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Development and management of selected fresh-cut tropical products in Trinidad and Tobago[1,2]

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ABSTRACT

Trinidad has been producing fresh-cut fruit and vegetable products since the mid1990's and the quantity and range of products have been expanding. Staff of the Postharvest Unit of the Research Division of the Ministry of Agriculture, Land and Marine Resources conducted a survey of retailing of the fresh-cut products in Trinidad. The results were reported to stakeholders at a seminar / workshop in January 2006. The quantity and quality of domestically produced crops, papaya (*Carica papaya* L.), watermelon (*Citrullus lanatus*), pineapple (*Ananas comosus* (L.) Merr), dasheen leaves (*Colocasia esculenta*), pumpkin (*Cucurbita maxima*), carilla (*Momordica charantia*) and okra (*Hibiscus esculentus* L.) used in fresh-cut products were not consistent and this has implications for the sustainability and profitability of the fledging industry. Both survey and workshop discussions revealed that, although the products had strong visual appeal, stringent and consistent quality standards were lacking. Future prospects were examined and recommendations made for improvements in the sector. Recommendations were made for developments in the quantity, quality, safety and marketing of fresh-cut products. International food safety standards needed to be applied to ensure a consistently safe product to the consumer. Key areas for research, development and education were identified at the workshops and these are presented as short, medium and long-term strategies for the development of a vibrant fresh-cut industry in Trinidad.

Key words: Fresh-cut tropical product, Development, Food safety standards, Management, Survey

INTRODUCTION

Background. Trinidad has been producing fresh-cut fruit and vegetable products since the mid 1990's. The production started initially with the 'callaloo' pack (dasheen leaves, okra, pumpkin pieces and a choice of condiments), a popular side dish in

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Trinidad cuisine. The market gradually expanded to include other single and mixed vegetable and fruit salad packages. Fresh-cut produce is defined by the International Fresh-cut Produce Association (IFPA, 2004) as any fresh fruit, vegetable or combination thereof that has been trimmed, and/or peeled, and/or cut into 100% usable product that is bagged or pre-packaged to offer consumers high nutrition, convenience and value while still maintaining freshness.

The contribution of agriculture to Gross Domestic Product has been declining from 5.4% for the period 1966-1976 (Ministry of Finance, 1977) to 3.3% in 1997 and 1.3% in 2004 (Central Bank, 2004). Plans were needed to arrest this decline as the agricultural sector continues to be an employer of 6% of the labor force (GORTT, 2006). The Medium-Term Policy Framework 2001-2003 of the Republic of Trinidad and Tobago identified goals for the agriculture sub-sector that included employment creation, national food and nutrition security and increased foreign exchange earnings. Strategies to achieve these goals included the development of agro-industries and the enhancement of the focus, co-ordination and effective management of the Ministry of Agriculture, Land and Marine Resources (MALMR) to support a private sector led agricultural development.

The development of the value-added industry could act as a boost to primary agricultural production and increase the earning capability of the primary and secondary producers. Many national agencies felt that the fledgling fresh-cut industry was one area that could add value to agricultural raw materials. No data were available on the current status of the industry in Trinidad and Tobago at that time.

On the international market, trends were showing that fresh-cut produce sales were increasing three fold (3.3 to 9.0 billion) from 1994 - 1999 as consumers demanded healthy convenience foods of high quality (Cook, 2005). Fresh-cut products were more expensive than the whole produce but were considered more cost effective and convenient to the consumer due to reduced waste and time saved in preparation (Cantwell and Suslow, 1999). An integrated chain of production, postharvest handling, food science and marketing operations was necessary to ensure a quality product. Microbial quality and safety of fresh-cut products was a high priority concern and prevention strategies to ensure microbial safety was a key aspect of the fresh-cut production process (Gorny, 2001).

Project Development. In view of the above, the Postharvest Unit (PHU) of the Research Division of the MALMR developed a project under the Public Sector Investment Programme (PSIP) in 2001 "Improvement of technologies in postharvest crop handling". The purpose of the project was to develop improved technologies in packing and packaging in minimally processed products development and in postharvest handling. These improvements should provide our stakeholders with technologies that have given their produce and products a competitive advantage on the national and global market.

The project entailed an assessment of the retailing and production of fresh-cut products in Trinidad. It was initiated in 2002 to inform the direction of future research that would be relevant to support the industry. Concurrently, an upgrade of plant and equipment to facilitate the conduct of fresh-cut research was set in motion as well as training to enhance staff capability for the anticipated research activities. The final phase of the project was the dissemination of relevant information to stakeholders.

Independently, the Caribbean Agricultural Research and Development Institute (CARDI) in collaboration with the International Institute for Cooperation in Agriculture (IICA) conducted a market assessment for convenience foods (pre-packaged vegetables) in Trinidad (Marketing Department, CARDI, 2004). The Food Science Department of the University of the West Indies (UWI) published papers on research of fresh-cut papaya and pineapple in 2000 and 2002.

In 2005, the National Agricultural Marketing and Development Corporation (NAMDEVCO) initiated an ad hoc working committee with UWI and the MALMR to provide technical leadership and support in the development of a local fresh-cut industry, to collaboratively research and establish technologies for the production of fresh-cut products suitable to local conditions, to establish a network mechanism among partners in the development of new products from the country's indigenous raw materials and to provide educational and training support to the fresh produce sector.

Postharvest Project, MALMR. At a seminar/workshop held in January 2006, the Postharvest Unit, MALMR presented results of the assessment of the retailing aspect of the fresh-cut products to stakeholders in the industry. Staff has since followed up with the stakeholders to assess the initial impact the presentations and workshop recommendations had on the operations of producers. Regulatory agencies have to be contacted to solicit comments and seek their inputs in charting a way forward for the development and management of the fresh-cut industry in Trinidad and Tobago. All stakeholders should have an input in this development process since a collaborative effort may have a more streamlined impact on achievement of desired goals (Strieter and Blalock, 2006).

This paper sought to highlight the implications of the findings of the survey of retail outlets conducted by the PHU as it pertained to selected tropical produce in Trinidad as well as the summary of the deliberations of the workshops' participants. Reference was also made regarding the positive and negative observations on food safety at fresh-cut production sites. The information generated was used to assess the fresh-cut industry and suggestions were made on the future prospects of the industry.

MATERIALS AND METHODS

The approach to the development and management of selected fresh-cut tropical produce, papaya (*Carica papaya* L), watermelon (*Citrullus lanatus*), pineapple (*Ananas comosus* (L.) Merr), dasheen leaves (*Colocasia esculenta*), pumpkin (*Cucurbita maxima*), carilla (*Momordica charantia*) and okra (*Hibiscus esculentus* L) in Trinidad was multi-faceted and the program of the Postharvest Unit, MALMR comprised:

A reconnaissance survey of 294 retail establishments in fifteen localities in Trinidad over the period 2002-2004. Data on the quality of the range of fresh-cut products available and the packaging and storage of these products were obtained by observations and interviews with produce managers and other key personnel. Data were collected on questionnaires; quantitative and qualitative analyses were conducted (Mootoo et al., 2006 unpublished);

Dissemination of the results of the survey of retail outlets to stakeholders at a seminar/workshop "The fresh-cut products industry in Trinidad- current status and future prospects" (Mootoo et al., eds, 2006);

A survey of producers of fresh-cut products from 2003-2005 to assess the standard of the manufacturing practices and quantitative and qualitative analyses are in progress; and

Soliciting opinions of stakeholders in private and public sector agencies at workshops conducted at the seminar/workshop in the areas of:

i. Research on product and packaging development,
ii. Strategies for good agricultural practices, transport and marketing and
iii. Sanitation and Food Safety.

Workshop findings were restructured into suggested short, medium and long-term measures towards the development of a viable fresh-cut industry. Suggestions on future prospects for the fresh-cut industry were made based on results of surveys and workshop deliberations

RESULTS AND DISCUSSION

Results of Reconnaissance Survey. Availability and range of fresh-cut products at retail outlets. The fresh-cut products prepared from the selected tropical commodities are shown in Table 1. These products were found at the supermarket (SM)- self-service retail store selling food and other domestic goods; wayside stall (WS)- make-shift stalls, fixed or mobile on sides of roadways; open-market (OM)- municipal market and food court restaurant (FCR).

All outlets produced their own fresh-cut products but the supermarkets also sold dasheen leaves products and fruit salads produced by a few micro and small local entrepreneurs. Supermarkets offered for sale the widest range and the largest quantity of fresh-cut products and this may be attributed to the more suitable holding conditions at these outlets, the larger area available for storage and display and the higher consumer demand from the clients who patronize these outlets (Mootoo et al., 2006 unpublished).

Table 1. Availability and range of selected fresh-cut tropical products at retail outlets in Trinidad.

Commodities	Product types		Retail Outlet[1]
	Single Items	Mixed Items	
Carilla	Cut in rings		SM
Dasheen Leaves	Cut leaves	Dasheen leaves combined with okra, pumpkin and condiments as callaloo pack	SM
Okra	None	whole or cut into rings in callaloo pack	SM
Pumpkin	Large chunks	With peel	SM,WS,OM
		Without peel	SM
	Small chunks	In callaloo pk with or without peel	SM
		In soup pk without peel	SM
Papaya	Chunks		SM
		Chunks in fruit salad without peel	SM, FCR, WS
Pineapple	Chunks	Chunks/rings in fruit salad without peel	SM
	Quarters		SM, FCR, WS
Watermelon	Chunks	Chunks in fruit salad without peel	SM
	Quarters	With peel	SM, FCR, WS
	Halves		SM, OM

[1]SM- Supermarket WS- wayside stall OM - Open Market FCR- Food court restaurant

The raw materials for the fresh-cut products are leafy immature tissue (dasheen leaves), immature (okra) and mature fruit (pumpkin, papaya, pineapple and watermelon). The wounding of the plant tissues during fresh-cut preparation, the removal of protective epidermal tissues, the developmental stage of the plant part being used and their unique physiological functions all contribute to producing products with higher levels of metabolic activity than intact plant parts. As a consequence, fresh-cut products have higher rates of respiration and ethylene production, there is an intermixing of enzymes and substrates and faster rates of deterioration than for intact produce. Changes are manifested as undesirable color changes (enzymatic browning), and a faster loss of texture, taste and aroma that characterizes the fresh-cut product. The cut surfaces also become increasingly susceptible to plant and food-borne pathogens depending on the holding and storage conditions. Consideration must be given to understanding the physiological and biochemical processes of fresh-cut products under varying environmental conditions to limit undesirable responses and ensure a quality product with optimum storage life (Nisperos and Baldwin, 1995; Cantwell and Suslow, 1999; Lamikanra and Watson, 2001).

Packaging and Labeling of Fresh-cut Products in Trinidad. Results from survey identified polyethylene (PE) bags, foam bowls/trays, film overwrap, and molded plastic trays with and without hinged lids as the containers used for the fresh-cut products. The products used in these packages and the retail outlets at which they were displayed are shown in Table 2.

Table 2. Packaging used for selected fresh-cut tropical products at retail outlets in Trinidad.

Type of Package	Commodity Type	Retail Outlet[1]	Comments
Polyethylene (PE) bags (sealed) of Low density polyethylene (LDPE)	Callaloo	SM	Perforated or imperforated (0.02-0.04 mm in thickness)
PE bags (unsealed or knotted at top)	callaloo, pineapple quarters, watermelon slices	SM,WS, OM	
Film overwrap (stretch film) of polyvinylchloride (PVC) or LDPE	Watermelon slices	SM, OM, WS	0.011mm in thickness
Foam cups/bowls of expanded polystyrene with film overwrap	Fruit salad	WS, SM, FCR	
Foam trays with film overwrap	Callaloo	SM	
Molded plastic trays of clear polystyrene with hinged lids	Callaloo pks, fruit salads	SM, FCR	Depths ranged from 5 cm to 10 cm
Molded plastic bowls of high density polyethylene (HDPE)	Mixed fruit salads	WS, FCR	Depths ranged from 5 cm to 10 cm

[1]SM Supermarket WS- Wayside stall OM - Open Market FCR- Food court restaurant

Plastic Bag. The thickness of the low-density polyethylene (LDPE) bags (0.025 mm to 0.04 mm) used in the local industry fell well within recommended ranges for horticultural products (Robertson, 1993). Condensation of water was seen in sealed PE bags at supermarkets and unsealed PE bags at wayside and open markets. This has significance for the impact of packaging on product quality as condensation in the bags at the supermarket suggested fluctuations of the holding temperature. The build up of heat from high respiration of produce under tropical ambient conditions and poor air circulation at the open market and wayside stalls also contributed to condensation in bags. This condensation in bags would facilitate the growth of microorganisms and increase decay (Kader et al., 1989). The flavor, aroma, texture and food safety of the fresh-cut product may be adversely affected (Mootoo et al., 2006 unpublished).

Plastic Film Overwrap. Film overwrap provided a barrier from direct contact with hands, dust and other contaminants. Oxygen may be depleted to low levels in film wrapped fresh-cut products because of inadequate permeability of film and higher respiration rates of the product leading to development of anaerobic conditions and associated off-flavors (Ko et al., 1995; Cantwell and Suslow, 2002).

Polystyrene (PS) foam bowls. Gaseous exchange (important for shelf-life extension and prevention of development of anaerobic conditions) in the PS foam bowls with film overwrap is limited. Products with this type of packaging were sold within 6-24 hours at wayside stalls and food court restaurants thereby minimizing opportunities for anaerobiosis developing. The PS bowls and the shallow trays with a wide surface area of film overwrap were often observed at the supermarket where cooler holding conditions may contribute to extending shelf- life of the product (Mootoo et al., 2006 unpublished).

Plastic molded trays and bowls. Rigid plastic molded containers and clear plastic bowls and trays offered rigid support and visibility to the product but locking mechanisms often provided an inadequate seal and needed reinforcement with film wrap to avoid accidental opening and to be tamper-proof (Mootoo et al., 2006 unpublished data).

Effect of packaging on atmosphere within package. Modified Atmospheres (MA) of gases in proportions different to air are developed when fresh-cut products are enclosed within packages. The permeability of the packaging material (the Oxygen Transmission Rate-OTR), the respiration rate of the fresh-cut product and the storage conditions interact to produce a MA. The OTR of the packaging materials for local products was not known by suppliers or users. Cantwell and Suslow (2002) indicated that films are selected based on their OTRs in relation to the produce' respiration rate. Storage without an appropriate environment around the product may lead to anaerobic conditions and associated undesirable changes in flavor, aroma, texture as well as a greater susceptibility to pathological infection.

Labeling. Fresh-cut products at open markets and wayside stalls carried no labels. Labels on products at the supermarket carried some or all of the information as brand name, common name of product, net weight, price, ingredients, bar code, name, address and telephone number of producer, special handling instructions and recommended storage temperature.

The labels did not carry best before dates or codes for first in, first out (FIFO). Labels therefore did not strictly adhere to the labeling regulations of Trinidad and Tobago, which has been revised to meet international standards. Adoption and monitoring of the improved regulations will enhance the usefulness of labels on the packages (Mootoo et al., 2006 unpublished).

Storage and display conditions. Supermarkets which were usually air-conditioned buildings, were the only outlets that stored fresh-cut products. Display conditions for fresh-cut products at retail outlets ranged from ambient conditions (mean maximum temperature of 33° C and 49-99% RH) at wayside stalls and open markets to air-conditioned rooms at food courts and supermarkets. Supermarkets used refrigerated chillers to display produce and temperatures noted on these chillers ranged from –7 to 15 °C.

The optimal storage temperature range for fresh-cut products is 1-5 °C (IFPA and PMA, 1999). At outlets where temperatures of chillers were at –7° C, products could develop freezing injury and at those outlets where temperatures were at 15° C, products would undergo faster rates of deterioration than at optimum temperatures. Products at supermarkets may also be exposed to unfavorable temperature conditions if the height of tiers of products or flow of cool air around products prevents an adequate temperature from being maintained uniformly around products (Kader and Thompson, 2004).

Products displayed at tropical ambient conditions were held at unfavorable temperatures. Vendors at these outlets prepared products for same day sale and exposure to ambient conditions was short-term. The exposure to dust, vehicular exhaust fumes and other environmental contaminants at wayside stalls was unacceptable for food products. There was need for some vendors of fresh-cut products to improve temperature management and protection from environmental contaminants to meet good manufacturing and sales practices (Mootoo et al., 2006 unpublished).

Quality of fresh-cut products. Fresh-cut products of high quality are characterized by their visual appearance, texture, odor, flavor, nutritive value and safety. Although most products were of satisfactory quality at the retail outlets surveyed, quality deterioration symptoms were observed and are summarized in Table 3 based on their impact on appearance and texture.

Table 3. Deterioration symptoms resulting in loss of appearance and texture in selected fresh-cut products in Trinidad.

Symptoms	Product	Remarks
Brown/black discoloration on cut surfaces	Okra, dasheen leaves	Oxidative Browning
Orange/red discoloration	Carilla	Mature fruits/high holding temperature
Wilting/Drying may be associated with a brown discolor	Carilla	Loss of turgidity at above optimal temperatures
Tissue softening/tissue breakdown	Pumpkin, carilla, papaya, watermelon	Pathological infection/ wounding
Excessive liquid in container, water-soaked appearance	Fruit salads	Soft textured-fruit/above optimal holding temperature

Brown/black discolorations on the surface of cut okra and cut petioles of dasheen leaves were common. This may be due to development of oxidative browning as naturally occurring enzymes, polyphenol oxidases and peroxidases and tissues intermix on cutting (Nisperos and Baldwin, 1995). This discolor detracted from the appearance of the product and while alternative strategies were available to manage this discolor, local

entrepreneurs used acidic solution (lemon solution) on discolored imported fruits, held products at low temperatures or left okras intact in the callaloo pack.

Green carilla slices may develop yellow/red pigmentation if holding temperatures are above optimum and/or very mature fruits were selected for fresh-cut use. Such products are pulled off the shelves. Some carilla products that may have been held at above optimal temperatures, displayed the light brown discolor of wilted tissue as a result of moisture loss from tissues.

Pumpkin, carilla, papaya and watermelon fruit pieces with tissue softening or breakdown of textural integrity had some pathological infection or suffered severe wounding during the cutting process. Some fruit salads had excessive liquids in the container and some of the fruits also had an unappealing water-soaked appearance. These undesirable features may be attributed to selection of fruits that were not of best firmness for fruit salads and/or to holding of products at above optimal temperatures. These products may become unsafe to consume. Good manufacturing practices (GMPs), incorporating management of the raw material, the production and distribution processes, needed to be employed to ensure a quality product.

ASSESSMENT OF PRODUCTION SITES IN THE 2003-2005 SURVEY

Preliminary assessment. Data of the assessment of production sites are still being analyzed but initial observations suggested that there was no screening for date of harvest on receipt of produce, to establish the freshness of the produce. There was no screening for the source of raw material which was important for traceability of produce. Produce was assessed for wholesomeness and those with defects were rejected. However, at some supermarkets, produce (with signs of mild decay) from display shelves was salvaged as raw material source for fresh-cut production.

The physical facilities at retail outlets were not designed for fresh-cut preparation and makeshift arrangements with varying degrees of operational efficiency existed. At other production sites, fresh-cut products were prepared under conditions with varying standards of operation. Table 4 summarized some of the positive and negative conditions/procedures observed at the production sites.

Table 4. Some positive and negative conditions/procedures observed at the fresh-cut production sites.

Positive conditions/procedures	Negative conditions/procedures
Wholesome produce and varieties from which products with longer shelf-life were achieved, were preferred.	Produce with mild decay was salvaged from display shelves. No screening for source or date of harvest of raw material occurred. Transport and reception areas were at tropical ambient conditions.
Produce was used directly on receipt from suppliers or stored in chillers specifically for plant material and/or non-meat chill products.	Chillers not available for storage. Produce used within 12 h of purchase.
Sturdy containers used for produce.	Containers/trolleys used for raw produce were also used for finished products without any sanitizing process between activities.
Temperature of preparation area was at air-conditioned temperatures of 20-24 °C but still not at recommended 1-5 °C.	Temperature of preparation area was at ambient conditions or fans were used to cool room.
Work station/equipment were all sanitized with bleach solution or some other sanitizer.	Rate and concentration of sanitizer was not specified. Frequency of sanitation was inconsistent with needs.
Produce washed and/or sanitized and air dried before use.	Produce may or may not be washed and/or sanitized and dried before use.
Staff had food badges, legal tender for food handlers, and used head covers, aprons or coats and gloves.	Available gloves were not consistently used or its use was not enforced. The few men did not use moustache and beard covers.
Staff had some knowledge of good manufacturing practices and sanitary standard operation procedures.	Experience as women working in home kitchens guided operation standards.
Waste material was efficiently disposed.	Timing of waste removal and path for removal through reception area were not in keeping with standards of operation.

Quality assurance testing before, during and after preparation was non-existent at the production sites surveyed. The increase in the cut surfaces of fresh-cut products and the cell nutrients available at these cut surfaces provide conditions that favor microbial growth. Increased handling of produce by preparation personnel also offered opportunity for human pathogens as *E. coli*, *Listeria*, *Yersinia* and *Salmonella* to be readily transmitted (Gorny, 2001). Fresh-cut products had good visual quality but may be harboring pathogens without displaying visual indicators. Any microbes in fresh-cut products should not contribute to the decay and faster deterioration of the product nor should the microbes be pathogenic to human health and safety.

Standards of operations at the production sites were rudimentary and though improvements of plant, equipment or procedure were noted at many sites over time, upgrade of standards consistent with good management practices were essential for continuation of expansion of the industry as a viable, healthy entity.

Findings of workshops. Responsibility for facilitating regulation and upgrade of the fresh-cut industry falls under the purview of a number of organizations in the public and private sector. An opportunity was sought to canvas input from these organizations into the development and management of the fresh-cut industry at the workshop sessions hosted by the Postharvest Unit of the MALMR. Table 5 is a compilation of the suggestions generated from discussions at the workshops and possible time frames for achieving goals if found mutually acceptable to the relevant organizations.

Table 5. Suggestions from Workshop on "Research on Product and Packaging Development" and possible time frame for achievement.

Activity	Yearly timeline				
	Year 1	Year 2	Year 3	Year 5	Year 7+
Identify quality parameters for commodities to be used in fresh-cut production.	→	→	→		
Conduct trials on appropriate types of packaging for shelf life extension of quality fresh-cut products (link with food microbiologist to complement postharvest research studies).	→	→	→	→	
Conduct commodity-based shelf life studies (link with food microbiologist to complement postharvest research studies).	→	→	→		
Product development using seasonally available local fruits to enhance fruit salads.	→	→	→	→	→
Assess cost and consumer acceptability of high vs. low impact graphic packaging.		→	→		
Source and screen cultivars specific for fresh-cut use.			→	→	→
Link with agencies for feasibility studies in the production of fresh-cut products.		→	→	→	
Review possibility of cultivating broccoli, cantaloupe, honeydew melon domestically by conducting web site searches for cultivation practices in other tropical countries and sourcing appropriate varieties.				→	→
Structure a land use plan to produce adequate supplies of produce year round			→	→	

Table 5b. Suggestions from Workshop on "Strategies for Good Agricultural Practices, Transport and Marketing" and possible time frame for achievement.

Activity	Yearly timeline				
	Year 1	Year 2	Year 3	Year 5	Year 7+
Educate processors/technicians on postharvest handling, traceability and sanitation practices. Educate hoteliers on seasonal availability and use of indigenous fruits.	→				
Improving NAMDEVCO facilities to handle fresh-cut products.	→	→	→		
Identify market segments eg hoteliers, restaurants, household, offices, special events, school feeding program and export market.	→	→			
Expansion of certification program to wider cross- section of farmers concomitant with an increase in certifying and monitoring agencies	→	→	→	→	→
Education of farmers on GAP and use of grades and standards.	→	→	→	→	→
Educate consumers on postharvest handling and sanitation practices.		→	→	→	
Establish standards for packaging materials, storage temperature and quality raw material.					
Strengthening farming community with trained farmers and farm attendants from graduates of UWI, ECIAF and YAPPA.		→	→		
Incentives as improved infrastructure, ADB loan facilities, refrigerated vehicles and simple chill rooms for business development.	→	→	→	→	→
Strategies to expand criteria presently monitored as part of GAP certification program.					→

Table 5c. Suggestions from Workshop on "Sanitation and Food Safety" and possible time frame for achievement.

Activity	Yearly timeline				
	Year 1	Year 2	Year 3	Year 5	Year 7+
Due diligence by management re health certificates/food badges etc as part of a quality management system.	→				
Education of Inspectors and Health Personnel/ Business managers, training of trainers and suitable selection of trainers and trainees.	→				
Preparation, institution and monitoring of sanitation standard operation procedures (SSOPs).		→	→		
Verification by Testing Procedures.		→	→	→	→
Use of all media in preparing educational material. Link with Consumer Affairs Division.	→	→	→	→	→
Political will to pass amended Laws - Solicit NGO's to lobby for passing of amendments to Laws.		→	→	→	→
Enforcement of OSHA Law for worker health and Safety.					→
Towards HACCP and GAP:					
• Improve GAP- Farm production, transportation					
• Improve Good Manufacturing Practices (GMP)- Storage, processing, sanitation distribution etc.	→	→	→	→	→
• Legislation to regulate farm certification and improved food safety	→	→	→	→	→
• Increase certified laboratories for testing and verifying products (International Sponsorship?)		→	→	→	→
• Training personnel for HACCP and GAP programs and offering attractive remuneration packages to retain experienced staff.		→	→	→	→

SWOT statement derived from findings of the surveys of retail and production sites and workshops' deliberations. After assessing the findings of the surveys of the retail and production sites and the workshops' deliberations, the information generated was prepared as a statement of the strengths, weaknesses, opportunities and threats (SWOT) for the fresh-cut industry.

Strengths

1. Industry attracted new producers of fresh-cut products.
2. Ability to develop ingenious products appealing to local cuisine.
3. Absence of external competitors of fresh-cut products using local products.
4. Availability of female labor with natural intuitiveness for fresh-cut production.
5. Personnel in fresh-cut industry were keen to improve management practices.
6. Qualified personnel available from a number of regulatory and research agencies to train industry personnel on improved practices.
7. Present packaging allows for containment, good visual appeal and protection from tampering.
8. Facility for duty free importation of equipment for fresh-cut preparation was available.

Weaknesses

1. Good agricultural practices were not well entrenched in farming community to support provision of produce year round, in terms of the desirable quantity and quality for agro-processing industries.
2. Freshness of raw materials for fresh-cut products was questionable.
3. Reliance on imported commodities (carrots, broccoli, cabbage and apples) for fresh-cut products.
4. Supermarkets considered fresh-cut preparation to be labor intensive and time consuming.
5. Supermarkets lack the physical space for the preparation and display of the desired quantity of fresh-cut products.
6. Cold chain from field to table was not maintained to minimize quality deterioration of the products.
7. Use of blunt cutting implements in preparation of fresh-cut products.
8. Current prevention strategies were inadequate to ensure microbial safety.
9. Producers were unaware of the range of improved packaging options available for the fresh-cut product industry.
10. Labels lacked pertinent information to guide customer purchasing and to meet international standards.
11. Fresh-cut products were not priority products for public health monitoring.
12. Personnel in fresh-cut industry either considered that their standard of operations required no improvement or seemed lukewarm to raise the standard of operations in the industry.

Opportunities

1. Supply of fresh-cut products were often less than demand.
2. Small entrepreneurs willing to invest in the fresh-cut industry were increasing.
3. Technologies for management of wound induced metabolic activity were available.

4. Availability of packaging options with suitable modified atmospheres for specific products.
5. Inclusion of more informative, attractive but cost effective labels on fresh-cut products was an option.
6. Possibility of increasing production using available mechanized techniques.
7. Niche ethnic markets existed for tropical fresh-cut products in the global market.
8. Sustained demand for domestic fruit and vegetables can fuel increased crop production.
9. Development of local grades and standards in keeping with international standards, driven by demand for quality produce.
10. Develop linkages with producers, researchers, regulatory agencies and consumers, locally and internationally.

Threats

1. Outbreaks of plant pest, inclement weather and/or drought conditions would affect supply and demand of produce and product pricing.
2. Loss of consumer confidence in fresh-cut products as a result of increased health and safety risks.
3. Import of fresh-cut products with longer shelf-life.

CONCLUSION

The fresh-cut industry has the potential to add value to agricultural production and provide higher returns on investment to primary producers. This return will only be sustained if the fresh-cut industry is managed to counteract present deficiencies. Establishing best agricultural practices for the desired crops and using sound marketing information would contribute to the provision of produce in consistent quantities and of optimal quality on a year round basis. The range of local fruits and vegetables used in fresh-cut production may also be increased. Application of good manufacturing practices and sanitary standard operation procedures that were self or externally regulated may improve the quality and safety of fresh-cut products. Maintaining of the cold chain from harvesting of produce to the consumer was a key aspect of the manufacturing procedure that needed upgrading. Sourcing of appropriate machinery, technologies and packaging were crucial to maintain quality and extend shelf life of fresh-cut products for an economically feasible fresh-cut industry.

Managers in the industry needed to be sensitized as to the importance of using trained staff to lift their standard of operations. Managers should aim to improve their good manufacturing practices to the level that a hazard analysis critical control points (HACCP) program could be implemented to elevate the fresh-cut production to international standards. Regulatory agencies should facilitate the upgrade of current practices by gaining a better understanding of the agricultural and manufacturing producers and conditions that could influence a change of attitude and approach to better maximize the impact of their services. These agencies needed to affirm the positive skill, knowledge and values of producers and support self directed discovery and problem solving (Eckert and Bell, 2006). Management and development of the fresh-cut products industry would benefit from the collaboration of public and private

sector agencies with farmers, producers and retailers in the areas of research, education, marketing and health and safety surveillance.

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