

Agro-Processing of *Amaranthus* (Spinach) in Trinidad and Tobago

R.H. Singh, C.K. Sankat, W. Ishmael and R. Maharaj

The study examined the technical and financial feasibility of a processing and marketing venture for local *Amaranthus* in Trinidad and Tobago. Potential product lines and current consumption levels were identified from market studies.

Product evaluations, both laboratory and consumer, were conducted in the processing of local *Amaranthus*. Commercial systems for processing of local amaranthus were developed for the Trinidad and Tobago Market. Additionally, financial analyses of the processing and marketing of *Amaranthus* were performed.

BACKGROUND OF INDUSTRY

Amaranthus is a leafy vegetable that is traditionally grown in Trinidad and Tobago. It is commonly referred to as "Chorai", "Bhagi" or "Spinach." The commodity has a high nutritive value and is readily available in the fresh form on the local market. It is not processed commercially in Trinidad nor is it imported in any processed form at the present time.

Production data have not been recorded for this commodity. It is nonetheless a commodity which is generally marketed by vendors in the municipal markets as well as the other outlets for vegetables such as roadside stalls.

OBJECTIVES OF THE STUDY

The primary focus of the project on which this paper reports is on the processing of locally grown *Amaranthus* in order to increase utilization of this commodity.

More specifically the objectives are to:

- (1) analyse trade and consumption data on *Amaranthus* for the local market in order to determine opportunities for processed *Amaranthus*;
- (2) identify product lines which seem to have market potential both for the local as well as the export market;
- (3) determine the processing systems, the product handling and packaging required for the various product lines selected for evaluation;

- (4) evaluate alternative technologies by processing samples of the various product lines;
- (5) evaluate processed samples to determine consumer acceptability as well as relative preferences;
- (6) identify plant and equipment as well as capital costs for the processing systems selected; and
- (7) conduct a financial appraisal of agribusiness venture in the processing and marketing of *Amaranthus*.

METHODOLOGY

This study attempted to examine the feasibility, both technical and financial, of the production, processing and marketing of *Amaranthus* in Trinidad and Tobago. The methodology adopted is based on the concept that agro-industrial development should be market-led.

The study as illustrated in Figure 1, examined the market characteristics for *Amaranthus* in order to develop parameters in terms of preferred product lines, market volume, structure of the market and consumer taste and preferences.

Product lines which have good potential were identified and for such products, processing technologies were determined. Samples of the products were processed in an attempt to evaluate the processing technologies. These products were evaluated for quality (laboratory analysis) as well as consumer acceptability (consumer product tests – taste as well as other product attributes). Given the targeted production volume and selected product line a commercial processing system was designed.

Finally, financial appraisal of the processing and marketing of process *Amaranthus* was conducted.

MARKET ANALYSIS

Introduction

The first area of analysis of the market study focussed on consumption, market structure and merchandising. The second aspect focussed on consumer preferences.

With respect to the first area of the study, attempts were made to obtain information on current production and merchandising from the Central Statistical Office (CSO) and the Central Marketing Agency (CMA).

Since information supplied by these agencies were limited, interviews were held with various agencies/firms involved in importation, packaging, distribution, merchandising and utilization.

The information in consumer preferences was obtained by conducting a survey of consumers. A sample of 130 consumers was chosen with a stratification of sample accounting to the following factors:

- (i) geographic – in the main urban areas,
- (ii) type of retail outlet – supermarket, wholesale, fresh produce market, food stall.

A total of 13 establishments located in seven town centres were chosen as the points for selecting customers for the survey. A sample size of ten customers was chosen at each establishment.

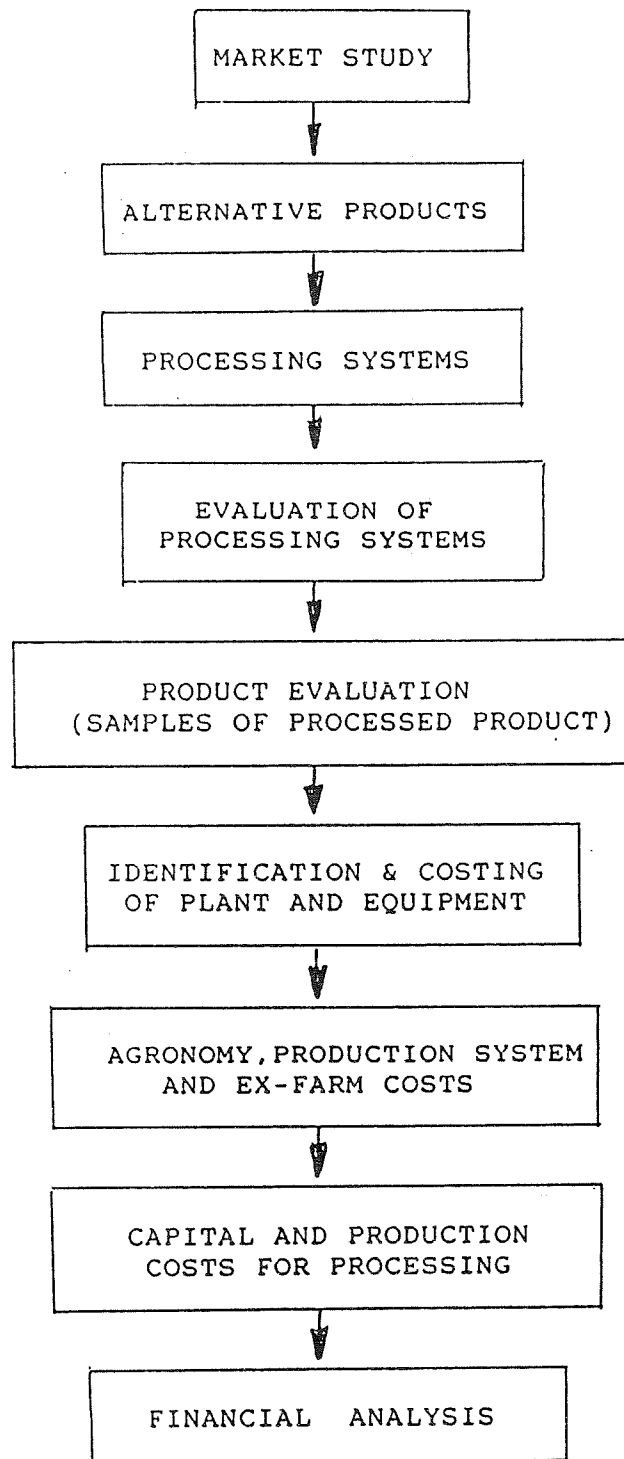


Figure 1
Methodological Steps

Domestic Marketing

The frozen form of the product was previously imported by C.A.J. Lashley from Cahada under the brand name of "Mc Cains." In 1988 Lashley imported 620 pound cases per year (4,536 kg of spinach). However, this spinach was mainly imported to cater for the French community that existed at that time.

Amaranthus is not canned by any of the major local processors. A similar leafy vegetable, Dasheen leaves, is used as a major ingredient in canned "Callaloo" which is canned by National Cannery Ltd. for export to the United States.

In the local market *Amaranthus* is sold by the bundle. The size of these bundles may vary, however, the average bundle weighs approximately 0.5 kg. The wholesale prices per bundle is \$0.50 while the retail price varies from \$1.00 to \$1.50 per bundle depending on the time of year. Fresh *Amaranthus* is sold on a regular basis to Government institutions. These institutions purchase 4,175 kg/year at an average price of \$3.00/kg. Caterers such as Airline caterers, use approximately 337 kg/year of fresh *Amaranthus*.

Hotels on the other hand have a much lower consumption level of *Amaranthus*. Because of its distinctive flavour, it is not a favourite with foreign guests. Hotels which use it in their menus cater mainly for local guests, conferences, staff etc.

Hotel menus are generally rotated every three months, and at one particular hotel the product is used for only 12 weeks of the year. The bundle sizes are at least three times as large as the bundles sold in the municipal markets and roadside stalls. All hotels using *Amaranthus* indicated that they will purchase *Amaranthus* that has been washed, cleaned, chopped and frozen.

Consumer Taste and Preferences

The majority (91%) of consumers surveyed use fresh spinach. There is a distinct preference for the local "Chorai" variety.

Consumers, although familiar with chilled spinach, are not acquainted with other processed forms of the product. Only 16.36% of them have ever tasted processed spinach (Table 1).

Table 1
Consumers Who Have Tasted Processed Spinach

Percentage of Consumers	16.36%
Canned	2.72%
Frozen	13.64%

There is a distinct preference for the frozen form of spinach as opposed to canned spinach. At least 50% of the consumers stated that they would purchase frozen spinach.

Target Market

The analysis of data identified two product lines for processed *Amaranthus*. One product line which can be exploited is frozen *Amaranthus*.

The market segment initially targeted is the institutional (inclusive of hotels) and supermarket demand. Here it is assumed that the frozen processed *Amaranthus* will substitute for fresh and chilled products which are currently utilized. The rationale for this strategy is based on the assumption that both institutions as well as consumers who purchase the product from supermarkets seem to have a preference for convenience foods.

The estimated requirements for these various segments is 19,000 kg (Table 2).

Table 2

Amaranthus by Institutions, Hotels, Caterers and Supermarkets

Amaranthus	Kilogrammes
Fresh <i>Amaranthus</i>	
Hotels	1,188
Government Institution	4,175
Caterers	332
Processed <i>Amaranthus</i>	
(i) Chilled: Supermarkets	8,920
(ii) Frozen: Previous Import Level	4,536
Total	19,151

DESIGN OF A PROCESSING SYSTEM

Introduction

The major processing stages, involved in producing either chilled or frozen *Amaranthus* are shown in Figure 2. These include:

- (i) post-harvest (in plant)
- (ii) pre-treatment
- (iii) processing
- (iv) storage

The processing system was designed for frozen *Amaranthus* for the local industry given the production volume targeted is shown in Figure 3. The flow diagram shows that bundled *Amaranthus* on entering the plant is inspected and unbundled. It then goes through the following processes: washing, cooling, sorting and grading: blanching, cooling and draining, chopping, bin collecting, packaging and cold storage. All of the processes are handled manually except for chopping which is a mechanically assisted operation.

The plant throughput is constrained by the amount of raw material handled at the receiving and inspection stage. The final processed product has the following throughput:

21 boxes/hr

Where 1 box = 12 x 0.5 kg packs

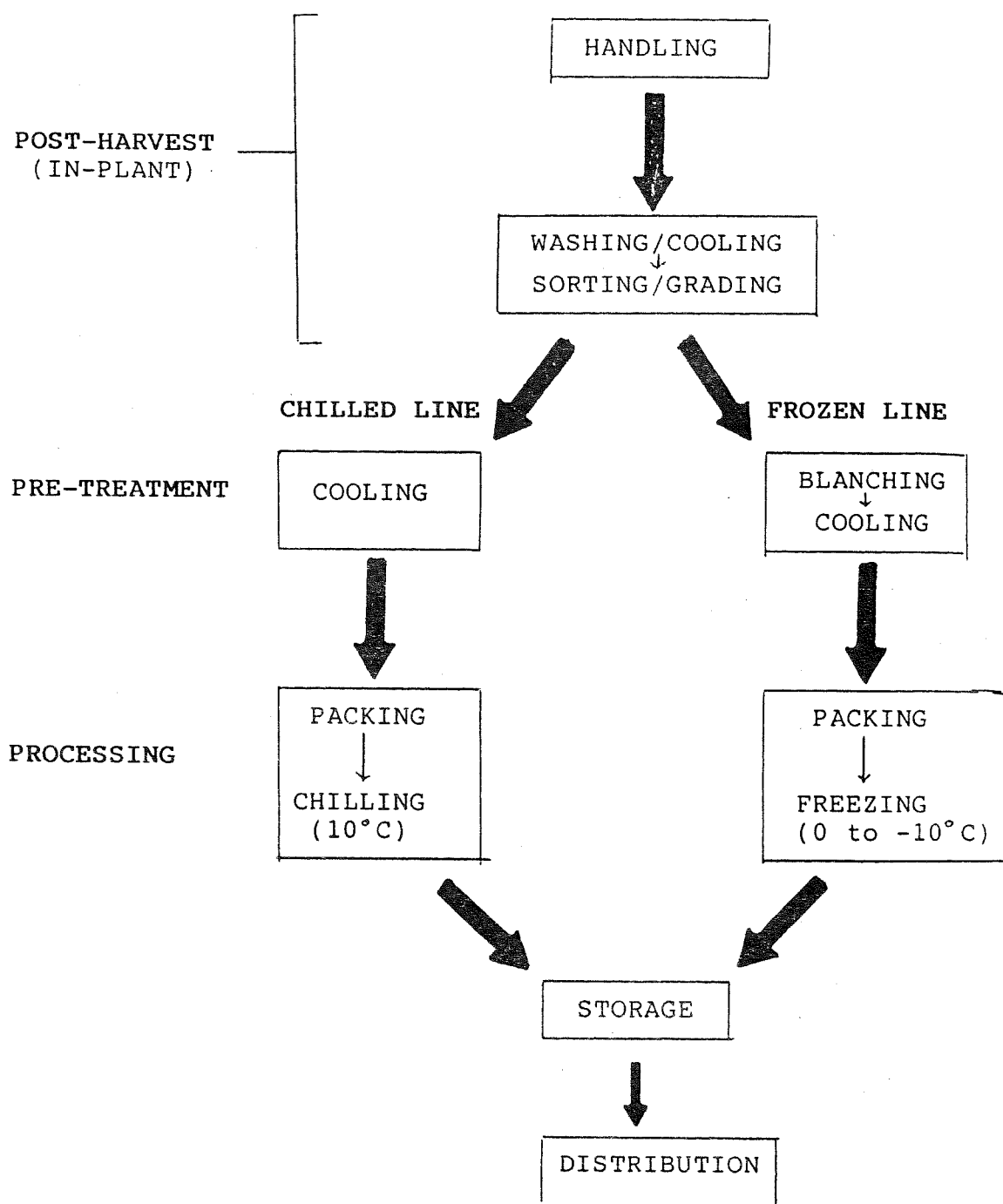


Figure 2
Flow Chart of the Main Operations for an *Amaranthus* Packing Line

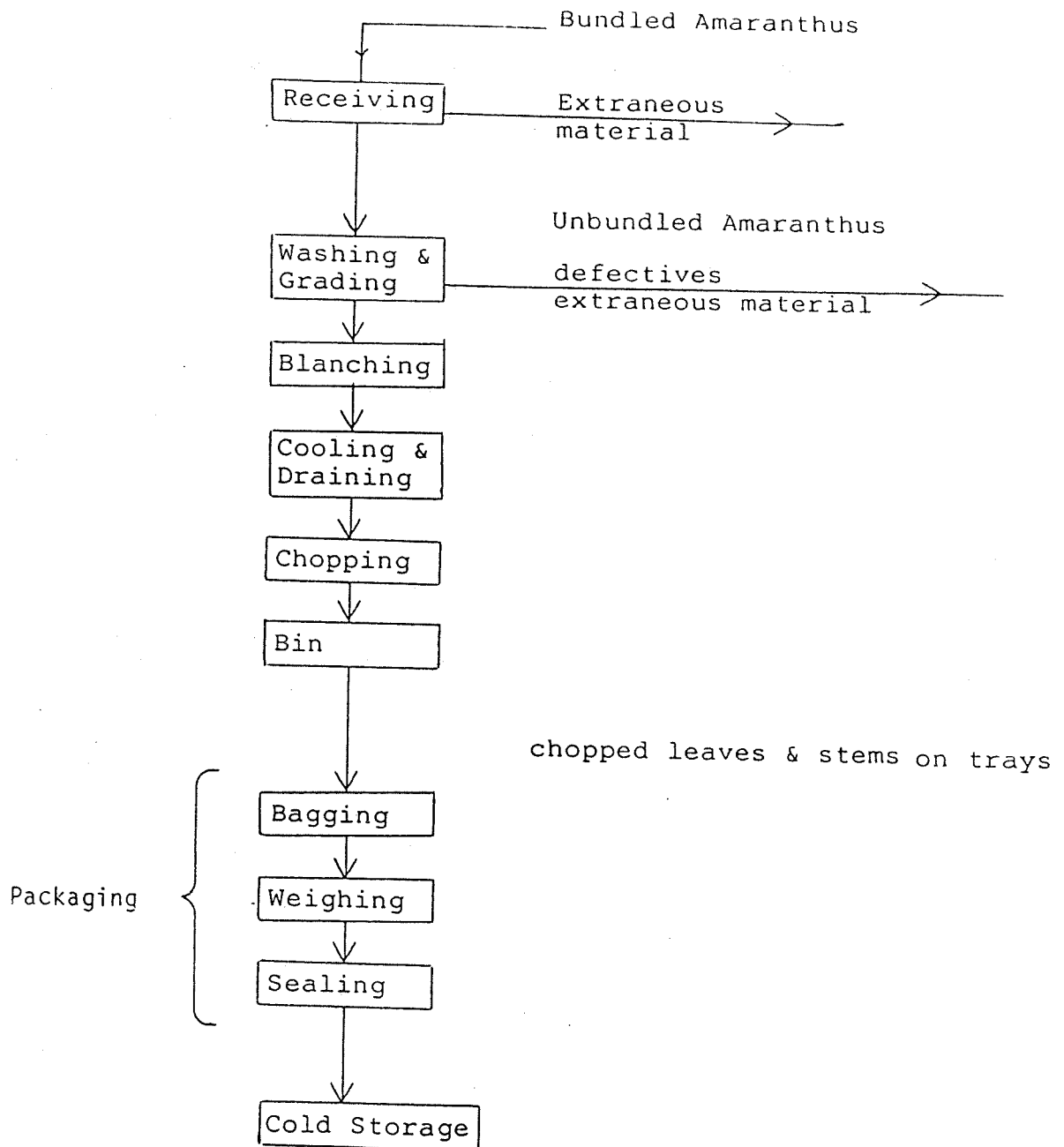


Figure 3
Process Flow for Freezing Preservation of *Amaranthus* for the Trinidad and Tobago Market

PRODUCT PROCESSING AND EVALUATION

Material and Methods

Locally available *Amaranthus* variety *Amaranthus dubius* was purchased from a farmer at Aranguez, Trinidad. Examination of 20 bundles revealed noticeable uniformity in the number of leaves at approximately the same stage of maturity. The bundles were precooled, transported to the laboratory upon which they were weighed, washed, cleaned and sorted, blanched and frozen.

Freezing

Spinach bundles were again separated into two categories before freezing viz: whole and chopped spinach. Chopping was carried out both manually by cutting the stems and leaves and mechanically using a forage chopper.

All samples for freezing were blanched after cleaning, sorting and grading. The blanching consisted of immersing samples in water at 70°C for 0.5 – 1 minute before cooling quickly under running tap water and draining. Some samples were packaged in 8" x 12" freezer bags before storage at -10°C, while other samples were bulk frozen by Food Masters Limited.

Consumer Preference Test

After two weeks in storage samples of frozen spinach were rated for acceptance by use of a "preference test" which is most often used in marketing research of a product. Two types of evaluations are conducted in this category, taste tests and product tests. In this case product tests were used since they lend themselves to products requiring preparation by the consumer at leisure, in the home. This adds some reality to the situation.

(1) Selection of Consumers

A cross section of housewives was selected to evaluate the product. Because of limited samples only 20 consumers were selected.

(2) Sample Preparation

Approximately 250g of frozen spinach were placed in freezer-lock bags and distributed to consumers. Each sample was accompanied by the appropriate questionnaire. Consumers were asked not to thaw samples before cooking.

(3) Design of Test and Questionnaire

The product test design was based on a typical two call monadic design which is the simplest form where a sample of a single product is left with each consumer.

The questionnaire was designed to extract qualitative judgements from consumers rather than mere hedonic responses.

A simple ranking system was used in the design of the questionnaire. In addition, respondents were asked to comment on particular characteristics under consideration.

Results

Examination of 40 bundles revealed a uniformity in the number of leaves at approximately the same age of maturity. Sample leaves were also turgid on arrival at the laboratory.

Initial weights of *Amaranthus* bundles were recorded giving an average weight per bundle as 673g/0.7kg. After grading and blanching samples were again weighed before storage, revealing that 57% of the raw materials was utilized for processing. The results of the product test are presented in Table 3.

Mechanically chopped frozen *Amaranthus* received a higher rating than the manually chopped frozen sample. Eighty percent of the judges considered the appearance of colour of the uncooked mechanically chopped product to be very good.

With respect to the cooked product, 70% of the respondents rated the appearance of the mechanically chopped samples as excellent.

Table 3
Results of Consumer Reaction Test for Frozen Spinach

Attributes	(% of respondents)			
	Manually Chopped		Mechanically Chopped	
Uncooked product:				
Appearance	Good	(80%)	Very Good	(60%)
Colour	Good	(80%)	Very Good	(70%)
Cooked Product:				
Appearance	Good	(60%)	Excellent	(70%)
Taste	Slightly bitter	(80%)	Mild	(83%)
Texture	Satisfactory	(55%)	Good	(72%)
Comparison to Cooked Spinach:	Same	(90%)	Same	(95%)
Rating as a Convenience Food Item	Good	(66%)	Good	(50%)

Discussion

Controlled samples deteriorated within two days and this could be due to the fact that spinach has a very high respiration rate which could have resulted in the severe wilting of samples. In addition there was no pre cooling of samples and no packaging was used.

Chopped samples from the forage chopper remained in the best condition compared to the hand-chopped and whole spinach after a maximum of 12 days in storage. The chopped samples also had lower weight losses compared to the whole samples and by the seventh day of storage most the the whole spinach had deteriorated due to severe wilting of leaves.

From these results, it appears that a maximum shelf-life of approximately two weeks can be obtained by mechanically chopping spinach, packaging in perforated polyethylene bags 150–200 gauge and storing at 10°C with a high relative humidity (95%).

Frozen samples (both whole and chopped) were able to store for a longer period of four weeks. During storage, frozen storage which were manually chopped deteriorated slowly

in that a light brown colour was observed by the third week in storage, compared to mechanically chopped samples which retained their green colour.

From the results of the questionnaires, it appears that frozen *Amaranthus* is an acceptable product to the consumer. However, mechanically chopped frozen *Amaranthus* seems to be superior product compared to the manual separation of leaves and stems in that it had an excellent appearance when cooked, mild taste and good texture. The manually chopped samples had a good appearance but had a slightly bitter taste and this difference may be attributed to the method of preparation of the *Amaranthus*.

Consumers stated that there was no difference between freshly cooked *Amaranthus* and frozen *Amaranthus* and rated both forms of the product as a good convenience food item.

CAPITAL AND OPERATIONAL COST

The estimated capital cost for the plant and equipment is TT\$70,620 whereas the cost of the building is TT\$18,000 – giving a total cost of TT\$88,620 for plant and facilities for the processing of *Amaranthus*. The cost of various components are itemized in Table 4.

Operational cost may be grouped into a fixed cost component and a variable cost component. The fixed cost items of production are management and overheads.

Given that the total operation can be completed in six months, annual management cost is assumed to be 50% of a man-year. The variable component of cost includes items which are consumed in production and therefore depend entirely on the volume of output. It includes items such as utilities (electricity, water), packaging materials, labour, miscellaneous items and maintenance cost. For an agro-processing operation storage and marketing costs may also be relevant.

Table 4
Capital Cost of Plant and Equipment and Building for Processing *Amaranthus*

A Plant & Equipment	Cost (\$)
Freezer Room	42,500
Chopper	4,250
Blancher (tank and immersion heater)	600
Storage Tank	1,000
Wash Tank	400
Scale	1,275
Sealer	200
Other equipment and installation	8,625
	58,850
Contingencies (20%)	11,770
Sub-Total	\$70,620
B Building	
(20' x 30') = 600 ft. @ \$30/ft.	18,000
	\$18,000
Total Capital	\$88,620

Table 5 presents the annual fixed operational cost for the processing of *Amaranthus*. The total cost shown is \$23,678. The variable production cost per 100 kg of processed product is shown in Table 6. The total amount per 100 kg is \$283.92 with labour being the most significant cost item.

The final cost item is for storage and distribution. This is assumed at 5% of the variable cost which gives \$13.52/100kg.

Table 5
Fixed Annual Operational Cost – Processing of *Amaranthus**

Items	Annual Cost (\$)
1. Management (50% x \$36,000)	18,000
2. Overhead (10% of variable costs)*	5,678
Total	<u>\$23,678</u>

* (200 x \$283.92/100kg x 10%)

Table 6
Variable Processing Cost for *Amaranthus**

Items	Cost/100kg of Processed Product
Electricity	18.06
Water	0.37
Labour	95.39
Plastic bags (40 bags/100 @ \$0.10/bag)	20.00
Cardboard boxes (17 boxes/100 kg @ \$2.00/box)	84.00
Miscellaneous items	25.00
Plant maintenance (5% of annual cost)	3.00
	<u>245.82</u>
Contingency (10%)	24.58
	<u>270.40</u>
Marketing and Storage (5%)	13.52
Total Variable Cost	<u>\$283.92</u>

* Excludes financing charges for working capital

FINANCIAL ANALYSIS

Basis for Financial Analysis

This section of the paper examines the financial feasibility of an agribusiness venture into the processing of *Amaranthus* for the Trinidad and Tobago processed market. This project aims principally at a targeted volume of 19,000 kg. for the local market which was estimated from the market study. Although two product lines for processed *Amaranthus* have been identified, only frozen *Amaranthus* will be considered.

The financial aspects of the project examined only costs associated with the processing of *Amaranthus* including cost of raw material. These aspects include investment and cost structure, unit production costs, break-even prices, profit margins, pay-back period, return to investment and cash flow analyses.

Total Unit Costs

The unit cost of frozen spinach packaged in 0.5 kg polypropylene bags and repackaged in 6 kg cardboard boxes, is estimated at \$4.59/kg. The computations are shown in Table 7 in which a conversion of 2.5 bundles is used to produce 1 kg of frozen *Amaranthus*.

The cost of raw material is estimated at the average wholesale price at municipal markets. This together with a processing cost of \$4.59/kg results in a total cost of \$5.84/kg of frozen *Amaranthus*. This cost does not include allowances for profits.

Table 7
Unit Costs – Final Product

(i) Cost of raw material/kg (bundles) – (2.5 @ \$0.50)	\$1.25
(ii) Processing costs (cost/kg <i>Amaranthus</i>)	\$4.59
(iii) Total Unit Cost (\$4.59 + \$1.25)	\$5.84/kg

Break-Even Prices

The unit costs presented in the previous sub-section do not include returns on investment and risk-taking.

Break-even prices are therefore computed assuming relatively modest profit levels. Table 8 shows the break-even prices for frozen *Amaranthus* assuming three levels of profitability – 20%, 25%, 30%. The corresponding prices range from \$7.01/kg to \$7.59/kg.

Because this venture is small scaled profits are relatively small ranging from \$23,360 for a 20% profit to approximately \$35,000 for a 30% return.

Table 8
Break-Even Prices for Frozen *Amaranthus*

Profit levels (% Return to Investment)	Break-even Prices (\$/kg)
0	5.84
20	7.01
25	7.30
30	7.59

Pay-Back, and Cash Flow

The cash flow analysis and returns to investment were conducted assuming two alternate levels:

- (i) the 20% profit margin : frozen *Amaranthus* = \$7.01/kg
- (ii) the 30% profit margin : frozen *Amaranthus* = \$7.59/kg

Using 20% profit margin the project showed an Internal Rate of Return to Total Capital of 30%. Cash flow after the initial investment was \$35,000 which meant the pay-back of capital investment was completed at the end of the third year of operation.

The Net Present Value as shown in Table 9 was \$44,000 over a project life of five years at a discount rate of 12%. Analysis of the project levels giving approximately 30% profit margin gave a NPV of \$87,000 at the same discount rate of 12%. The IRR is 46% with the pay-back period of capital of two years. Assuming loan funds of 66% of initial capital, at a loan rate of 12%, the IRR increases to 93% with pay-back period of two years.

Table 9
Summary of Financial Analysis

	IRR (%)	NVP 12% (\$ '000)	Pay-backs (Yrs)
ANALYSIS 1			
Return to Total Capital at price = 20% margin	30	44	3
ANALYSIS 2			
Return to Total Capital at price = 30% Margin	46	87	2
ANALYSIS 3			
Return to Owner's Equity at price = 30% Margin	93	87	2

CONCLUSION

The study has shown that *Amaranthus* can be successfully processed to produce a frozen product which consumers found to be of good quality. Indeed consumers were unable to detect differences in taste and quality from the fresh form of the product.

As a business venture, the market segment initially targeted was the supermarket, institutional and hotel demand for the fresh and chilled forms of the product.

The investment cost associated with a locally designed processing system for 19,000 kg of product was \$88,620. The unit cost of final product was \$5.84/kg. The break-even price for a 25% profit margin is \$7.30/kg. Although this price is less than it would be for the imported equivalent, this product would need to be tested in the market place to determine demand at a price of \$7.30/kg. The market potential would therefore need to be establishment.

REFERENCES

- Ferguson, T.U. 1984. Increasing Food Production Through Underexploited Crops. *International Seminar on New Technologies in Food Production for the Eighties and Beyond-Agro-Tech '83*. Proceedings, St. Augustine, U.W.I. p. 35-42.
- Holdsworth, S.D. 1983. *The Preservation of Fruit and Vegetable Food Products*. London MacMillan Press, London.
- Lopez, A. 1981. A Complete Course in Canning. *Book II - Processing Procedures for Canned Food Products 10th ed.* Publ. of the Canning Trade; Maryland, USA.
- Martin, F.W. and L. Telek. 1979. *Amaranth and Celosia : Vegetables for Hot Humid Tropics*. Part 6, Publ. USDA, New Orleans, USA.
- Rogers, J.L. 1974. *A Course in Canning 5th Edition*. Food Trade Press Ltd., London.
- Ryall, A.L., and W.J. Lipton. 1972. *Handling, Transportation and Storage of Fruits and Vegetables. Vegetables and Melons*. Vol. 1. AVI Publ. Co. Westport, Conn, USA.
- Tressler, D.K., and C.F. Evers. 1957. *The Freezing Preservation of Foods*. 3rd ed. AVI Publ. Co., Westport, Conn., USA.