Cassava and Sweet Potato

Suitability of Popular Caribbean Varieties for Value Added Product Development

CASSAVA AND SWEET POTATO

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PREFACE

Only a few root and tuber crops contribute extensively to world food production, food and nutrition security, income generation and poverty alleviation. Among the most important crops in this group are cassava (*Manihot esculenta* Crantz) and sweet potato (*Ipomoea batatas* (L.) Lam.). These crops are considered major staples and produce large quantities of dietary energy for significant populations in the developing world.

Historically, cassava and sweet potato have been important crops in the economic, social and cultural space of the Caribbean. Over the past five years, with the increasing cost of imported grains and cereals and the rising food import bill, there has been an increasing thrust in the Region to improve food and nutrition security, in particular as it pertains to carbohydrates. Building of a viable and competitive root and tuber crop industry which provides consumers with high quality fresh and value added products requires in part, the use of efficient technologies, infrastructure strengthening and capacity building of stakeholders. Improving information access in areas such as production, processing and marketing are also critical for enhancing the efficiency and profitability of operations along the value chain and for sustainable industry development.

Recognising the dearth of information in the Region on the processing of local varieties, this bulletin seeks to provide processors, producers and other key stakeholders with information on the suitability of local varieties for value added product development. The utilisation of this type of information will lead in part, to greater processing efficiencies and an improved quality product for consumers.

The information presented herein is the outcome of a project, "*Enhancing the Value Added Processing of Roots and Tubers in the Caribbean through the Transfer of Improved Technologies*" funded by the Inter-American Institute for Cooperation on Agriculture Competitive Fund for Technical Cooperation (FonTC). The overall goal of the project was to improve the capacity of Caribbean countries to attain the Region's food and nutrition security strategy as it pertains to staples. This project was executed in four target countries (Barbados, Dominica, St Kitts and Nevis and Trinidad and Tobago) where cassava and sweet potato production have traditionally been important to livelihoods of many small farmers and processors. The information is intended for processors as well as producers who are supplying raw materials to processors.

INTRODUCTION

Importance of root and tubers to the economies of the Caribbean and profile of production systems.

Cassava and sweet potato are ranked within the top three root and tuber crops produced and consumed in the Caribbean Region. These traditional staples are particularly attractive for the Region not only because of their nutritive and caloric value and contribution to livelihood systems, but also their adaptability to a wide range of growing conditions and their low susceptibility to natural disasters, such as hurricanes, which frequently plague the Region.

Traditionally, these root and tuber crops are grown by small farmers on small parcels of marginal land with low input. However, as they gain more importance locally, production systems are transitioning to commercial sized acreages of 2 hectares or more and the use of Good Agricultural Practices (GAP). Production in 2012 was over 1.3 million tonnes and 650,000 tonnes for cassava and sweet potato respectively (FAO STAT).

Several constraints impact the sustainable development of the cassava and sweet potato industries in the Region; among these are the low yields attributed to the generally poor agronomic practices undertaken by producers, sub-standard quality due to pests and diseases (arthropods and pathogens) both at pre and post-harvest stages. Poor market intelligence and limited knowledge of market opportunities have also hindered development.

Role of traditional staples for the attainment of food and nutrition security

Globally, rising food prices and the reduced availability for staples (such as cereals and grains) have led the Governments of CARICOM Member States to establish food and nutrition security goals that seek to reduce the Region's reliance on imported staples through the increased use of traditional staples. Studies conducted in several CARICOM Countries indicate that there are huge, untapped import-substitution market opportunities that can be addressed by the utilisation of traditional root and tuber crops such as cassava and sweet potato.

Moreover these commodities have significant nutritional properties that make them attractive substitutes to imported grains and cereals. Dietary properties associated with traditional staples such as, cassava and sweet potato include: dietary fibre, beta carotene and a range of vitamins and micro-nutrients that exceed many of the imported starches (Table 1).

Table 1: Nutritional comparison of local and imported staples

Nutrient content in 100g	Cassava	Sweet potato	Corn	Rice	Wheat
Energy (kJ)	670	360	360	1528	1419
Energy (cal)	160	86	86	365	339
Protein (g)	1.40	1.60	3.20	7.10	13.70
Fat (g)	0.28	0.05	1.18	0.66	2.47
Saturated fatty acids (g)	0.07	0.02	0.18	0.18	0.45
Mono-unsat. fatty acids (g)	0.08	0	0.35	0.21	0.34
Poly-unsat. fatty acids (g)	0.05	0.01	0.56	0.18	0.98
Carbohydrates (g)	38	20	19	80	71
Fiber (g)	1.80	3	2.70	1.30	10.7
Calcium (mg)	16	30	2	28	34
Iron (mg)	0.27	0.61	0.52	4.31	3.52
Magnesium (mg)	21	25	37	25	144
Phosphorus (mg)	27	47	89	115	508
Potassium (mg)	271	337	270	115	431
Vitamin C (mg)	20.6	2.4	6.8	0	0
Thiamin (mg)	0.09	0.08	0.20	0.58	0.42
Riboflavin (mg)	0.05	0.06	0.06	0.05	0.12
Niacin (mg)	0.85	0.56	1.70	4.19	6.74
Pantothenic acid (mg)	0.11	0.80	0.76	1.01	0.94
Vitamin B6 (mg)	0.09	0.21	0.06	0.16	0.42
Folate Total (mcg)	27	11	46	231	43
Vitamin A (IU)	13	14187	208	0	0
Vitamin E (mg)	0.19	0.26	0.07	0.11	0
Vitamin K (mcg)	1.90	1.80	0.30	0.10	0
Beta-carotene (mcg)	8	8509	52	0	0

Sourced from: http://janderson99.hubpages.com/hub/Health-Benefits-Sweet-Potatoes-Nutrition-Facts-Healthy-Recipes

These nutritional properties are linked to the prevention and management of many of the life style diseases that plague the Region; hence the need to promote their increased consumption.

Value addition of traditional staples

Currently, more than 99% of the total production of cassava and sweet potato is channelled into the fresh market, with less than 0.5% utilised for value added product development. These root crops are eaten primarily boiled as the main starch at a meal, added to soups, used as base for other dishes or fried as chips or snack crisps. As consumers are encouraged to transition from imported grains and cereals to more traditional staples, there will be a growing demand not only for fresh but also various forms of processed traditional staples, that is, minimally processed "ready to eat" and "easy to prepare" forms to fully processed forms such as flour, cereals, snacks, pudding mixes etc.

Status of root and tuber processing in the Region

There are approximately 100 processors of cassava and sweet potato in the Caribbean; with a greater number of operations processing cassava as compared to sweet potato. The majority of processors operate small scale, low input operations within a home environment. These small scale processors have relied on traditional knowledge to develop their operations and have been processing these traditional root and tuber crops for over ten years.

The most popular fully processed products from cassava are flour, farine and "bammy" (flat bread), and chips. For sweet potato, flour, konki and chips are the most popular products. Minimally processed products such as fries, cubes and wedges, chunks, slices and logs and "easy-to-use" packages with other commodities such as a soup-pack are also produced.

Constraints impacting the development of the processing industry include: appropriate machinery for small scale processing, market support, training and technical support, cost of labour, quality and cost of raw materials. In addition, limited knowledge of the suitability of local raw materials (i.e. crop varieties) for processing has limited the diversity and quality of value added products available to consumers. These constraints therefore need to be addressed to expand value added product development of the root and tuber crops.

Physical Features and Chemical Properties of Popular Cassava and Sweet Potato Varieties grown in Selected CARICOM Member States

Selecting the most appropriate root and tuber crop varieties is critical for producing high quality value added products. The Caribbean Agricultural Research and Development Institute (CARDI) and the Food Science and Technology Unit (FSTU) of the University of the West Indies (UWI) have undertaken studies to determine the potential of popular local varieties of cassava and sweet potato for processing. These studies highlighted the importance of the physical features and chemical properties of varieties on the quality of value added products. These physical features and chemical properties in part, include: colour of the flesh, moisture content, dry matter ("dryness"), sugar content ("sweetness"), fibre ("coarseness") and starch levels. Each value added product has different requirements as it pertains to these properties and processors need to be aware of the characteristics associated with the varieties that are being used in relation to the requirements of the product that is to be processed.

Flours and the associated products (e.g. cakes, cookies etc.), fries and crisps, cereals as well as juices are popular value added products being produced by small and medium sized processors in the Region. Such products require a range of cassava and sweet potato varieties that vary in their physical and chemical characteristics. Generally, the guide in Table 2 can be used in part, for the selection of varieties suited for these popular value added products.

Table 2: Physical and chemical characteristics for the selection of popular value added products for cassava and sweet potato

Value Added Product	Physical and Chemical Characteristic Requirements	Reason for Product Selection
CASSAVA		
FLOUR	High dry matter (>40%) High starch yield (>30%)	Secondary processing potential into bakery products, fabricated snacks, thickener. Substitution of imported wheat flour.
FRIES/CRISPS	High dry matter (>40%) Low fibre content (<5%) Low sugar (<1%)	Demand for snack foods. Substitution for imported products.
SWEET POTATO		
FLOUR	High dry matter (>38%) High starch yield (>29%)	Secondary processing potential into bakery products, fabricated snacks, thickener. Substitution of imported wheat flour.
FRIES/CRISPS	Medium dry matter (20 – 30%), Low sugar (<1%)	Demand for snack foods. Substitution for imported products.
JUICE	Low dry matter (<20%) Colour (subjective and based on personal choice) High sugar (1-5%)	Health and wellness trend towards nutritious drinks, vitamin levels.

Reference: Camejo 2014. Cassava - all values are on a dry matter basis. Sweet potato – all values except total sugar content for juice are on a dry matter basis.

For each of the following countries; Barbados, Dominica, St Kitts and Nevis and Trinidad and Tobago, information relating to the suitability of popular cassava and sweet potato varieties for value addition is presented. For each variety, the physical features and chemical properties are outlined as well as the value added products for which they are most suited. A total of 25 varieties are profiled; 13 sweet potato varieties and 12 cassava varieties.

BARBADOS

SWEET POTATO

Sweet potato is a very popular root crop in the Barbados landscape. Annual production averages just over 2,000 tonnes per year. It is traditionally planted to occupy the land after the sugar cane crop, as a consequence the scale at which the crop is planted varies widely; from large acreages on estates to small plots cultivated by low resource farmers. Most of the crop is eaten fresh or used to prepare traditional dishes such as doucna, puddings, or cooked and used as stuffing for the popular “weekend” pudding. Sweet potato flour is now being made by a number of small processors and can be found in retail outlets. There is a growing interest in its industrial potential; example ethanol and starch.

SWEET POTATO VARIETY: C105

Physical features of the sweet potato root

Shape: Oval

Skin Colour: Pink

Flesh Colour: Cream

Physico-chemical properties of fresh root

PROPERTIES	LEVELS
Moisture (%)	48.0
Protein (%)	1.48
Fat (%)	0.31
Ash (%)	2.37
Carbohydrate (%)	47.84
Total Sugar (%)	2.87
Fibre (%)	0.24
Starch (%)	44.73
Vitamin C (mg/100g)	1.06

Physico-chemical properties of flour

PROPERTIES	LEVELS
Moisture (%)	5.55
Protein (%)	2.85
Fat (%)	0.60
Ash (%)	4.55
Carbohydrate (%)	86.45
Total Sugar (%)	5.51
Fibre (%)	2.95
Starch (%)	77.99
Vitamin C (mg/100g)	2.03

Product Recommendation

Primary processing: Flour

Secondary processing: Extruded Snacks

SWEET POTATO VARIETY: C32

Physical features of the sweet potato root

Shape: Oval

Skin Colour: Red

Flesh Colour: Orange

Physico-chemical properties of fresh root

PROPERTIES	LEVELS
Moisture (%)	48.0
Protein (%)	1.11
Fat (%)	0.06
Ash (%)	2.13
Carbohydrate (%)	48.7
Total Sugar (%)	2.94
Fibre (%)	0.65
Starch (%)	45.1
Vitamin C (mg/100g)	1.07

Physico-chemical properties of flour

PROPERTIES	LEVELS
Moisture (%)	4.55
Protein (%)	2.13
Fat (%)	0.12
Ash (%)	4.09
Carbohydrate (%)	89.1
Total Sugar (%)	5.65
Fibre (%)	2.08
Starch (%)	81.4
Vitamin C (mg/100g)	2.06

Product Recommendation

Primary processing: Flour

Secondary processing: Bread, Cakes, Thickener

SWEET POTATO VARIETY: Q

Physical features of the sweet potato root
Shape: Oval
Skin Colour: White
Flesh Colour: Orange

Physico-chemical properties of fresh root

PROPERTIES	LEVELS
Moisture (%)	48.2
Protein (%)	1.24
Fat (%)	0.26
Ash (%)	2.21
Carbohydrate (%)	48.1
Total Sugar (%)	2.66
Fibre (%)	0.44
Starch (%)	45.0
Vitamin C (mg/100g)	0.45

Physico-chemical properties of flour

PROPERTIES	LEVELS
Moisture (%)	4.77
Protein (%)	2.40
Fat (%)	0.51
Ash (%)	4.27
Carbohydrate (%)	88.0
Total Sugar (%)	5.13
Fibre (%)	1.61
Starch (%)	81.3
Vitamin C (mg/100g)	0.86

Product Recommendation
Primary processing: Flour
Secondary processing: Bread, Cakes, Thickener

DOMINICA

SWEET POTATO

As in most CARICOM countries, sweet potato is widely grown in Dominica. The production has generally increased over the years and as reported by FAOSTAT, the country now produces just over 2,000 tonnes annually. Most of the crop produced is sold fresh in the market. Typically, sweet potatoes are consumed boiled or baked in traditional dishes. A small quantity is traded within the Region. Cultivation is primarily by small farmers on marginal lands and there is currently no processing of this crop.

SWEET POTATO VARIETY: KIZZIE RED

Physical features of the sweet potato root
Shape: Elliptical
Skin Colour: Burgundy
Flesh Colour: White

Physico-chemical properties of fresh root

PROPERTIES	LEVELS
Moisture (%)	45.0
Protein (%)	1.02
Fat (%)	0.09
Ash (%)	1.76
Carbohydrate (%)	44.9
Total Sugar (%)	2.59
Fibre (%)	0.41
Starch (%)	41.9
Vitamin C (mg/100g)	0.48

Physico-chemical properties of flour

PROPERTIES	LEVELS
Moisture (%)	5.35
Protein (%)	2.28
Fat (%)	0.16
Ash (%)	3.20
Carbohydrate (%)	89.0
Total Sugar (%)	4.72
Fibre (%)	2.36
Starch (%)	81.9
Vitamin C (mg/100g)	0.88

Product Recommendation
Primary processing: Flour
Secondary processing: Bread, Cake and Cookies

CASSAVA

In Dominica, cassava has a lower production value when compared to sweet potatoes (i.e. under 1,000 tonnes per annum). The crop is grown mainly by small farmers on small acreages and grown with minimal inputs. The main value added products for cassava in Dominica are farine and cassava bread. These value added products are generally produced using traditional equipment such as manual graters and wooden trays. Recently however (2010-2012), CARDI with funding from the Common Fund for Commodities and the European Union provided three processing facilities with motorised graters, squeezer presses, stainless steel sinks and food grade containers and utensils. This intervention has allowed for increased efficiencies in the making of farine and cassava bread. The resultant improvement is now driving the increased production of cassava on the island.

CASSAVA VARIETY: BOIS BLANC (SWEET CASSAVA)

Physical features of the cassava tuber
Shape: Cylindrical
Skin Colour: Light brown
Flesh Colour: Cream

Physico-chemical properties of fresh root

PROPERTIES	LEVELS
Moisture (%)	50
Protein (%)	0.10
Fat (%)	0.09
Ash (%)	1.30
Carbohydrate (%)	45.0
Total Sugar (%)	2.33
Fibre (%)	0.80
Starch (%)	41.9
Vitamin C (mg/100g)	0.60

Physico-chemica properties of flour

PROPERTIES	LEVELS
Moisture (%)	4.24
Protein (%)	0.19
Fat (%)	0.17
Ash (%)	2.60
Carbohydrate (%)	92.8
Total Sugar (%)	4.64
Fibre (%)	1.59
Starch (%)	86.6
Vitamin C (mg/100g)	1.20

Product Recommendation
Primary processing: Flour, Fries
Secondary processing: Thickener

CASSAVA VARIETY: CENT LIVRE (BITTER CASSAVA)

Physical features of the cassava tuber
Shape: Cylindrical
Skin Colour: Light brown
Flesh Colour: Cream

Physico-chemical properties of fresh root

PROPERTIES	LEVELS
Moisture (%)	58.3
Protein (%)	0.07
Fat (%)	0.14
Ash (%)	1.06
Carbohydrate (%)	83.6
Total Sugar (%)	1.97
Fibre (%)	0.33
Starch (%)	81.3
Vitamin C (mg/100g)	0.44

Physico-chemical properties of flour

PROPERTIES	LEVELS
Moisture (%)	1.98
Protein (%)	0.17
Fat (%)	0.33
Ash (%)	2.55
Carbohydrate (%)	95.0
Total Sugar (%)	4.72
Fibre (%)	1.46
Starch (%)	88.8
Vitamin C (mg/100g)	1.05

Product Recommendation
No product development due to the high level of cyanide.
Primary processing: None
Secondary processing: None

CASSAVA VARIETY: BOIS BLEU

Physical features of the cassava tuber
Shape: Cylindrical
Skin Colour: Light brown
Flesh Colour: Cream

Physico-chemical properties of fresh root

PROPERTIES	LEVEL
Moisture (%)	66.7
Protein (%)	0.05
Fat (%)	0.07
Ash (%)	0.83
Carbohydrate (%)	30.0
Total Sugar (%)	1.58
Fibre (%)	0.32
Starch (%)	28.1
Vitamin C (mg/100g)	0.35

Physico-chemical properties of flour

PROPERTIES	LEVELS
Moisture (%)	3.83
Protein (%)	1.40
Fat (%)	0.20
Ash (%)	2.49
Carbohydrate (%)	92.1
Total Sugar (%)	4.74
Fibre (%)	2.35
Starch (%)	85.0
Vitamin C (mg/100g)	1.04

Product Recommendation
Primary processing: Flour
Secondary processing: Extruded snacks

CASSAVA VARIETY: SEPT FEYE

Physical features of the cassava tuber
Shape: Cylindrical
Skin Colour: Light brown
Flesh Colour: Cream

Physico-chemical properties of fresh root

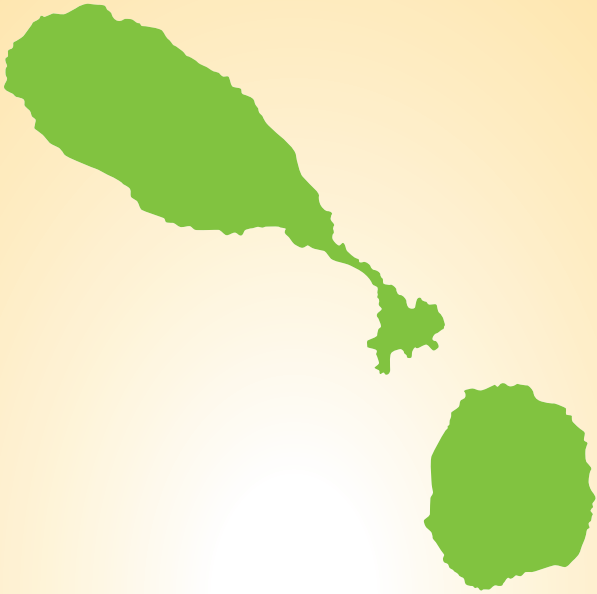
PROPERTIES	LEVELS
Moisture (%)	70.0
Protein (%)	0.05
Fat (%)	0.05
Ash (%)	0.83
Carbohydrate (%)	27.1
Total Sugar (%)	1.38
Fibre (%)	0.19
Starch (%)	25.5
Vitamin C (mg/100g)	0.44

Physico-chemical properties of flour

PROPERTIES	LEVELS
Moisture (%)	1.24
Protein (%)	0.17
Fat (%)	0.16
Ash (%)	2.77
Carbohydrate (%)	95.7
Total Sugar (%)	4.58
Fibre (%)	2.10
Starch (%)	89.0
Vitamin C (mg/100g)	1.46

Product Recommendation
Primary processing: Flour
Secondary processing: Extruded snacks

ST. KITTS AND NEVIS



SWEET POTATO

Sweet potato is a major staple in St Kitts and Nevis. Over the past two years there has been an increase in the production of the crop due to major steps taken by the Government to promote its cultivation and provide assistance to farmers. At the CARDI Field station in St Kitts, more than 60 local and introduced varieties are being conserved. Collaborative research efforts have been undertaken between CARDI, the Departments of Agriculture (on both islands) and the Taiwanese Technical Mission to effectively manage the major pest in the Federation, the sweet potato weevil, (*Cylas formicarius*; *Coleoptera*: *Apionidae*). Technologies such as sex pheromones and selective insecticides show potential to reduce the losses in yield due to this pest. There is a growing interest in value added product development from sweet potato. A recent CARDI sweet potato field day gave processors, from both St Kitts and Nevis, the opportunity to display value added products which included flour, chips, fries, breads, cakes, puddings, and ice cream. Enterprising processors are exploring new markets for their products which they endeavour to sell as health foods.

SWEET POTATO VARIETY: AVRDC

Physical features of the sweet potato root
Shape: Long elliptic
Skin colour: Red / brown
Flesh colour: Cream

Physico-chemical properties of fresh root

PROPERTIES	LEVELS
Moisture (%)	63.1
Protein (%)	0.56
Fat (%)	0.15
Ash (%)	0.85
Carbohydrate (%)	35.3
Total Sugar (%)	2.10
Fibre (%)	0.49
Starch (%)	32.7
Vitamin C (mg/100g)	0.77

Physico-chemical properties of flour

PROPERTIES	LEVELS
Moisture (%)	5.21
Protein (%)	1.52
Fat (%)	0.40
Ash (%)	2.31
Carbohydrate (%)	90.6
Total Sugar (%)	5.69
Fibre (%)	1.17
Starch (%)	83.5
Vitamin C (mg/100g)	2.10

Product Recommendation
Primary processing: Flour
Secondary processing: Bread

SWEET POTATO VARIETY: BLACK VINE

Physical features of the sweet potato root
Shape: Long
Skin Colour: Red
Flesh Colour: Light orange

Physico-chemical properties of fresh root

PROPERTIES	LEVELS
Moisture (%)	70.8
Protein (%)	0.56
Fat (%)	0.25
Ash (%)	1.04
Carbohydrate (%)	27.4
Total Sugar (%)	1.37
Fibre (%)	0.42
Starch (%)	25.6
Vitamin C (mg/100g)	1.63

Physico-chemical properties of flour

PROPERTIES	LEVELS
Moisture (%)	5.56
Protein (%)	1.92
Fat (%)	0.84
Ash (%)	3.56
Carbohydrate (%)	88.1
Total Sugar (%)	4.72
Fibre (%)	1.09
Starch (%)	82.3
Vitamin C (mg/100g)	5.60

Product Recommendation
Primary processing: Flour, Fries
Secondary processing: Bread, Cake, Cookies

SWEET POTATO VARIETY: VIOLA

Physical features of the sweet potato root
Shape: Elliptic
Skin Colour: Burgundy
Flesh Colour: White

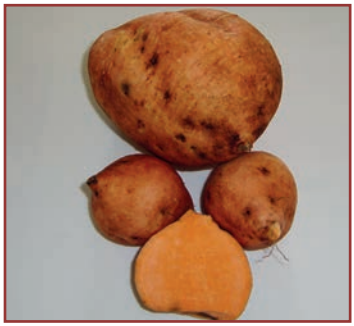
Physico-chemical properties of fresh root

PROPERTIES	LEVELS
Moisture (%)	61.7
Protein (%)	0.79
Fat (%)	0.16
Ash (%)	1
Carbohydrate (%)	36.4
Total Sugar (%)	0.99
Fibre (%)	0.25
Starch (%)	35.2
Vitamin C (mg/100g)	1.23

Physico-chemical properties of flour

PROPERTIES	LEVELS
Moisture (%)	4.87
Protein (%)	2.05
Fat (%)	0.41
Ash (%)	2.60
Carbohydrate (%)	90.1
Total Sugar (%)	2.59
Fibre (%)	1.28
Starch (%)	86.8
Vitamin C (mg/100g)	3.20

Product Recommendation
Primary processing: Crisps, Fries
Secondary processing: None



SWEET POTATO VARIETY: CLARKE

Physical features of the sweet potato root
Shape: Elliptic
Skin Colour: Brown
Flesh Colour: Bright orange

Physico-chemical properties of fresh root

PROPERTIES	LEVELS
Moisture (%)	69.4
Protein (%)	0.65
Fat (%)	0.15
Ash (%)	0.90
Carbohydrate (%)	28.9
Total Sugar (%)	2.05
Fibre (%)	0.26
Starch (%)	26.6
Vitamin C (mg/100g)	2.54

Physico-chemical properties of flour

PROPERTIES	LEVELS
Moisture (%)	3.89
Protein (%)	2.13
Fat (%)	0.49
Ash (%)	2.95
Carbohydrate (%)	90.5
Total Sugar (%)	6.68
Fibre (%)	1.68
Starch (%)	82.2
Vitamin C (mg/100g)	8.30

Product Recommendation
Primary processing: Fries
Secondary processing: None

CASSAVA

Similar to the rest of the Region, in St Kitts and Nevis cassava is produced mainly by small farmers. Currently, most of the production is used for processing. Nevertheless, with the changing population dynamics there is an increased interest in the consumption of fresh sweet cassava. In a study conducted by IICA and CARDI (2013), that sought to review the status of the processing of root and tuber processing in the Caribbean, St. Kitts and Nevis had the widest range of processed products. Cassava bread and cassava meal were the two most popular products followed by cassava biscuits and flour. Products such as chips, fries, wedges, starch and wafers were also produced but in smaller quantities. The wide variety of processed products manufactured in this country shows its potential to further develop the cassava value chain.

CASSAVA VARIETY: CM 3306-4

Physical features of the cassava tuber
Shape: Cylindrical
Skin Colour: Brown
Flesh Colour: Cream

Physico-chemical properties of fresh tuber

PROPERTIES	LEVELS
Moisture (%)	56.4
Protein (%)	0.62
Fat (%)	0.34
Ash (%)	0.97
Carbohydrate (%)	41.6
Total Sugar (%)	1.05
Fibre (%)	0.30
Starch (%)	40.3
Vitamin C (mg/100g)	4.27

Physico-chemical properties of flour

PROPERTIES	LEVELS
Moisture (%)	4.98
Protein (%)	1.36
Fat (%)	0.79
Ash (%)	2.11
Carbohydrate (%)	90.7
Total Sugar (%)	2.41
Fibre (%)	1.68
Starch (%)	86.7
Vitamin C (mg/100g)	9.80

Product Recommendation
Primary processing: Crisps, Fries
Secondary processing: None

CASSAVA VARIETY: GUYANA SWEET

Physical features of the cassava tuber
Shape: Cylindrical
Skin Colour: Light brown
Flesh Colour: Cream

Physico-chemical properties of fresh tuber

PROPERTIES	LEVELS
Moisture %	76.5
Protein %	0.34
Fat %	0.23
Ash %	0.19
Carbohydrate %	22.8
Total Sugar %	0.73
Fiber %	0.32
Starch %	21.7
Vitamin C (mg/100g)	1.92

Physico-chemical properties of flour

PROPERTIES	LEVELS
Moisture %	4.79
Protein %	1.36
Fat %	0.96
Ash %	0.77
Carbohydrate %	92.1
Total Sugar %	3.14
Fibre %	1.36
Starch %	87.6
Vitamin C (mg/100g)	8.18

Product Recommendation
Primary processing: None
Secondary processing: None

CASSAVA VARIETY: CM GREEN STEM

Physical features of the cassava tuber
Shape: Cylindrical
Skin Colour: Light brown
Flesh Colour: Cream

Physico-chemical properties of fresh tuber

PROPERTIES	LEVELS
Moisture %	71.8
Protein %	0.35
Fat %	0.32
Ash %	0.33
Carbohydrate %	27.3
Total Sugar %	1.32
Fibre %	0.23
Starch %	25.8
Vitamin C (mg/100g)	0.96

Physico-chemical properties of flour

PROPERTIES	LEVELS
Moisture %	5.12
Protein %	1.18
Fat %	1.12
Ash %	1.10
Carbohydrate %	91.5
Total Sugar %	7.66
Fibre %	1.81
Starch %	82.0
Vitamin C (mg/100g)	3.42

Product Recommendation
Primary processing: None
Secondary processing: None

TRINIDAD AND TOBAGO

SWEET POTATO

Sweet potato is very popular in Trinidad and Tobago and is consumed in almost all households. It is mostly eaten boiled, in soups. It is also used in bread, pies, pone and chips. Production in 2012 was 1,296 tonnes (FAO STAT); additional quantities are also imported from other Caribbean territories, mainly St Vincent and the Grenadines. Over the last five years, there has been an increase in value addition initiatives. Sweet potato fries are now available in fast food restaurants as a substitute for white potato fries. There are over 50 varieties of sweet potato in the germplasm collection at the Ministry of Food Production, Research Division, Centeno, however, only a few are utilised in the production system of the country. Over the past five years, CARDI and the Ministry of Food Production have made significant interventions to strengthen production and processing operations.

SWEET POTATO VARIETY: TIS 9191

Physical features of the sweet potato root
Shape: Obovate
Skin Colour: White
Flesh Colour: Cream

Physico-chemical properties of fresh tuber

PROPERTIES	LEVELS
Moisture %	66.0
Protein %	0.73
Fat %	0.07
Ash %	0.93
Carbohydrate %	28.4
Total Sugar %	1.62
Fibre %	0.81
Starch %	29.9
Vitamin C (mg/100g)	0.39

Physico-chemical properties of flour

PROPERTIES	LEVELS
Moisture %	3.75
Protein %	2.35
Fat %	0.25
Ash %	3.31
Carbohydrate %	90.3
Total Sugar %	3.16
Fibre %	2.24
Starch %	84.9
Vitamin C (mg/100g)	0.87

Product Recommendation
Primary processing: Flour
Secondary processing: Bread, Cake, Cookies

SWEET POTATO VARIETY: CARROT

Physical features of the sweet potato root

Shape: Round elliptical
Skin Colour: Brownish orange
Flesh Colour: Intermediate orange

Physico-chemical properties of fresh tuber

PROPERTIES	LEVELS
Moisture %	70.5
Protein %	0.49
Fat %	0.10
Ash %	0.97
Carbohydrate %	24.9
Total Sugar %	1.41
Fibre %	1.01
Starch %	23.5
Vitamin C (mg/100g)	0.12

Physico-chemical properties of flour

PROPERTIES	LEVELS
Moisture %	5.27
Protein %	4.34
Fat %	0.15
Ash %	5.00
Carbohydrate %	85.3
Total Sugar %	5.44
Fibre %	3.07
Starch %	76.7
Vitamin C (mg/100g)	2.70

Product Recommendation
Primary processing: Fries
Secondary processing: None

SWEET POTATO VARIETY: O49

Physical features of the sweet potato root
Shape: Elliptic
Skin Colour: Pink
Flesh Colour: Cream

Physico-chemical properties of fresh tuber

PROPERTIES	LEVELS
Moisture %	53.7
Protein %	0.47
Fat %	0.08
Ash %	1.17
Carbohydrate %	42.6
Total Sugar %	2.58
Fibre %	1.07
Starch %	41.0
Vitamin C (mg/100g)	0.50

Physico-chemical properties of flour

PROPERTIES	LEVELS
Moisture %	3.43
Protein %	3.49
Fat %	0.20
Ash %	6.89
Carbohydrate %	86.0
Total Sugar %	4.96
Fibre %	2.06
Starch %	79.0
Vitamin C (mg/100g)	0.73

Product Recommendation
Primary processing: Flour
Secondary processing: Extruded snacks

SWEET POTATO VARIETY: NINA

Physical features of the sweet potato root
Shape: Round elliptical
Skin Colour: Brownish orange
Flesh Colour: Dark yellow

Physico-chemical properties of fresh tuber

PROPERTIES	LEVELS
Moisture %	61.8
Protein %	1.09
Fat %	0.18
Ash %	0.8
Carbohydrate %	33.4
Total Sugar %	1.77
Fibre %	0.79
Starch %	33.5
Vitamin C (mg/100g)	0.33

Physico-chemical properties of flour

PROPERTIES	LEVELS
Moisture %	4.02
Protein %	2.39
Fat %	0.48
Ash %	3.06
Carbohydrate %	90.1
Total Sugar %	3.50
Fibre %	1.98
Starch %	84.6
Vitamin C (mg/100g)	1

Product Recommendation
Primary processing: Flour
Secondary processing: Bread, Cakes, Cookies

SWEET POTATO VARIETY: CHICKEN FOOT

Physical features of the sweet potato root
Shape: Round elliptical
Skin Colour: Purple red
Flesh Colour: Dark yellow

Physico-chemical properties of fresh tuber

PROPERTIES	LEVELS
Moisture %	53.4
Protein %	0.12
Fat %	0.27
Ash %	2.74
Carbohydrate %	40.2
Total sugar %	2.15
Fibre %	1.56
Starch %	39.7
Vitamin C (mg/100g)	0.70

Physico-chemical properties of flour

PROPERTIES	LEVELS
Moisture %	3.73
Protein %	2.75
Fat %	0.60
Ash %	3.72
Carbohydrate %	89.2
Total Sugar %	1.36
Fibre %	3.25
Starch %	84.6
Vitamin C (mg/100g)	0.98

Product Recommendation
Primary processing: Flour
Secondary processing: Bread, Cakes, Extruded snacks

CASSAVA

According to data provided by FAOSTAT, the annual production of cassava in Trinidad and Tobago has fluctuated greatly over the years with the average for the last five years being 1,500 tonnes per annum. Sweet cassava is the main type produced and is mostly eaten boiled. Traditionally, in Tobago both bitter and sweet cassavas are processed into farine. Small quantities of cassava bread are also made. Recently, there has been a thrust to produce more value added products from cassava, and on the market there are now a wide range of minimally processed products such as frozen fries, logs and chunks. Grated cassava is also being added to wheat flour to produce healthier bread. The Trinidad and Tobago Agri-Business Association (TTABA) is working along with several bakeries in the country in this venture. CARDI and the Ministry of Food Production have made strategic interventions along the value chain to assist both producers and processors on both islands to improve the efficiency and profitability of their operations.

CASSAVA VARIETY : BUTTERSTICK

Physical features of the cassava tuber

Shape: Cylindrical

Skin Colour: Light brown

Flesh Colour: Cream

Physico-chemical properties of fresh tuber

PROPERTIES	LEVELS
Moisture %	61.8
Protein %	1.09
Fat %	0.18
Ash %	0.80
Carbohydrate %	33.4
Total Sugar %	1.77
Fibre %	0.25
Starch %	31.4
Vitamin C (mg/100g)	0.33

Physico-chemical properties of flour

PROPERTIES	LEVELS
Moisture %	7.01
Protein %	2.85
Fat %	0.47
Ash %	2.10
Carbohydrate %	87.6
Total Sugar %	4.62
Fibre %	1.6
Starch %	81.3
Vitamin C (mg/100g)	0.87

Product Recommendation

Primary processing: Chips, Flour, Fries

Secondary processing: Bread, Cake, Cookies

CASSAVA VARIETY: MARACAS BLACK STICK

Physical features of the cassava tuber

Shape: Cylindrical

Skin Colour: Light brown

Flesh Colour: Cream

Physico-chemical properties of fresh tuber

PROPERTIES	LEVELS
Moisture %	53.4
Protein %	0.12
Fat %	0.27
Ash %	2.74
Carbohydrate %	40.2
Total Sugar %	2.15
Fibre %	0.42
Starch %	37.6
Vitamin C (mg/100g)	0.70

Physico-chemical properties of flour

PROPERTIES	LEVELS
Moisture %	7.04
Protein %	0.26
Fat %	0.57
Ash %	5.89
Carbohydrate %	86.2
Total Sugar %	4.62
Fibre %	1.75
Starch %	77.5
Vitamin C (mg/100g)	1.51

Product Recommendation

Primary processing: Chips, Flour, Fries

Secondary processing: Bread, Cake, Cookies

CASSAVA VARIETY: MMEX 59

Physical features of the cassava tuber

Shape: Cylindrical

Skin Colour: Light brown

Flesh Colour: Cream

Physico-chemical properties of fresh tuber

PROPERTIES	LEVELS
Moisture %	66.0
Protein %	0.73
Fat %	0.07
Ash %	0.93
Carbohydrate %	28.4
Total Sugar %	1.62
Fibre %	0.40
Starch %	26.5
Vitamin C (mg/100g)	0.39

Physico-chemical properties of flour

PROPERTIES	LEVELS
Moisture %	8.45
Protein %	2.14
Fat %	0.20
Ash %	2.73
Carbohydrate %	86.5
Total Sugar %	4.77
Fibre %	1.73
Starch %	80.0
Vitamin C (mg/100g)	1.14

Product Recommendation

Primary processing: Flour

Secondary processing: Cake, Cookies, Extruded Snacks

CASSAVA VARIETY: CIAT HYBRID

Physical features of the cassava tuber
Shape: Cylindrical
Skin Colour: Light brown
Flesh Colour: Cream

Physico-chemical properties of fresh tuber

PROPERTIES	LEVELS
Moisture %	70.5
Protein %	0.49
Fat %	0.10
Ash %	0.97
Carbohydrate %	24.9
Total Sugar %	1.41
Fiber %	0.36
Starch %	23.2
Vitamin C (mg/100g)	0.12

Physico-chemical properties of flour

PROPERTIES	LEVELS
Moisture %	10.6
Protein %	1.24
Fat %	0.34
Ash %	3.28
Carbohydrate %	84.5
Total Sugar %	4.77
Fibre %	1.18
Starch %	78.5
Vitamin C (mg/100g)	0.42

Product Recommendation
Primary processing: None
Secondary processing: None

CASSAVA VARIETY: YUCA 4200

Physical features of the cassava tuber
Shape: Cylindrical
Skin Colour: Light brown
Flesh Colour: Cream

Physico-chemical properties of fresh tuber

PROPERTIES	LEVELS
Moisture %	53.7
Protein %	0.47
Fat %	0.08
Ash %	1.17
Carbohydrate %	42.6
Total Sugar %	2.58
Fibre %	0.39
Starch %	39.6
Vitamin C (mg/100g)	0.50

Physico-chemical properties of flour

PROPERTIES	LEVELS
Moisture %	4.36
Protein %	1.02
Fat %	0.18
Ash %	2.52
Carbohydrate %	91.9
Total Sugar %	5.57
Fibre %	1.53
Starch %	84.8
Vitamin C (mg/100g)	1.09

Product Recommendation
Primary processing: Chips, Fries
Secondary processing: None

Fries/Chips/Crisps

Country	Cassava	Sweet Potato
Barbados	-	-
Dominica	Bois Blanc (sweet cassava)	-
St. Kitts and Nevis	CM 3306-4	Black Vine, Clarke
Trinidad and Tobago	Butter Stick, Maracas Black Stick, Yuca 4200	Carrot

Flour - Bread/Cakes/Cookies

Country	Cassava	Sweet Potato
Barbados	-	C105, C32, Q
Dominica	Bois Blanc (sweet cassava)	La Planc*
St. Kitts and Nevis	CM 3306-4	AVRDC
Trinidad and Tobago	Butter Stick, Maracas Black Stock, Yuca 4200	Chicken Foot*, Nina*

*Recommended prime choices.

THE WAY FORWARD:

Advancing the Development of Cassava and Sweet Potato Value-added Products in the Caribbean Region

Many countries in the developed world have exploited the potential of cassava and sweet potato not only for food, but also for feed and fuel. These achievements have been attained in part, through: (i) investments in product development, (ii) the use of efficient technologies, and (iii) extensive marketing and promotion of value added products. As a result of these interventions, these countries have been able to diversify the range of food products made from sweet potato and cassava and are retailing value added products of these commodities in mainstream and niche markets. For example, in Japan where the sweet potato processing industry is well developed, there is a range of primary and secondary processed products available on the market and in some cases, these are retailed in specialty sweet potato stores. Primary products include frozen cuts, fries/crisps, flour, starch, juices. Secondary products include noodles, jams and jellies, sauces, wines, salad dressing, thickeners, ice cream and alcohol. Similarly for cassava, a wide range of value added products, and a well-developed market has been established in several countries in Latin America, products include: minimally processed forms, such as flour, starch and secondary products which include snack foods, cakes and cookies.

Research and development efforts are being made by a number of national and regional institutions to develop value added products. These include: the Barbados Agricultural Development and Marketing Corporation (Barbados), Northern Caribbean University (Jamaica), Scientific Research Council (Jamaica), the Trinidad and Tobago Agri-Business Association (Trinidad and Tobago), the University of the West Indies.

Moving forward, it will be imperative that these and other institutions continue their efforts in product development and diversification of the current range of value added products available on the market. In addition, it will be necessary to identify appropriate machinery for small and medium sized operations, facilitate and monitor the adoption of international food safety standards, packaging and labelling as well as marketing and promotion of these products. Such interventions will be necessary to strengthen and sustain the value chain for these commodities and assist the Governments of CARICOM Member States to realise the established food and nutrition security goals.

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