry, cooked/fresh sugar	90 days	70 days from date of processing
Camarind (1:1:1L:1.3) SP-tamarind:water:sugar	240 days	215 days from processing date

seeds according to consumers is a disturbance during eating.

Phase 3. Storability of modified camberry and camarind candies

The potential formulation was processed then packed in Poly ethylene bag (PEB) (.03 mm) for storage evaluation. The sensory qualities such as taste and flavor were monitored at weekly intervals (destructive sampling). The storability refers to number of days from processing to the time a change in the quality characteristics has been detected.

In phase 1, the storability was observed to be shorter when stored on the month of June. For this reason, determination of the storability of the potential formulation was started on the month of June.

Table 6. Estimated production cost and income derived from camberry candy

ITEM	MODIFIED FORMULATION		
	QUANTITY	UNIT COST (Php)	TOTAL COST (Php)
Strawberry, fresh, cleaned	3 kgs	35/kg	105.00
Sweetpotato, mashed	2 kgs	20/kg	40.00
Sugar, brown	2.6 kgs	30/kg	78.00
Flour, ordinary	400 gms	30/kg	12.00
Star margarine	200 gms	90/kg	18.00
Confectionaries sugar	100 gms	50/450g	11.10
Packaging wrapper			
PEB	65 pcs	1.00/pc	65.00
SUB-TOTAL			
Gas	6 hours	6/hour	36.00
Labor	10 hours	31.25/hr	312.50
TOTAL			677.60
Add: overhead cost, 30%			203.28
TOTAL COST			880.88
Estimated sales	65 p@ P18.50/p		1,202.50
Prodn cost/pk			13.55
Net income			321.62
RCE (%)			36.51
Breakeven selling price			13.55

* Price based on prevailing market price/daily wage. 2008

Phase 4. Production cost and potential income derived from camberry and camarind candies

The production cost encountered in the processing of camberry and camarind was estimated based on the prevailing market price (2008). The production costs included the cost of raw materials, labor, fuel and overhead cost (30%). The overhead cost included the depreciation cost and other expenses e.g transportation, cleaning materials etc.

The formulation could yield 65 packs of camberry and camarind candies. For camberry, a production cost of P 13.55 per pack was estimated. At a wholesale price of P18.50/pack, the potential income is P321.62 per formulation. The computed ROI is 36.51%.

For camarind, the computed production cost is P14.25 per pack (85g/pack). At a wholesale price of P17 per pack, the estimated income per formulation is P276.25 and the ROI is 29.82%.

Based on the computations, it is suggested that the wholesale price be increased from P17 to P19 per pack.

Phase 5. Marketability of camberry and camarind candies

Camango was not included in this phase because of the observed low marketability in Phase 1.

The marketability of camberry and camarind was gathered for at least 3 years. Table 8 shows the number of packs processed, delivered and sold per month by the BSU Marketing Center.

Table 7. Estimated production cost and income derived from camarind candy

ITEM	MODIFIED		
	QUAN-TITY	UNIT COST (Php)	TOTAL COST (Php)
Tamarind pulp	2 kgs	25/kg	50.00
Sweetpotato, mash	2kgs	20/kg	40.00
Sugar, brown	2.6 kgs	30/kg	78.00
white	250 g	40/kg	10.00
Flour, ordinary	400 gms	30/kg	12.00
Star margarine	200 gms	90/kg	18.00
Water	2 liters	1/li	2.00
Packaging wrapper	7 pcs	5.50/pc	38.50
PEB	65 pcs		65.00
SUB-TOTAL			313.50
Gas	6 hours	4/hour	24.00
Labor	12 hours	31.25/hour	375.00
TOTAL			399.00
Add: overhead cost, 30%			213.75
TOTAL COST			926.25
Prod'n cost/pk (65 @85 g/pk)			14.25
Estimated sales	18.50/pk		1,202.50
Net income			276.25
RCE (%)	18.50/pk		29.82
Breakeven selling price			14.25

* Based on prevailing market price/daily wage. 2008

The volume processed depends on the supply of strawberry. Low supply during the months of October and November can be attributed to the limited supply of fresh strawberries. For camarind where the supply is stable the number of packs sold ranges from 103 – 330 packs.

The total number of packs sold for one year is 2,611 for camberry and 2,722 for camarind. At P10/pack, the total sales of these candies was P53,340.



Table 8. The monthly sales and number of packs delivered and sold by the BSU Marketing Center (2005)

PRODUCT	NUMBER OF PACKS SOLD													Total	Total Sales (Php)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
Camberry	-	515	389	318	173	215	339	307	232	38	80	117	2,611	26,110	
Camarind	206	192	177	167	169	172	285	253	330	103	235	322	2,722	27,230	
Total														53,340	

* Source: BSU- University Business Affairs (UBA) monthly audited financial report, 2005

The marketability of such candies was observed until 2007 (Table 9). Based on records, there was a decline in the number of packs processed and delivered for sale. The decrease in volume is not due to reduced market but rather the reduction of labor.

In 2006, the total number of packs sold was 689 and 605 for camberry and camarind respectively. In 2007, the total number of packs sold was 1,523 and the total sales were P25,891.

Table 9. Number of packs of camberry and camarind candies sold by the BSU Marketing Center

PRODUCTS	2006		2007	
	Volume sold	Amount	Volume sold	Amount
Camberry	689	8,957.00	788	13,396
Camarind	605	7,865.00	735	12,495
TOTAL	1294	16,822.00	1523	25,891

Based on records, camberry and camarind has potentials for commercialization. The formulation could be adapted by processors e.g strawberry processors.

SUMMARY AND RECOMMENDATIONS

The study was done to develop the qualities of sweetpotato-based candies intended for commercialization. The procedures involved preliminary evaluation of formulations, market testing, and modification of formulation, product costing and marketing of potential product.

The study showed the important role of the consuming public in developing products for commercialization. Information gathered during market testing had given directions in developing the qualities required in the market.

The Sweetpotato-based tamarind (camarind) and strawberry (camberry) candies have a sweet- sour taste. Camarind candy has soft, leathery texture and is seedless. Camberry has soft textural moistness.

The sensory qualities of camberry was observed to change at three months after processing. For camarind, the quality started to deteriorate at eight months after processing. Camango has the shortest shelf life of two to four weeks after processing.

At a selling price of P18.50/pack and respective production costs of P13.55/pk and 14.25/pk for camberry and camarind. Estimated ROCEs of 36.51% and 29.82%, respectively can be derived.

Based on results and observations, SP-based tamarind and strawberry candies have potentials for adoption by processors in La Trinidad. The processing techniques



ensure stakeholders that the quality is acceptable to consumers, can be stored longer and can provide additional income.

However, since marketing was done only to gather information needed to improve the product quality; it does not provide information on the marketability of the product. Hence, market testing involving additional market outlets and improving the packaging of the product is being recommended as the next phase of the project.

REFERENCES

- MIYAZAKI, K. 2007. Functional Components of Sweetpotato/Anti-cancer Effect Potassium-Effect for Lowering Blood Pressure. <http://www.jrt.gr.jp/sminie/sminio14.html>.access in October 2007
- B. T. Gayao *et al.* 2004. Contribution of Sweetpotato Snack Food Products to Nutrient Intake of Children. NPRCRTC Working Paper Series.
- Hou WC, Chen YC, *et al.* 2001. Antioxidant Activities of Trypsin Inhibitor, a 33 KDa Root Storage Protein of Sweetpotato (*Ipomoea batatas* (L.) Lam cv. Tainong 57). J Agric Food Chem 2001 Jun; 49(6):2978-81. PMID: 13860.
- The Philippine Food Composition Tables 1997. Food and Nutrition Research Institute. Department of Science and Technology.

ACKNOWLEDGMENT

Thanks are due to the root crop technical staff and some of the BSU students of the College of Agriculture who participated in judging the products.

Benguet State University – Marketing Center and Betag Sattelite Market as the venue for the market testing of the products.

The almighty God for giving the authors the strength and courage to conduct the research successfully.

