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Food Security Project

Improving the Nutrition and Health of CARICOM populations

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ANNEX 4

Final Technical Report (2011 – 2014)

School Feeding in St Kitts and Nevis and Trinidad and Tobago

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THEMATIC AREA: **Community Nutrition and Health**

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CONTENTS

OVERALL PROJECT OBJECTIVES ADDRESSED

The thematic project objective addressed in this report is to **"**Improve nutrition and health outcomes of vulnerable segments (children and women) of the populations, through availability of foods that would increase intake of vegetables and fruits, decrease caloric intake and increase micronutrient intake." The more specific research objectives addressed are as follows:

1. To describe the baseline diet of children from a sample of primary schools in St. Kitts-Nevis and Trinidad and Tobago in order to understand current eating patterns, rates of anemia, and under-and over-nutrition (through anthropometric indices) in children from food secure and food insecure households.

2. To assess the progress in changing the food offerings in terms of food sources and nutritional value during the implementation of the project.

3. To measure differences in dietary intake (from lunch meal and full day) of children resulting from the changes in the school lunch menu and nutrition education interventions.

4. To measure changes in nutritional status indicators (underweight, overweight and anemia) resulting from the changes in the school lunch meal and the nutrition education interventions.

5. To measure changes in nutrition knowledge among children in Trinidad due to the introduction of nutrition education sessions to the children.

6. To map the food value chain associated with the supply of food to the school meal caterers in Trinidad, with emphasis on the supply of food from local farmers.

7. To analyse the supply and demand conditions in the markets studied in Trinidad.

SUMMARY

Interventions in school lunch programmes in St Kitts-Nevis and Trinidad and Tobago led to important changes in the procurement of fresh produce from local farmers, and enhanced availability of fruits and vegetables offered to children in 8 primary schools. As a consequence of these changes, the children consumed more fruits and vegetables during the daily school lunch meals, thereby improving the nutritional quality of their dietary intake. The project interventions proved to be feasible and sustainable in providing new market opportunities for small-holder farmers in St. Kitts, while offering children healthy choices of local produce. Despite increases in vegetable and fruit consumption by school children over a 15 month period, the prevalence of child hood obesity was not reduced. Factors such as the duration of the study, and children's access to sugary and high-fat snacks sold within the school and the surrounding environment, may explain the lack of an impact of vegetable and fruit consumption on overweight and obesity. Irrespective of the nutrition intervention, 6 % of the children studied became overweight or obese between the baseline and endpoint periods of the study. In the long run,

improvements in fruit and vegetable intake, along with enhanced nutrition education of the population and changes in the snack food policy for schools, could be expected to reverse the growing prevalence of childhood obesity in the Caribbean.

RESEARCH PROBLEM AND CONTEXT

Relatively low consumption of vegetables and fruits, as well as high levels of import and consumption of energy-dense obesogenic foods, are contributing to the rising prevalence of adult and childhood obesity (3) among populations of the Caribbean Community (CARICOM). The prevalence of obesity in CARICOM countries (3) is higher among females than males (1, 4-6), and obesity is a major risk factor in chronic non-communicable diseases in the Americas (Hospedales et al 2011), placing a significant burden on national health systems of CARICOM countries(1).

In dealing with prevention of chronic non-communicable diseases (NCDs), it is now known that once a child is overweight, it becomes difficult to reverse the trend; hence, early interventions (2) to encourage healthy eating among children represent a sound approach to address the public health problems of obesity and NCDs in CARICOM.

The nutritional status of children in the Caribbean has not been well studied and there remains the question as to whether overweight and obesity co-exist with the problem of under-nutrition, contributing to the recently characterized “double-burden of malnutrition”.

In St Kitts-Nevis, a country in the Eastern Caribbean, there is a universally-free school lunch programme, funded by the Government’s Ministry of Education and Information and, centrally operated by the School Meals Center (SMC); the SMC offers a hot meal each day to approximately 3200 primary schoolchildren and 92% of the children interviewed report consuming the school lunch meal daily. In Trinidad and Tobago, the Government’s Ministry of Education funds a national school nutrition programme (SNP) under a semi-private model, whereby the National Schools Dietary Services Limited (NSDSL) manages a system with 75 private caterers preparing and delivering free hot meals daily to over 100,000 underprivileged children. In both countries, imported food is utilized widely in the school meals programs (SMP) and sugar drinks are offered on most days; fruits and vegetables are offered rarely or offered in small quantities.

The project was under taken with the aims of: a) utilizing the SMPs in St. Kitts and Trinidad as vehicles to improve the intake of vegetables and fruits by children in primary schools, as a means of reducing the prevalence of childhood obesity; b) evaluating, through emphasis on local produce procurement for school feeding (a “farm to fork” approach), the potential for SMPs to serve as new markets for local vegetable and fruits farmers, while increasing and improving the dietary quality and diversity school lunch meals.

METHODOLOGY

School Feeding Interventions

The studies were conducted following research ethics approval from McGill University, University of West Indies, St. Augustine Campus, and from appropriate local authorities in St. Kitts and Nevis and Trinidad and Tobago. In Trinidad, the school feeding study was undertaken from October 2012 to April 2014, and in St. Kitts, from January 2013 to June 2014, approximately 18 months in each country.

Before the nutrition interventions could be implemented at the SMC in St. Kitts, significant improvements in the physical facilities, standards of food service and personnel training had to be undertaken. The project provided the SMC with new kitchen equipment (including coolers to store farm produce, a braising table for preparing vegetables, and new commercial sinks), and supported alterations in the physical facilities to enhance good manufacturing practices and food safety. The project also secured the professional services of staff from the National Schools Dietary Services Limited (NSDSL) in Trinidad to provide skills training in quantity food service and food safety for staff at the SMC. Such efforts in the area of human and institutional capacity building at the SMC in St. Kitts ensured that the project interventions could proceed as planned.

Primary schools (7 in St. Kitts and 8 in Trinidad) were randomly assigned to nutrition interventions or control groups for the period of the intervention. In St. Kitts, the nutrition intervention consisted of a change in the school lunch menu (menu change), whereas in Trinidad the nutrition intervention consisted of a combination of menu change and nutrition education in a 2X2 factorial arrangement of treatment; the nutrition education intervention was delivered to the children in the study, as well as their caregivers. The menu change intervention was designed to improve the school lunch meals in both St. Kitts and Trinidad; there was no change in lunch menus in the control schools.

In St. Kitts, the 7 schools were randomly allocated to treatment (menu change) or control such that there were 4 “intervention schools” and 3 “control schools” (Table 1). In collaboration with professionals and study investigators in the Ministry of Health and Social Services in St. Kitts and Nevis, a professional dietitian at the University of West Indies in Trinidad and Tobago developed a new 10-day experimental menu for the intervention schools in St. Kitts. Table 2 provides a comparison of the old and new 10-day menus implemented in St. Kitts; local fruits and vegetables were added to the new menu, which also included a fish sandwich and greater variety in meat items. The control schools continued with their normal menu which contained virtually no fruits or vegetables.

Table 1: List of schools in St. Kitts (control and intervention) participating in the school feeding study

Intervention (menu change) or Control	Study Site	School Name	School population	Number of children on whom measurements were made
Menu change	Stapleton	Beach Allen	406	50
Menu change	Tabernacle	Edgar T. Morris	53	8
Menu change	Saddlers	Saddlers Primary	319	15
Menu change	St. Paul's	St. Paul's Primary	177	29
Control	Stapleton	Dean-Glasford (St. Peter's)	156	24
Control	Canyon	Canyon Primary	249	46
Control	Mansion	Joshua Obadiah Williams	111	16

Table 2: Lunch menus implemented in intervention (menu change) and control schools in St. Kitts based on 10 days of observations

Day	Control	Intervention (menu change)
1	Spaghetti with corned beef Sugar sweetened drink	Oven baked chicken in light gravy Seasoned baked sweet potato Sautéed string beans and carrots Sugar sweetened drink
2	Stewed turkey wings in tomato sauce Rice and pink beans Sugar sweetened drink	Stewed turkey wings in tomato sauce Rice and pink beans Watermelon slices Sugar sweetened drink
3	Stewed turkey wings and lentils Rice Sugar sweetened drink	Spaghetti with stewed turkey wings (in a chunky tomato sauce with cubed pumpkin and string beans) Sugar sweetened drink
4	Hot dogs with bread (ketchup and onions as condiments) Sugar sweetened drink	Hot dog (in Creole Sauce) with bread Sugar sweetened drink
5	"Cook up" (lentils, chicken, rice, onions and seasoning) Sugar sweetened drink	Stewed chicken Stewed pink beans in tomato sauce with cubed pumpkin Rice Sliced Tomato Sugar sweetened drink
6	Spaghetti with stewed chicken Sugar sweetened drink	Baked chicken in light gravy Seasoned mashed sweet potato Sautéed cubed pumpkin & string beans Sugar sweetened drink
7	Rice and beans in tomato sauce Sugar sweetened drink	Baked fish sandwich Hot slaw (seasoned carrot & cabbage) Sugar sweetened drink
8	Split pea soup (sweet potato, potato, pumpkin and dumplings) Sugar sweetened drink	Split pea soup (sweet potato, potato, pumpkin and dumplings) Sugar sweetened drink

Day	Control	Intervention (menu change)
9	Grilled cheese sandwiches Sugar sweetened drink	Hamburger (in a creole sauce) Hamburger bun Cucumber slices Watermelon slices Sugar sweetened drink
10	"Cook up" (lentils, chicken, rice, onions and seasoning) Sugar sweetened drink	Stewed turkey wings Stewed pink beans in tomato sauce with cubed carrots Rice Sugar sweetened drink

The list of schools participating in the study in Trinidad is shown in Table 3. The schools were stratified by the number of students in the school (small, medium and large) and randomized to one of the 4 treatment combinations (menu change alone; menu change plus and nutrition education; nutrition education alone; control-no intervention). Table 4 shows the control and intervention menus for the 10-day period.

Nutrition education of the children was provided in the classroom setting of the schools, while nutrition education of parents was undertaken in the schools, after school hours. Five nutrition education modules were developed and four of these were provided to the schools targeted for nutrition education intervention. One of the four nutrition education modules dealt with agricultural production. This module was delivered only in one school (Guiaco Government) due to challenges encountered in the availability of a trained agricultural specialist for the other school. Attendance of children at the nutrition education sessions ranged from 59% to 91%, depending on the module offered. Nutrition education sessions for parents involved a session on nutrition and food buying and preparation tips. These sessions were offered in schools targeted for the nutrition education intervention, and a total of 134 different caregivers attended the sessions.

Table 3: List of schools (control and intervention) in Trinidad participating in the school feeding study

Intervention (menu change/ nutrition education) or Control	Study site	School Name	School population	Number of children on whom measurements were made
Menu change + Nutrition education	Sangre Grande	Guaico Government	266	53
Menu change + Nutrition education	San Juan-Laventille	St. Joseph Government	315	48
Menu change only	Sangre Grande	Valencia Government	515	33
Menu change only	San Juan-Laventille	Aranguez Government	200	47
Nutrition education only	Sangre Grande	Valencia South Government	493	26
Nutrition education only	San Juan-Laventille	Febeau Government	310	28
Control	Sangre Grande	Sangre Grande Government	519	40
Control	San Juan-Laventille	El Socorro Central Government	115	28

Table 4: Lunch menus implemented in Intervention (menu change) and control schools in Trinidad over a 10 day period.

Day	Control	Intervention menu (menu change)
1	Braised chicken Pumpkin rice Hot cassava salad with bodi and corn	Braised chicken Pumpkin rice Hot cassava salad with bodi and corn/ Vegetable combo Fruit
2	Regular white crust vegetable pizza Juice drink or Corn soup	Whole-wheat vegetable Pizza Fruit Juice or Soup
3	Chicken patty in hamburger bun Cucumber relish Drink	Fish sub with Hot slaw Fruit Juice
4	Stewed lentils with pumpkin Herbed rice Cheesy elbows with sweet peppers and carrots	Stewed Lentils with pumpkin Herbed rice Sliced plantain Vegetable combo Fruit juice
5	Stewed chicken Pigeon peas & rice pelau with pumpkin Vegetable chow	Stewed chicken Pigeon peas & rice pelau with pumpkin Hot slaw Fruit
6	Chicken teriyaki or fish nuggets Fried rice with celery Vegetable chow	Chicken teriyaki Fried rice with celery Vegetable lo mein Fruit juice
7	Pink beans with tomatoes and sweet peppers, Pumpkin rice Macaroni pie	Pink beans with tomatoes and sweet peppers Pumpkin rice Hot slaw Fruit juice
8	Oven-fried chicken with Chili sauce Mexican rice	Baked chicken with chili sauce Mexican rice Vegetable combo Fruit

Day	Control	Intervention menu (menu change)
9	Curried channa with potato Paratha roti Pumpkin or bodi Mango amchar	Curried channa and potato Bighan tamatar or pumpkin or bodi Mango amchar Fruit juice
10	Roasted chicken with BBQ sauce Spanish rice Vegetable combo	Fish with BBQ sauce Spanish rice Vegetable combo Fruit

Community Nutrition and Health Survey

In order to assess the impact of the nutrition interventions in the school feeding studies in St. Kitts and Trinidad, *baseline* and *end point* data (on health, nutrition, and socio-economic status) were collected using a *community health and nutrition household survey* (CHS) of the children (5-12y) in the participating schools in St. Kitts and Trinidad, and of the households of children in the participating schools in both countries. The baseline CHS was implemented in Trinidad in January/ February 2012, and in St. Kitts in June/July 2012. The same families were re-interviewed during endpoint CHS which took place in October/November 2013 in Trinidad, and in February/March 2014 in St Kitts. Local teams were recruited to conduct the interviews and obtain anthropometric and other measurements from children and their caregivers.

An 18-module CHS questionnaire, with 170 questions, was administered by local interviewers to the caregivers of the children. The measurement tools included standard measures. Household composition, income and other demographic data were collected from the caregivers using the administered questionnaire. At baseline, household food security was measured using the USDA short 6-item questionnaire but at end point, we utilized the more comprehensive 18-item USDA questionnaire to measure child as well as household food security.

The CHS questionnaire included a 24-hour recall interview which was conducted with the caregiver and child together in order to determine the dietary intake of the children. Food portion models were used to accurately reflect food quantities. The 24-hour dietary recall interview for each child was conducted at both baseline and end point; from these data we calculated intake of fruits, vegetables and nutrients. The change in diet over time was not assessed given the day-to-day variability in children's diet and the fact that we only measured 1 day's intake which does not give a precise portrait of a child's usual intake. Data on a group of children with 1 day intakes is however more reliable. Children's height and weight were recorded and the percentage of children changing weight status over time was examined as weight for height is a measure that does not have day to day fluctuation. Hemoglobin, obtained by finger prick method from a capillary blood sample from children, was measured by photometry (STAT-Site® M^{Hgb} Hemoglobin Photometer, Stanbio Laboratory, Texas, USA). A hemoglobin level <11.5 g/dL was used to

assess the prevalence of anemia at baseline and end point. Caregivers' height, weight and waist circumference were also measured.

At baseline, interviews were conducted with 503 caregivers and measurements were taken on 643 children from 7 schools in St. Kitts and 8 schools in Trinidad. However, the matched sample, where paired data are available for both children and their caregivers was 483 for both countries; 295 for Trinidad and 188 for St. Kitts.

Monitoring of food service

Several strategies were used to monitor the interventions over time. In St Kitts, three parameters of food service were evaluated at the School Meal Centre; *compliance* with the new menu; the *nutritive value* of the school meals offered for treatment and control schools; and the *lunch meal cost* due to the project's nutrition interventions. This process evaluation of the food served in St. Kitts was undertaken at two time periods in 2013 (May 2013, October 2013) for a duration of two weeks. During these two evaluation periods, we recorded and itemized all food purchased for both treatment and control schools. In each period the compliance with planned menus was measured in terms of the proportion of the calculated menu needs for fruits and vegetables, the nutritional value of the meals, and the cost of the meals. In Trinidad, compliance with the planned menus was monitored over three school terms, January – March, 2013; April – July, 2013; and September – December, 2013 and the change over these three time periods analysed.

Chemical analyses of foods

A chemical analysis of four different meals was completed at the Caribbean Industrial Research Institute (CARIRI) to establish whether the menus met established guidelines for nutrient content of 1/3 of the Recommended Dietary Allowance; data for both control and intervention meals were evaluated.

Procurement of Fruit and Vegetables by School Meal Centre in St. Kitts

Weekly data on the weight of the fruits and vegetables foods from local farmers was monitored to measure the increase in produce procured by the SMC from local small holder farmers for use in the school lunch meals.

Dietary intake analysis and nutritional status among children surveyed

Outcome measures to test the impact of the interventions in both countries were based on "total day" (24h) dietary intake by all children in a particular school, as well as for those children eating the school lunch meal on the day of the "dietary recall interview". In both countries, we also recorded what was eaten by the children as the school lunch meal on the day of the dietary recall interview. CANDAT Nutrient Analysis Software (Godin London Incorporated, London, ON), which provides a nutrient analysis based on the Canadian Nutrition Files (CNF) release 2010, was used to analyze the nutrient

content of the food and form food group servings. Recipes for Caribbean foods were added to the database. Foods were grouped based on the Caribbean Food Groups (staples, legumes and nuts, foods from animals, fruits, and vegetables). Intake was compared across schools at the end of the intervention in both countries. In St Kitts, this comprised 167 children at endpoint, divided into a treatment (new menu) and control groups. In Trinidad, the analysis of 241 children isolated the differences between menu change, education, and both treatments compared to controls.

Overweight and obesity (using weight for height for age) as well as blood hemoglobin levels of children were used as outcome variables. In Trinidad, a pre/post-test questionnaire was used to evaluate nutrition knowledge to assess the impact of the nutrition education intervention.

Food acceptance by children

In both Trinidad and St. Kitts, the acceptability by children of the fruits and vegetables offered in the lunch meal was measured by questioning a sample of 10-12 children each day of lunch offering at school. The children were questioned by trained "lunch monitors", who also examined children's plates (or bowls) for the portions of the food served that was not eaten. The data from these food acceptance questionnaires was analysed to obtain estimates of acceptance of food items. Estimates of food acceptance were based on qualitative assessment of plate waste with categories of <25%, 25-50%, 50-75% and >75% consumed. The midpoint value of each category was used to derive a mean food acceptance score for each food item in order to measure change over time.

Mapping the value chain in Trinidad and Tobago

In Trinidad we mapped the "food value chain" to assess the supply of food to the caterers with emphasis on local food from farmers. This study was undertaken during the months of July to September, 2013 with a survey of 37 caterers from the School Meals Programme and 100 farmers in north east Trinidad.

The food value chain analysis was based on supply and demand conditions, and its purpose was to identify areas where greater linkages in food procurement could be made between local small holder farmers and the private caterers providing service for the school lunch programme in Trinidad. The utility of this food value chain map would be to identify "opportunity gaps" in the supply chain to facilitate adoption of a "farm to fork" approach to school feeding, with emphasis on locally-sourced produce.

On the demand side of the food value chain, we investigated factors affecting household expenditure patterns with regards to the food groups in the Caribbean Food Guide. On the supply side, we undertook a linear programming analysis to determine whether the private caterers providing service for Trinidad's School Meals Programme could utilize greater quantities of locally farmed produce, within the budgetary constraints of the National School Dietary Services Limited in Trinidad.

RESULTS AND FINDINGS

We present results organized according to the 7 main research objectives outlined above.

1. Description of baseline diet and nutritional indices of children from food secure and food insecure households.

At baseline, the mean age of the children studied was 7.48 ± 1.03 y (Table 7). The majority of the children were of Afro-Caribbean descent and the sexes were equally represented. The caregivers of the children were predominantly female (94%), and 60% of these women were unmarried. A high proportion of the children live in households deemed food insecure.

The baseline level of childhood food insecurity (Table 5) was 54% in St Kitts and 42% in Trinidad, indicating that the study sample included a nutritionally vulnerable population of children. The prevalence of food insecurity was greater among unmarried female caregivers than married female caregivers (53% vs. 38%, p <0.002). In addition, food insecurity was more prevalent than food security among households in the lowest income quartile (59.2% vs. 40.8%, p<0.0001) (income data were available only in Trinidad).

By utilizing the USDA long form questionnaire for the end point interviews, we were able to obtain data on child hunger as well as household food security. Based on the use of this detailed survey instrument for this study sample, we were able to identify a level of childhood food insecurity of 20% among households in St. Kitts and 30% among households in Trinidad. The overall prevalence of severe household food insecurity was 12% for the two countries.

Table 5: Household and childhood food security at baseline and end point.

Country	BASELINE	END POINT			
	Food insecure households, Total	**Food insecure households, Total**	**Moderately food insecure households**	**Severely food insecure households**	**Food Insecure children**
St Kitts, *n (%)*	91 (54.2)	71 (42.3)	52 (31.0)	19 (11.3)	33 (19.6)
Trinidad, *n (%)*	96 (42.3)	120 (52.2)	92 (40.0)	28 (12.2)	69 (30.0)
Total	187 (47.3)	191 (48.0)	144 (36.2)	47 (11.8)	102 (25.5)

Examination of daily intake of nutrients (Table 6) indicates that mean calcium intake (662 mg ± 404 mg) was below the Recommended Dietary Allowances (RDA) recommendation of 1000 mg/d (ages 4-8)

to 1300 mg/d (ages 9-13) (7). Added sugar contributed 15% to total energy intake; this level is higher than the proposed recommendations set forth by WHO (<10%) and the American Heart Association (100 kcal/d for women and 150 kcal/d for men) (8, 9).

Children from food secure households consumed significantly more fat compared to children from food insecure households (Table 6). Children's protein intake in food secure and food insecure households contribute 14% and 13%, respectively, to total energy intake; this is within the RDI acceptable macronutrient distribution range (10-30%) for children ages 4-18 years old. Fat intake in food secure and food insecure households contributes 30% and 29%, respectively, to the total energy intake, which is within the RDI acceptable macronutrient distribution range (25-35%) for children ages 4-18 years old (10). If one calculates protein intake in g/kg, one observes that protein intakes are on average well above the nutritional needs of both children living in food insecure and food secure households. There were no differences in measures of under-nutrition or overweight in children from food secure vs. insecure households. The baseline anthropometry indicated that 1% of children were stunted, 4.4 % underweight for height and 23% overweight or obese, with a tendency for more children from food secure households to be overweight or obese: 26% vs 20% ($p=0.07$). The caregivers, predominantly women, were overweight (32%) or obese (41%) putting them at high risk for NCDs.

Table 6: Nutrient intake by food security status at baseline in children aged 5-10 years in St Kitts and Trinidad.

Food/Nutrient	Food Secure (n= 256)	Food Insecure (n= 217)	Total (n= 473[1])	P
Energy, kilocalories	1977 ± 793	1869 ± 652	1927 ± 733	0.11
Carbohydrate, *g*	284 ± 126	276± 107	281 ± 118	0.45
Percent energy as carbohydrate, *%*	57.6 ± 11.3	59.3 ± 12.2	58.4 ±11.7	0.12
Protein, *g*	67.3 ± 33.2	61.46± 28.9	64.7 ± 31.4	0.05
Percent energy as protein, *%*	13.8 ± 4.63	13.3 ± 4.81	13.6 ± 4.71	0.26
Fat, *g*	65.9 ± 34.4	59.7 ± 30.8	63.1 ± 32.9	0.04
Percent energy as fat, *%*	29.8 ± 8.83	28.5 ± 9.54	29.2 ± 9.18	0.12
Added Sugar, *g*	72.5 ± 56.2	73.8 ± 51.8	73.1 ± 54.2	0.79
Calcium, *mg*	682 ± 436	638 ± 364	662 ± 404	0.24
Iron, *mg*	15.0 ± 11.8	14.2 ± 8.10	14.6 ± 10.3	0.39
Zinc, *mg*	8.11 ± 4.59	7.94 ± 4.86	8.03 ± 4.71	0.70
Vitamin A, *RAE*	847 ± 791	860 ± 1018	853 ± 901	0.88
Vitamin C, *mg*	180 ± 246	167± 163	174 ± 212	0.50
Vitamin D, *µg*	6.97 ± 7.17	7.09 ± 7.46	7.03 ± 7.30	0.86
Fiber, *g*	15.6 ± 11.1	13.8 ± 7.25	14.8 ± 9.58	0.04

[1] 10 participants were missing food security information.

Values in cells are means ± SD. P values are based on t-tests.

Foods were grouped based on Caribbean Food Groups; “milk products” group was a subcategory from “foods from animals”.

Serving sizes were calculated based on Canada's Food Guide.

These dietary and anthropometric data provide the most recent information in the Caribbean and indicate the problem of under-nutrition has given way to a growing problem of caloric over-nutrition, reflecting the “nutrition transition” in the Caribbean and a shift to obesogenic diets that are high in sugar and fat and low in fruits and vegetables. Interestingly, there is a large discrepancy in the literature in the findings dealing with the prevalence of childhood underweight depending on the international reference measure that is used. It is important to note that the WHO guidelines were used in the current study.

Figure 1 shows an absence of stunted children or those who are "too thin" according to WHO standards; however, 23% are overweight. Tables 7 and 8 provide additional anthropometric data on children and their caregivers by treatment group.

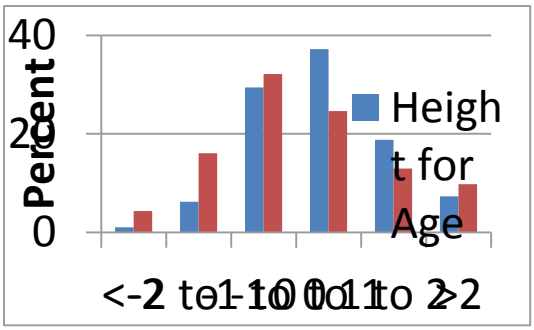


Figure 1: Height and BMI for age for 5-10 year old children in St. Kitts and Trinidad.

Table 7: Baseline characteristics of 5-10 year old school children and their caregivers measured in St. Kitts by treatment group[1].

Characteristic	ST. KITTS		
	Control n=86	**Menu change n=102**	**All n=188**
Child age, *y*	7.16±0.75	7.06±0.76	7.11±0.75
Child gender,			
Girls, *n (%)*	44 (51.2)	50 (49.0)	94 (50.0)
Boys, n (%)	42 (48.8)	52 (51.0)	94 (50.0)
Child ethnic group,			
African descent, *n (%)*	82 (96.5)	94 (94.0)	176 (95.1)
East Indian, *n (%)*	1 (1.18)	2 (2.00)	3 (1.62)
Mixed, *n (%)*	2 (2.35)	3 (3.00)	5 (2.70)
Other, *n (%)*	0 (0.00)	1 (1.00)	1 (0.54)
Child BMI z-score for age	0.20±1.25	-0.17±1.21	0.00±1.24
Prevalence of child thinness, *n (%)*	0 (0.00)	4 (3.96)	4 (2.14)
Prevalence of child overweight and obesity[2], *n (%)*	23 (26.7)	15 (14.9)	38 (20.3)
Prevalence of child obesity[3], *n (%)*	10 (11.6)	5 (4.95)	15 (8.02)
Child height z-score by age	0.43±1.00	0.46±1.00	0.44±1.00
Prevalence of child anemia[4], *n (%)*	28 (34.2)	40 (43.0)	68 (38.9)
Caregiver BMI ≥25, *n (%)*	69 (82.1)	73 (75.3)	142 (78.5)
Caregiver BMI ≥30, *n (%)*	35 (41.7)	48 (49.5)	83 (45.9)
Household food insecure, *n (%)*	51 (59.3)	46 (45.1)	97 (51.6)

[1]Means ± SD. [2] Based on WHO BMI z-score > 1. [3] Based on WHO BMI z-score > 2. [4] Anemia using WHO guidelines with hemoglobin <11.5 g/dL.

Chi square test for frequencies, non-parametric test for variables that were not normally distributed, T-tests for normally distributed variables.

Table 8: Baseline characteristics of 5-10 year old school children measured in Trinidad and Tobago by treatment group[1].

Characteristic	TRINIDAD AND TOBAGO				
	Control n=68	**Menu only n=79**	**Education only n=53**	**Menu and education n=95**	**All n=295**
Child age, *y*	7.56±0.94	7.91±1.10	7.77±1.37	7.62±1.19	7.71±1.10
Child gender,					
Girls, *n (%)*	25 (36.8)	43 (54.4)	25 (47.2)	43 (45.1)	141 (47.8)
Boys, n (%)	43 (63.2)	36 (45.6)	28 (42.8)	52 (55.9)	154 (52.2
Child ethnic group,					
African descent, *n (%)*	26 (39.4)	26 (34.2)	26 (49.1)	34 (36.2)	112 (38.8)
East Indian, *n (%)*	3 (4.55)	7 (7.45)	1 (1.89)	7 (7.45)	18 (6.23)
Mixed, *n (%)*	37 (56.1)	43 (56.6)	26 (49.1)	53 (56.4)	159 (55.0)
Other, *n (%)*	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
Child BMI z-score for age	0.20±1.56^{ab}	0.26±1.47^{ab}	0.22±1.36^{a}	-0.23±1.42^{b}	0.14±1.44
Prevalence of child thinness, *n (%)*	4 (6.06)	2 (2.53)	1 (1.89)	10 (10.6)	17 (5.82)
Prevalence of child Overweight and obesity[2], *n (%)*	17 (25.8)	19 (24.1)	15 (28.3)	20 (21.3)	71 (24.3)
Prevalence of child Obesity[3], *n (%)*	9 (13.6)	7 (8.86)	9 (13.6)	5 (5.32)	30 (10.3)
Child Height z-score by age	0.28±1.08	0.47±1.00	0.51±1.07	0.17±1.08	0.34±1.06
Prevalence of child anemia[4], *n (%)*	13 (21.0)	10 (13.7)	6 (12.0)	11 (12.6)	40 (14.7)
Caregiver BMI ≥25, *n (%)*	34 (64.2)	45 (79.0)	35 (71.4)	48 (62.3)	162 (68.6)
Caregiver BMI ≥30, *n (%)*	17 (32.1)	20 (35.1)	20 (32.1)	32 (41.6)	89 (37.7)
Household food insecure, *n (%)*	26 (38.8)	30 (39.0)	18 (34.0)	49 (52.1)	123 (42.3)

[1]Means ± SD. [2] **Based on** WHO BMI z-score <-2. [3] **Based on** WHO BMI z-score > 1. [4] **Based on** WHO BMI z-score > 2. [5] Anemia using WHO guidelines with hemoglobin <11.5 g/dL.

Non parametric test for variables that were not normally distributed ANOVA and Tukey pairwise comparison for normally distributed variables and chi square for frequencies. Numbers with different superscript are significantly different.

2 Measuring progress in procurement of local produce and changes in food offerings in schools.

In St. Kitts, the project introduced into the new school lunch menu at least 11 different vegetables and fruits, including tomatoes, sweet potatoes, carrots, string beans, cabbage, cucumber and watermelon (Table 9). The availability of vegetables from the local farmers increased over time (Figure 2). The imported vegetables that were used in small quantities prior to the project interventions were replaced with appropriate amounts of carrots, onions, pumpkin and potatoes when available. As seen in Table 9, with the exception the watermelon and the very occasional use of other seasonal fruit, the needs of the school lunch programme for local fruits were largely unmet. Sugar-sweetened fruit drinks remained as the regular offering although some very limited preparation of fruit drinks from local fruit was tried (e.g. lime juice).

Compliance with the menu was very good in terms of meats and fish. Meat (mutton) from local small ruminants (sheep and goats) was planned for inclusion in the menu but this animal source food was not available locally on a regular basis (Table 9). All chicken, turkey and fish on the menu were imported but beef was purchased locally.

Over the study period in St. Kitts, approximately 20 tonnes of produce were sourced by the school feeding programme from local farmers (Figure 3); between January and March 2014, the school lunch programme was utilizing an average of 2317 kg of produce per month from local farmers. About 76% of the new produce procured by the school lunch programme was supplied by local small holder farmers engaged in the project, and equipped with drip irrigation, post-harvest technology and training to enhance productivity and diversity of local vegetables and fruits. The remaining quantity of produce was supplied by local farmers not engaged on the project. Both the quantity (Figure 3) and diversity (Figure 4) of local produce provided to the SMC in St. Kitts increased over time but the supply of locally farmed produce still remained below the SMC's anticipated needs for following the menu for the 800 children in the intervention schools (Figure 2).

The main constraint to the provision of adequate quantities of fruit and vegetables for the lunch menu was the seasonality in crop production and produce availability as seen in Table 9. For example, carrots are not planted in summer so that none were available until December when children attend school for only one week. Fruits and vegetables were also offered in sub-optimal amounts, as on occasion the SMC chose to not use the prescribed quantities of produce, but rather an amount reflecting a smaller portion for each child. In St Kitts where food is delivered to schools in bulk and portioned there, it is more difficult for SMC staff to visually see the portion size offered to each child. As stated earlier, few fruits are grown in St Kitts in quantities sufficient to offer a portion for each child. The constraints to fully meeting the produce needs of the SMC varied by product; in addition to the realities of seasonal constraints on crop production, other factors that influenced procurement of local produce for school lunch meals included competition for particular items from hotels (offer of higher prices to farmers), farmer reluctance to plant sufficient area of some crops whose cultivation was considered labour intensive, and lack of appropriate planning and scheduling of crop planting. The compliance to offering

other foods was generally good as prior to the intervention, all meals contained a staple and a meat source each day and changes such as having fish or local beef on the menu were easily made.

In Trinidad, the model for preparing and delivering school lunch meals is different from that in St Kitts in that private caterers supply schools with the lunch meals which are provided as individual servings packaged and delivered to schools in standard format. In the study, three different private caterers supplied the lunch meals for schools with the menu change. Approximately 63% (33 out of the 52) of the meals served during the term January to March, 2013 complied with the planned changes in menu. For the school term April – July, 2013, the comparable figure was 71% (41 out of 54 planned meals were served); from September – December, the compliance rate was 90.8% (59 items out of the 65) planned menu changes occurred; there was some degree of deviation from planned menus across all school terms. Produce availability and cost were the main factors affecting menu compliance and dietary diversity. Starchy and non-starchy vegetables and fruits such as corn, cassava, sweet potato, pak choi, spinach, christophene and watermelon, while grown locally, were sometimes replaced with other food items or not served. Other items such as fish, carrots, banana and 100% fruit juice were imported, and their supply was inconsistent, resulting in unplanned menu changes.

While the NSDSL makes every effort to fulfil its objective "to stimulate the agricultural sector by utilizing local produce wherever possible in the meal plans", production constraints affect a sustainable supply of local produce to the caterers; this results in a high dependency on imported fruits and vegetables both regionally and internationally to sustain the school lunch programme in Trinidad. The project intervention has highlighted this challenge, and in an attempt to address this issue, NSDSL has introduced new systems for tracking the use of local produce and dedicated staff to facilitate enhanced procurement of local produce for the school feeding programme in Trinidad.

Table 9: Percentage of produce supplied by local farmers in St. Kitts relative to the School Meal Center needs – January 2013 to March 2104 school year.

	2013										2014		
Product	Jan	Feb	Mar	Apr	May	June	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Tomato	26	119	183	0	0	17	57	43	53	36	82	78	80
Pumpkin	19	0	23	45	62	88	25	72	97	22	67	88	94
Cucumber	63	133	25	0	30	73	114	0	38	67	33	0	0
String Beans	43	33	41	8	33	20	15	0	53	70	17	18	43
Carrots	8	25	105	33	114	92	0	0	0	86	77	82	108
Sweet Potato	73	0	33	0	19	35	19	58	59	0	22	28	10
White Potato	0	29	31	60	14	0	0	16	0	0	43	87	101
Cabbage	0	0	0	0	92	0	0	23	93	0	86	97	92
Watermelon	0	0	21	14	79	26	25	0	9	0	8	0	13
Cantaloupe	0	0	0	0	0	0	26	0	0	0	0	0	0
Banana	0	0	0	0	0	0	7	0	25	0	4	7	1
Other fruits	0	0	0	0	0	0	0	13	53	25	8	3	0
Onions											28	142	85
Mutton	0	0	24	0	0	0	0	0	0	0	0	0	0

Percent supplied (%)									
	0-24		25-490		50-74		75-100		Surplus

Figure 2: Percentage (%) of produce supplied to the St. Kitts School Meals Centre (SMC) by farmers in relation to SMC needs- January 2013 to March 2014 school year.

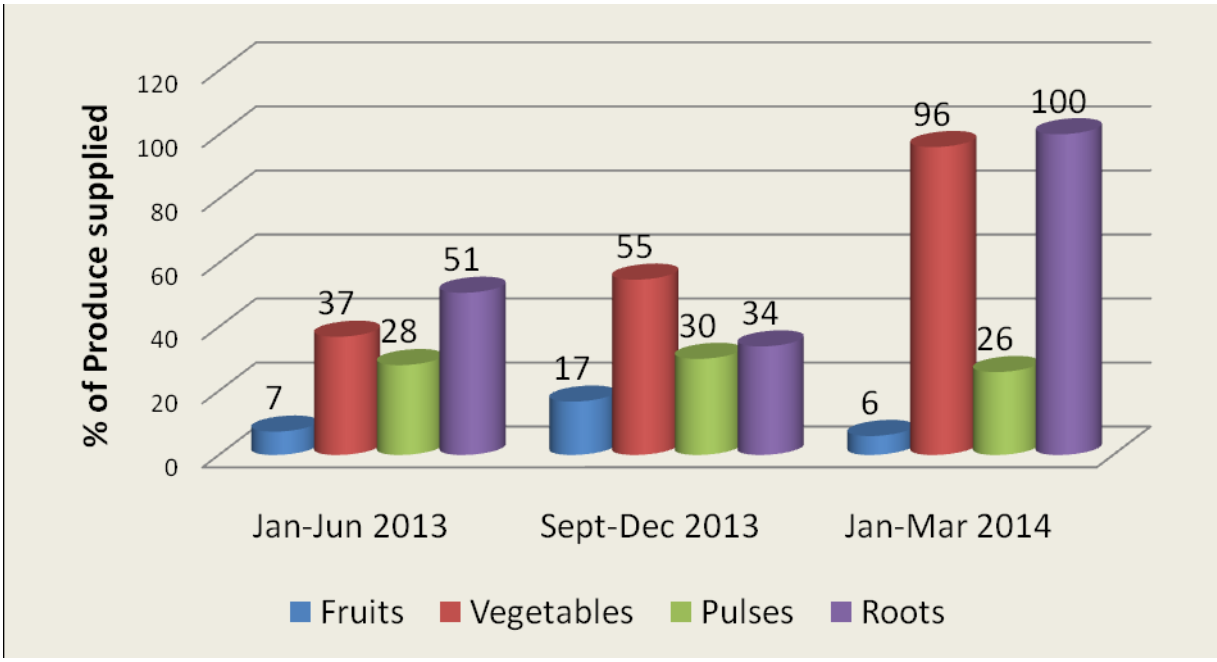


Figure 3: Total quantity of all produce received by St. Kitts SMC from local farmers – January 2013 to March 2014 school year.

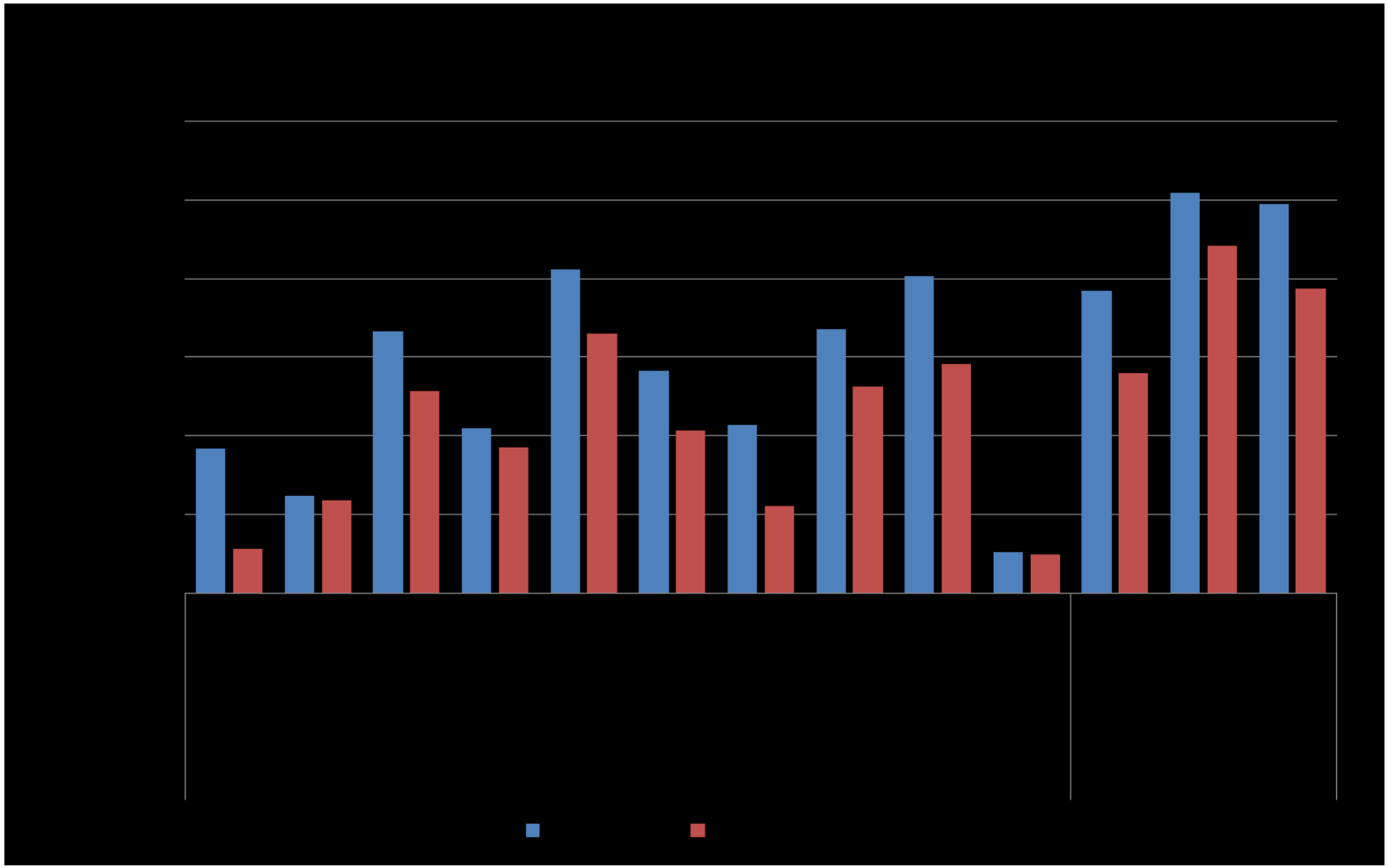
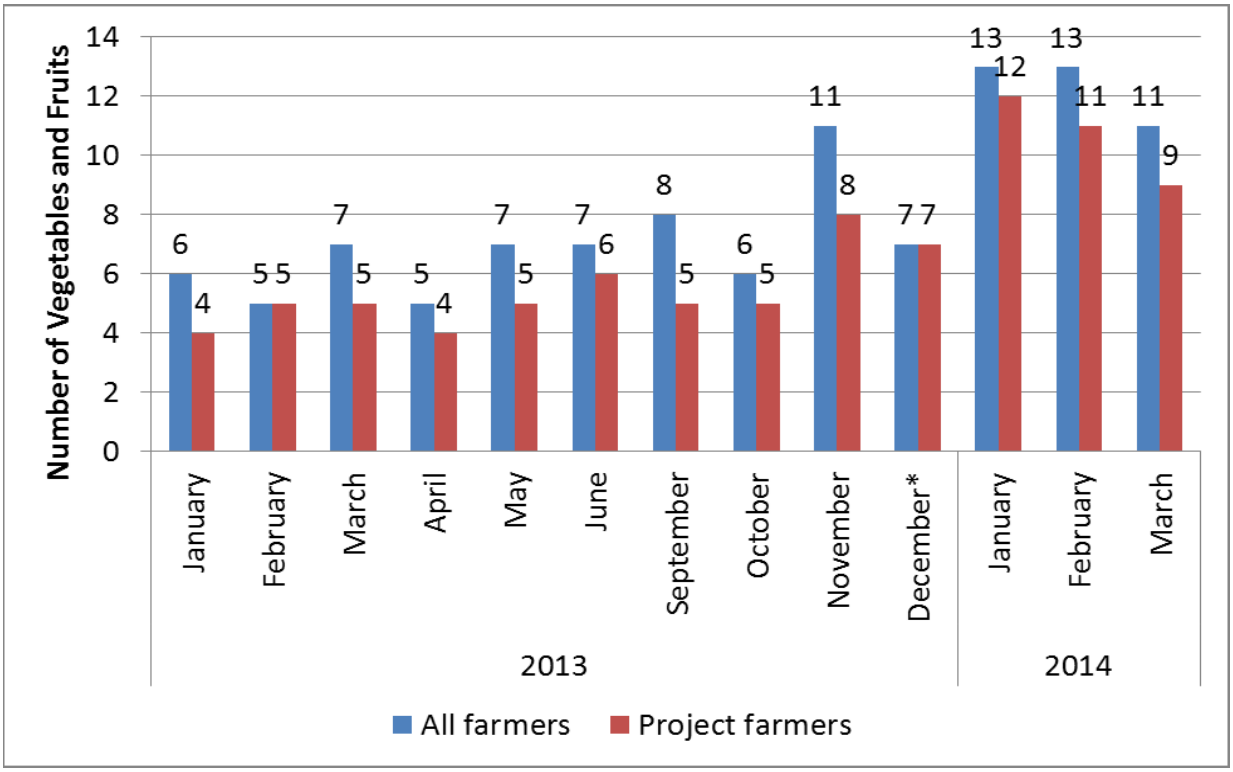


Figure 4: Diversity (number) of fruits, vegetable, pulses and roots received by St. Kitts SMC from local farmers – January 2013 to March 2014 school year.



During the first period of process evaluation in St. Kitts, the menu change increased the cost of the lunch meal from $0.96 EC (control schools) to $1.57 EC for intervention schools; during the second period of process evaluation, the cost of the lunch meal in the intervention school increased to $2.46 EC. Table 10 provides a detailed account of costs of lunch meal items offered. The cost increases were due to three major factors: larger quantities and better quality meat was served to children in the intervention schools; fish added to the menu was imported and costly; fruit was placed on the menu for the first time and the offerings of vegetables were substantially enhanced. The cost of the sugary drink ($ 0.32 EC) did not change over time and was not included in the previously quoted meal costs.

The nutritional value of the meals offered increased over time but only intakes of vitamin C and potassium were statistically significantly different. As would be expected, there was a high level of day to day variability in the nutrients offered in the 10 different meals. Given that the process evaluation took place only on two occasions (for 10 days), limitations in sample size of the recipes could have influenced the outcome of the evaluations. Using the records of the SMC for food items offered to intervention and control schools during the first and second periods of process evaluation, we the estimated number of portions of fruits and vegetables (including potatoes) offered to be 0.51 and 1.07 in the intervention and control schools, respectively. During the first period of process evaluation, a value of 0.13 servings in the control schools was found.

Table 10: Total cost and cost per child of school meals recipes from April 23, 2013-May 7, 2013 *

	Control		**Menu change**	
Date	Food	Cost per child	Food	Cost per child EC
April 23, 2013	Spaghetti with corned beef	1.26	Oven baked Chicken in light gravy Seasoned Baked Sweet Potato Sautéed String Beans and Carrots	2.33
April 24, 2013	Stewed turkey Wings in tomato sauce Rice and Pink Beans	1.15	Stewed turkey wings in tomato sauce Rice and Pink Beans Watermelon Slices	1.86
April 25, 2013	Stewed turkey wings Turkey and lentils with rice	1.05	Spaghetti with stewed turkey wings (in a chunky tomato sauce with cubed pumpkin and string beans)	1.52
April 26, 2013	Hot dogs with bread	0.95	Hot dog (in Creole Sauce) with bread	0.95
April 29, 2013	"Cook up" (lentils, chicken, rice, onions and seasoning)	0.87	Stewed chicken Stewed pink beans in tomato sauce with cubed Pumpkin Rice Sliced Tomato	1.60
April 30, 2013	Spaghetti with stewed chicken	1.27	Baked Chicken in light gravy Seasoned mashed sweet potato Sautéed cubed Pumpkin & string beans	1.32
May 1, 2013	Rice and beans in tomato sauce	1.42	Baked fish sandwich Hot Slaw	2.86
May 2, 2013	Split pea soup	0.62	Split pea soup	0.62
May 5, 2013	Grilled cheese sandwiches	0.52	Hamburger (in a creole sauce) Hamburger bun Cucumber slices Watermelon slices	1.35

May 7, 2013	"Cook up" (lentils, chicken, rice, onions and seasoning)	0.84	Stewed turkey wings Stewed pink beans in tomato sauce with cubed carrots Rice	1.57

*The EC dollar is valued at 0.37 USD

In Trinidad, the meal costs are well known because lunch meals are offered in single units to each child. The improvements in the lunch meals in Trinidad increased the cost over the control meals by TT $4.50. The cost to the NSDSL to produce the control meals per student is TT$8.15, while the cost to produce the modified meals per student is TT$12.65. The increased cost was due to the introduction to the menu of fruit and 100% fruit juice, the addition of vegetables, and packaging of the new lunch meal.

An examination of the children's acceptance of the new foods offered was based on the reports on plate waste in the schools. In St. Kitts, watermelon was consumed with the highest acceptance (85%), and lowest acceptance was for cooked carrots (51%) when not served as part of a mixed dish such as when mixed in with rice. In Trinidad, a comparison of the fruit and vegetable acceptance across intervention groups showed better acceptance in the group with the menu change and education together ($p<0.01$). While each intervention improved fruit and vegetable acceptance over that of control, the highest level of food acceptance was found among children receiving the combination of menu change plus nutrition education. We found that fruit acceptance was greater than vegetable acceptance across all groups studied. Regression analysis predicted change in acceptance of fruits and vegetables over the period studied; results showed an average of 3.6% increase in the acceptance of vegetables for every 6 months, and an average of 5.8% increase in the consumption for fruit for the same time period. Between the two programs there was a 7% difference in the amount of fruits consumed, and 10.6% difference in the amount of vegetables consumed.

An analysis of 7 meal samples from 3 caterers in Trinidad showed variations in serving sizes and the nutrient content of the different meals. On average the meals (representing one third of daily intake) met the nutrient requirements for protein, fat, iron, and dietary fiber. There was an important lack of calcium in the meals. Sodium levels in the meals were excessive, with the meals providing, on average, 50% (rather than 33%) of the daily maximum level for good health. Saturated fat was also excessive and points to the need to examine the types of fats used in meal preparation. The test meals offered a variety of foods from the six Caribbean Food Groups, but present concerns regarding calcium, sodium and saturated fats. The addition of fruit to the meal increased the vitamin C content of the meals in the intervention compared to the control meals.

There was some treatment contamination with the change in the meals. Treatment contamination occurs in studies where the control group has information that leads to change over time as a result of treatment innovations. In both countries improvements in the meals in the intervention schools were seen as good choices so these were adopted for all children, including control. An

example in St Kitts, the soup meal in the control schools became much richer in vegetables as the SMC received more vegetables for the intervention schools. Treatment contamination is well known in medical trials and diminishes the differences between treatment groups.

3. Differences in dietary intake of children resulting from the changes in the school meal and the educational interventions program.

Dietary intake measurements made at baseline on children in St. Kitts revealed similar intakes between control and intervention groups (Table 11). We chose not to analyse changes (between end point and baseline) in dietary intake over time because the St Kitts baseline data were collected in summer when the children were not in school while the endpoint data were collected during the school year on school days. In addition to the seasonal availability of fruits, the children may have had higher energy expenditure when on holiday.

Table 11: Baseline nutrient intake and food group portions for control and menu change groups of 5-10 year old children in St Kitts.

Nutrient/Food group	**All Children (n=187)**	
	Control (n=86)	**Menu change (n=101)**
Energy, *kilocalories*	1770±657	1937±698
Percent energy as protein, *%*	13.1±3.86	14.1±5.51
Percent energy as fat, *%*	25.8±9.69	26.3±8.38
Percent energy as carbohydrate, *%*	62.3±11.5	61.3±11.3
Fiber, *g*	15.4±9.23	16.1±9.42
Calcium, *mg*	636±361	625±372
Iron, *mg*	17.0±13.9	15.3±9.25
Potassium, *mg*	1695±893	1729±916
Vitamin A, *RAE*	1098±1023	1032±957
Vitamin C, *mg*	216±257	189±291
Fruits, portions	1.13±2.15	1.45±2.07
Vegetables, portions	0.68±1.28	0.49±0.93
Total of fruit and vegetables (including staple[1] vegetables), *portions*	2.24±2.62	2.25±2.45

Mean±SD. * $p<0.05$. T-tests for normally distributed variables and non-parametric; Wilcoxon test for those with non-normal distributions.

[1] Because staples in the Caribbean Food Guide include grain products and vegetables the staple vegetables are reported separately.

In St Kitts, the children who were studied at the intervention at the end of the project reported eating a higher percentage of protein, vitamin A, potassium and vegetables in their lunch meal than those in control schools (Table 12). This was true in examining all children studied and in a subset who reported eating the school lunch that day. Most, but not all children (74%) did eat the school lunch on the day of the interview; some children bring lunch from home on some of the days. Despite the better nutrient profile, energy intake from the school meal did not increase; this indicates that one can improve the dietary components of the meal without contributing to increased energy intake and overweight.

Table 12: Nutrient intake and food group portions at lunch for control and menu change groups of 6-12 year old children in St Kitts at end point.

Nutrient/Food group	All Children (n=163)		Children who consumed the school lunch (n=121)	
	Control (n=73)	Menu change (n=90)	Control (n=50)	Menu change (n=71)
Energy, *kilocalories*	586±357	536±260	603±375	529±225
Percent energy as protein, *%*	14.1±5.99	18.8±9.70**	13.8±4.74	19.3±10.4**
Percent energy as fat, *%*	22.5±13.2	23.7±10.3	18.3±11.1	21.9±9.41*
Percent energy as carbohydrate, %	62.9±17.1	57.2±15.3	66.8±13.5	58.3±15.4**
Fiber, *g*	2.79±2.97	3.03±2.65	3.21±3.40	3.07±2.56
Calcium, *mg*	144±107	128±95.0	141±106	131±88.4
Iron, *mg*	2.84±2.30	2.58±1.41	2.72±2.39	2.59±1.36
Potassium, *mg*	404±348	493±327**	403±330	481±310*
Vitamin A, *RAE*	104±253	184±229**	126±300	215±242**
Vitamin C, *mg*	69.3±73.1	80.7±78.1	66.6±54.2	86.1±75.5
Fruits, *portions*	0.21±0.67	0.23±0.70	0.17±0.54	0.20±0.65
Vegetables, *portions*	0.09±0.23	0.23±0.31**	0.11±0.27	0.24±0.32**
Staple vegetables[1], *portions*	0.08±0.36	0.11±0.34	0.06±0.35	0.07±0.21
Total of fruit and vegetables (including staple vegetables), *portions*	0.38±0.84	0.56±0.81**	0.34±0.65	0.50±0.73**

Mean±SD. * p<0.05 ** p<0.01.

T tests for normally' distributed variables and non-parametric Wilcoxon test for those with non-normal distributions.

[1]Because staples in the Caribbean Food Guide include grain products and vegetables the staple vegetables are reported separately.

When examining intakes for the entire day in St Kitts, the children in the intervention school reported consuming more vegetables and higher potassium levels than the control schools (Table 13). The energy intake for the whole day was no different between control and intervention groups.

Table 13: Total daily nutrient intake and food group portions from 24-hour recalls for control and menu change groups of 6-12 year old children in St Kitts at end point.

Nutrient/Food group	All Children (n=167)		Children who consumed the school lunch (n=121)	
	Control (n=76)	Menu change (n=91)	Control (n=50)	Menu change (n=71)
Energy, *kilocalories*	1754±895	1647±653	1782±967	1655±652
Percent energy as protein, *%*	14.1±4.60	15.3±6.71	13.3±3.40	15.4±7.07
Percent energy as fat, *%*	28.1±9.27	27.5±7.48	26.0±8.14	25.9±7.26
Percent energy as carbohydrate, *%*	57.5±12.3	57.7±9.67	60.1±10.9	59.1±10.5
Fiber, *g*	9.60 ±6.64	10.15 ±6.32	9.93±6.82	10.1±6.16
Calcium, *mg*	474 ±303	478 ±308	490±284	477±281
Iron, *mg*	11.0±5.82	11.8±5.44	12.0±10.7	13.1±9.59
Potassium, *mg*	1327±832	1461±670*	1327±882	1449±655
Vitamin A, *RAE*	880±1468	570±733	1355±1666	821±815
Vitamin C, *mg*	157±132	179±131	236±200	239±175
Fruits, *portions*	0.88±1.41	0.57±1.13	0.93±1.32	0.57±1.18
Vegetables, *portions*	0.34±0.65	0.60±1.13**	0.37±0.68	0.56±0.90**
Staple vegetables[1], *portions*	0.23±0.72	0.41±0.81	0.19±0.81	0.42±0.86**
Total of fruit and vegetables (including staple vegetables), *portions*	1.45±1.59	1.57±1.70	1.49±1.51	1.55±1.64

Mean±SD. * p<0.05 ** p<0.01.

T-tests for normally distributed variables and non-parametric Wilcoxon test for those with non-normal distributions.

[1]Because staples in the Caribbean Food Guide include grain products and vegetables the staple vegetables are reported separately.

Baseline data on dietary intake collected in Trinidad were generally similar across the different intervention groups (Table 14); at both baseline and endpoint, data were collected while the children were in school but in different seasons. Differences in carbohydrate and fat content of the diet were observed across intervention groups. As the schools were randomized and not the children, it may be that different school characteristics have a role to play in the choice or availability of certain foods. The protein levels not the fruit and vegetables differed across the assigned intervention group.

Table 14: Baseline nutrient intake and food group portions from the 24 hr period for control and intervention groups of 5-10 year old children in Trinidad.

Nutrient/Food group	All Children (n=295)			
	Control (n=66)	Menu alone (n=79)	Education alone (n=51)	Menu and education (n=94)
Energy, *kilocalories*	2012±846	1964±724	1953±669	1931±789
Percent energy as protein, *%*	14.5±5.96	12.9±4.43	13.2±3.49	13.5±4.33
Percent energy as fat, *%*	31.9±9.12^{ab}	28.8±9.33^{a}	29.2±8.03^{a}	33.5±7.81^{b}
Percent energy as carbohydrate, *%*	54.6±12.6^{ab}	59.1±12.2^{a}	58.2±10.2^{ab}	54.1±10.6^{b}
Fiber, *g*	15.3±14.9	14.1±7.49	13.6±6.67	313.5±8.00
Calcium, *mg*	646±390	715±431	621±393	707±462
Iron, *mg*	14.1±7.16	15.1±13.9	12.5±5.87	12.7±6.65
Potassium, *mg*	1852 ±819	1794±752	1822±6894	1728±772
Vitamin A, *RAE*	650±578	654±639	777±1108	765±892
Vitamin C, *mg*	159±161	166±153	200±198	129±130
Fruits, *portions*	0.78±1.46	1.34±2.31	1.34±2.11	0.68±1.16
Vegetables, *portions*	0.71±0.96	0.45±0.78	0.65±0.82	0.52±0.74
Staple vegetables[1], *portions*	0.61±0.95	0.39±0.75	0.52±0.74	0.38±0.63
Total of fruit and vegetables (including staple vegetables). *portions*	2.10±2.00	2.18±2.51	2.52±2.41	1.57±1.66

Numbers with different superscripts were significantly different using Tukey pairwise comparison.

[1]Because staples in the Caribbean Food Guide include grain products and vegetables the staple vegetables are reported separately.

The end point consumption of fruits was significantly higher in the intervention groups from lunch in the children who had the school lunch that day. The data for all children at school that day show the same differences as the subset of children eating the school meal that day influences the overall means (Table 15). In addition, those children in schools with both the menu change and nutrition education had an end point intake of total fruits and vegetables that was higher than the children in the control schools.

When dietary intake was considered over the entire day, there was a clear effect of the combination of menu change and nutrition education leading to a higher overall intake in fruits and vegetables (Table16). This change in increased fruits and vegetables did not add extra energy to the overall food intake.

Table 15: Nutrient intake and food group portions from lunch for control and intervention groups of 6-12 year old children in Trinidad at end point,

Nutrient/Food group	All Children (n=322)				Children who consumed the school lunch (n= 153)			
	Control (n=66)	Menu change alone (n=86)	Nutrition education alone (n=64)	Menu change and nutrition education (n=106)	Control (n=25)	Menu change alone (n=53)	Nutrition education alone (n=25)	Menu change and nutrition education (n=50)
Energy, kilocalories	437±242[a]	410±283[a]	471±340[a]	453±433[a]	366±183[a]	321±203[a]	354±251[a]	274.±221[a]
Percent energy as protein, *%*	13.1±7.55[a]	10.6±8.52[a]	12.7±12.3[a]	12.4±10.2[a]	10.3±5.93[a]	8.26±6.55[a]	9.24±13.9[a]	9.88±10.9[a]
Percent energy as fat, *%*	24.6±16.4[a]	16.6±15.5[b]	22.0±17.3[ab]	20.9±18.4[ab]	17.7±15.4[a]	12.2±11.6[a]	10.5±12.4[a]	13.0±13.6[a]
Percent energy as carbohydrate, *%*	59.6±22.3[a]	70.8±24.8[b]	64.7±26.7[ab]	64.4±27.2[ab]	68.0±22.0[a]	78.3±19.9[a]	78.0±27.7[a]	71.4±29.8[a]
Fiber, *g*	3.13±1.96[a]	2.73±2.12[a]	2.97±2.86[a]	3.34±3.91[a]	2.62±1.85[a]	2.38±1.86[a]	2.46±2.20[a]	1.92±1.73[a]
Calcium, *mg*	95.6±96.6[a]	74.8±115[a]	103±119[a]	83.9±76.9[a]	99.3±115[a]	55.6±46.2[a]	92.0±112[a]	51.7±41.8[a]
iron_mg	2.41±1.47[a]	2.19±1.68[a]	2.60±2.47[a]	2.58±4.39[a]	1.79±1.19[a]	1.71±1.30[a]	1.61±1.65[a]	1.35±1.85[a]
Potassium, *mg*	414. ±268[a]	416±275[a]	403±338[a]	541±666[a]	289±178[a]	361±201[a]	300±234[a]	370±325[a]

Nutrient/Food group	All Children (n=322)				Children who consumed the school lunch (n= 153)			
	Control (n=66)	Menu change alone (n=86)	Nutrition education alone (n=64)	Menu change and nutrition education (n=106)	Control (n=25)	Menu change alone (n=53)	Nutrition education alone (n=25)	Menu change and nutrition education (n=50)
Vitamin A, *RAE*	80.7±127[a]	65.8±97.8[a]	87.4±190[a]	119±205[a]	86.7±121[a]	61.6±96.0[a]	59.8±104[a]	60.6±82.2[a]
Vitamin C, *mg*	40.0±38.5[a]	56.0±57.1[a]	57.4±60.5[a]	47.3±54.8[a]	38.1±37.8[a]	57.0±51.5[a]	56.2±61.0[a]	48.3±55.9[a]
Fruits, *portions*	0.16±0.50[a]	0.68±0.96[bc]	0.43±0.95[abc]	0.66±1.15[bc]	0.21±0.58[a]	0.93±1.01[b]	0.46±0.90[ab]	0.97±1.11[b]
Vegetables, *portions*	0.31±0.43[a]	0.24±0.38[a]	0.21±0.51[a]	0.42±0.99[a]	0.32±0.42[a]	0.22±0.32[a]	0.15±0.33[a]	0.36±1.26[a]
Staple vegetables[1], *portions*	0.15±0.48[a]	0.07±0.19[a]	0.05±0.24[a]	0.24±0.85[a]	0.00±0.02[a]	0.06±0.17[a]	0.00±0.00[a]	0.09±0.23[a]
Total of fruit and vegetables (including staple vegetables), *portions*	0.62±0.75[ab]	0.99±0.96[abc]	0.69±1.10[ab]	1.32±1.73[c]	0.53±0.74[a]	1.21±1.00[a]	0.61±0.94[ab]	1.42±1.76[b]

Numbers with different superscripts were significantly different using Tukey pairwise comparison.

[1]Because staples in the Caribbean Food Guide include grain products and vegetables the staple vegetables are reported separately.

Table 16: Total daily nutrient intake and food group portions from 24-hour recalls for control and intervention groups of 6-12 year old children in Trinidad at end point.

Nutrient/Food group	All Children (n=331)				Children who consumed the school lunch (n= 153)			
	Control (n=69)	Menu change alone (n=88)	Nutrition education alone (n=66)	Menu change and nutrition education (n=108)	Control (n=25)	Menu change alone (n=53)	Nutrition education alone (n=25)	Menu change and nutrition education (n=50)
Energy, *kilocalories*	1563±782[a]	1665±706[a]	1842±731[a]	1551±749[a]	1449±502[ab]	1592±676[ab]	1765±700[a]	1351±589[b]
Percent energy as protein, *%*	13.3±4.81[a]	12.3±4.25[a]	12.4±4.59[a]	12.4±4.89[a]	11.5±3.52[a]	11.4±3.79[a]	11.0±4.68[a]	11.4±4.05[a]
Percent energy as fat, *%*	29.9±10.3[a]	26.9±8.93[a]	30.4±10.4[a]	28.5±10.1[a]	26.8±8.86[a]	26.1±8.44[a]	28.4±10.9[a]	26.5±10.1[a]
Percent energy as carbohydrate, *%*	57.7±13.1[a]	62.0±12.1[a]	58.0±12.8[a]	60.4±12.9[a]	62.9±11.0[a]	63.6±11.1[a]	61.1±13.6[a]	63.4±11.9[a]
Fiber, *g*	10.6±5.17[a]	11.3±10.8[a]	12.5±5.94[a]	11.5±8.62[a]	10.4±4.62[a]	10.5±5.67[a]	12.9±6.47[a]	10.7±9.66[a]
Calcium, *mg*	447±319[a]	568±404[ab]	619±419[b]	487±344[ab]	465±251[ab]	522±311[ab]	641±393[a]	428±325[b]
Iron, *mg*	9.62±5.47[a]	11.5±6.48[a]	13.1±10.7[a]	9.88±6.95[a]	8.69±4.19[a]	12.1±13.3[a]	10.9±5.34[a]	8.46±5.65[a]
Potassium, *mg*	1439±648[a]	1563±758[a]	1608 ±847[a]	1537±919[a]	1353±505[a]	1519±773[a]	1499±713[a]	1391±754[a]
Vitamin A, *RAE*	286±295[a]	374±401[a]	480±684[a]	392±409[a]	319±299[a]	413±480[a]	558±986[a]	338±374[a]
Vitamin C, *mg*	130±131[a]	145±127[a]	186±189[a]	159±185[a]	178±179[a]	141±115[a]	202±230[a]	167±205[a]

Nutrient/Food group	All Children (n=331)				Children who consumed the school lunch (n= 153)			
	Control (n=69)	Menu change alone (n=88)	Nutrition education alone (n=66)	Menu change and nutrition education (n=108)	Control (n=25)	Menu change alone (n=53)	Nutrition education alone (n=25)	Menu change and nutrition education (n=50)
Fruits, *portions*	0.82±1.34[a]	1.37±1.77[a]	1.01±1.61[a]	1.44±1.80[a]	1.31±1.81[ab]	1.40±1.15[ab]	1.10±1.44[a]	2.14±1.98[b]
Vegetables, *portions*	0.67±0.72[a]	0.46±0.50[a]	0.55±0.85[a]	0.72±1.13[a]	0.88±0.86[a]	0.49±0.44[a]	0.33±0.50[a]	0.72±1.46[a]
Staple vegetables[1], *portions*	0.31±0.63[a]	0.33±0.64[a]	0.28±0.57[a]	0.45±1.17[a]	0.10±0.26[a]	0.40±0.72[a]	0.32±0.69[a]	0.26±0.50[a]
Total of fruit and vegetables (including staple vegetables), *portions*	1.80±1.47[a]	2.17±1.82[ab]	1.84±1.84[ab]	2.61±2.51[b]	2.29±1.86[ab]	2.29±1.40[ab]	1.75±1.37[a]	3.12±2.74[b]

Numbers with different superscripts were significantly different using Tukey pairwise comparison.

[1]Because staples in the Caribbean Food Guide include grain products and vegetables the staple vegetables are reported separately.

The change in food and nutrient intake over time was not assessed. The data were collected in different seasons: in St. Kitts, children were interviewed in the summer when school was out. One challenge that occurs with dietary data is that the within-person variability is high; that is we all eat differently each day so that one day is not necessarily a good picture of our usual intake. However, the mean intake derived from the mean of a group is well known to produce a good estimate of group intake even with only one day assessment per person (11).

4 Measuring changes in nutritional status indicators (under and overweight and anemia) resulting from the changes in the school meal and the educational interventions program.

In both St. Kitts and Trinidad the number of overweight children increased over time (Tables 17 and 18). In St Kitts, the rates rose from 20.1% to 26.6% at baseline to endpoint. Similarly in Trinidad, the rates rose from 22.9% to 31.7% at baseline to endpoint. This indicates that over time the children are getting heavier in relation to their age and sex matched standards. In St Kitts, only 1 child in 167 went from overweight to healthy weight whereas 12 went from healthy weight to overweight, with similar figures in Trinidad, 2 vs. 23 of 331 children. There were no differences in the change in weight status by treatment group. At the endpoint survey, more children were classified as overweight in all treatment groups. This increase in the percentage of children who are overweight reflects excessive weight gains in a number of the children. There was no difference by sex or age of the children gaining the extra weight. In the long term, one can expect that better eating habits, particularly consuming more fruits and vegetables and less of other foods will have an impact but in the short term there is no reduction in total energy intake or increased energy expenditure (not measured) that can prevent children from gaining extra weight over time.

In addition to the school lunch meals offered, children have access to snack foods ("competitive foods"), sold within and around the school environment, that contribute to weight gain. From the survey conducted with the caregiver and child, a question on bringing money to school for food was asked. In St. Kitts 71% of children interviewed reported bringing money for treats to school each day; in Trinidad, this figure is 90%. From observations by the research team, there are very few nutritious foods offered as snacks or meals in schools or in the surrounding school environment.

Table 17: Percentage of overweight and obese (using WHO BMI z-scores > 1) children 6-12 years old in St. Kitts at baseline and end point with change by treatment group.

	Baseline	End Point	Change
Control	25.3	32.0	6.7**
Intervention	16.0	22.3	6.3**
All	20.1	26.6	6.5**

** p<0.01 McNamar's test for paired observations

Table 18: Percentage of overweight and obese (using WHO BMI z-scores > 1) children 6-12 years old in Trinidad at baseline, end point and change over time.

	Baseline	End Point	Change
Control	23.2	30.4	7.2**
Education only	29.4	35.3	5.9**
Menu only	18.6	28.6	10.0**
Menu and Education	22.4	32.9	10.5**
All	22.9	31.7	8.8**

** p<0.01 McNamar's test for paired data

The prevalence of anemia was high at both baseline and endpoint with no overall difference in the prevalence of anemia over time. A capillary blood sample tends to underestimate hemoglobin level (12) and as the method we used is designed as a screening tool, the results should be interpreted with care. In addition it would seem that iron intake is sufficient from the dietary analyses of the 24 hr intakes. There was no difference in mean iron intake between those with and without anemia. Given the high rates of anemia, health officials in both countries have been sensitized to the findings and venous samples are being used in clinics. Those children with test results indicating anemia were asked to go to clinics to have a venous blood test to confirm their low hemoglobin levels. The reporting on the re-evaluation of hemoglobin levels after notification of low levels was not systematically assessed as they went to different health care providers. In St Kitts, however, 40 children considered anemic by photometry were reassessed by the health nurses involved in the survey; 69% of the children with low capillary values were not anemic by a venous sample. Similarly in Trinidad, at a hospital clinic to which families of children with low hemoglobin values on the capillary test were referred, 75% initially classified as anemic were not anemic as assessed by a venous blood sample.

There are a number of concerns in the literature about the use of capillary samples (13) and photometry. Unfortunately, a venous puncture to test the hemoglobin was not feasible as it could not be done in the school setting. Because the low values were not confirmed by the repeat samples done in either country, we have little confidence in these measures. If there are a

substantial number of children with anemia it seems unlikely that diet is the main cause given the iron intake of these children. The boys and girls were analysed separately as some of the girls would have started menstruating over the time period of the project. There was no difference in the values for boys and girls or by country. The change in hemoglobin level did not increase in the intervention groups despite the use of more heme iron through meals containing higher levels of heme iron (beef vs. chicken).

5 Measuring changes in nutritional knowledge among children with the educational arm of the study in Trinidad

Table 19 reveals pre-and post-test treatment differences in nutrition knowledge scores but there was no significant effect of nutrition education or menu change on the change in (Time 2 minus time 1) in nutrition knowledge scores. It is possible that there may be a ceiling effect of nutrition education because the pre-test scores were around 11 out of a maximum possible score of 15; this would leave little room for a change in baseline score. The small changes seen with high variability in the change score also may reflect a problem of a lack of statistical power.

Table 19: Nutrition education test change score by treatment group of 6-12 year old children in Trinidad at baseline and endpoint.

Score	Control (n=52)	Menu change alone (n=42)	Nutrition education alone (n=62)	Menu change and nutrition education (n=62)
Time 1	10.2±2.04[a]	10.5±2.06[a]	11.5±1.13[b]	10.8±1.79[ab]
Time 2	11.4±1.54[a]	10.1±1.83[b]	12.1±1.68[ac]	12.3±1.42[c]
Difference	1.19±2.15[a]	-0.36±2.47[b]	0.61±2.08[ab]	1.47±2.09[a]

Mean±SD.

Numbers across rows with different superscripts were significantly different using Tukey pairwise comparison.

Although the parents who participated in the nutrition education sessions offered in different schools in Trinidad did not undergo a formal evaluation of any changes in behavior, some of their comments were recorded and are presented below. We discovered that the best way to work with parents was to offer an activity when they attended parent-teacher meeting in the evenings. The parents expressed interest in the new menu offerings and in learning about cooking.

> Parent 1 ...*"It encourages the children to eat food instead of snacks. It really does. It changed my son's eating habits…. My daughter is eating vegetables now… she would pick out certain things and eat them just like that (raw) or taste them before and after, so*

it's as though she's doing her own experimenting. She likes cucumber, carrots, cabbage, christophene and sweet peppers…"-

Parent 2 *..."Yes, I use less sugar, oil and salt and I could afford more vegetables. I try to use less of the things that we should not be using much of. It has improved … now as an adult I could sit down and eat the food that is actually prepared for the children, so it has improved. -And it's very healthy too".*

6 Mapping the food value chain in Trinidad

The food value chain map for the 37 caterers interviewed in the School Meals programme in Trinidad (Figure 5) shows that the most popular point of purchase for caterers was import wholesalers (48.4%). This point of purchase was the main source of several commodities for the caterers (chicken, fish and fruit) and an important source of root crops and vegetables. This point of purchase was also the source of most imported commodities used in the school meals programme. The next most important point of purchase by caterers was farmer's markets (25.8%). This point of purchase was the main source of vegetables and a major source of fruits and root crops. The caterers purchased only 6.7% of their food products directly from farmers. When caterers were asked where they would prefer to buy their produce, more stated that they would like to purchase from local farmers than markets. There is clearly an opportunity for increasing direct farmer-to-caterer linkages and purchases for vegetables, fresh fruit and root crops. However, it should be noted that when farmers were asked to whom they would prefer to sell their produce, 33% stated a preference to sell their crops/produce to wholesalers, because they obtained a fair market price, and this option was less time consuming and hassle free.

At a "Farm to Fork" Stakeholders consultation held in Trinidad, farmers shared concerns regarding the production and distribution of local produce as it relates to the implementation of a farm to fork or farm to school initiative in Trinidad. These comments from farmers were recorded and reflect their concerns and provide further understanding of the farmers' perspective on the challenge of providing produce for the caterers.

Farmer 1... *"one of the problems farmers face is this; farmers do not know what the requirements of the school feeding markets are. Perhaps one of the things the School Feeding Programme ought to be doing (throughout the region) is 3 or 4 months before the year ends, indicate to the farming community what their needs are for farming produce over the next year and perhaps do that for 2 years or 3 years, and that will be the way to create the linkage between the producer and the consumer."*

Farmer 2... *"there is a huge lacuna/gap between the productive aspects of the industry and the distributive aspects. The food can't get from where it's being produced to the*

consumer because the distribution network is so extremely poor. The linkage between production and distribution needs to be strengthened".

Farmer 3...*" the whole distributive network facilities/connecting farmers through one direct access points, connecting caterers to those access points as well. All those are facilitative things that would help drive the programme."*

These statements concerning the lack of coordination between farmers and the school meals caterers is clearly stated by the farmers and reflects the low value of 6.7% of the produce needed for school meals coming directly from farmers. With the large buying power of the school meals program, decreasing reliance on imported foods is important to agricultural production. While there is an appetite for better linkages, challenges remain in both providing local produce to children to improve their health and the potential for better local markets for farmer produce.

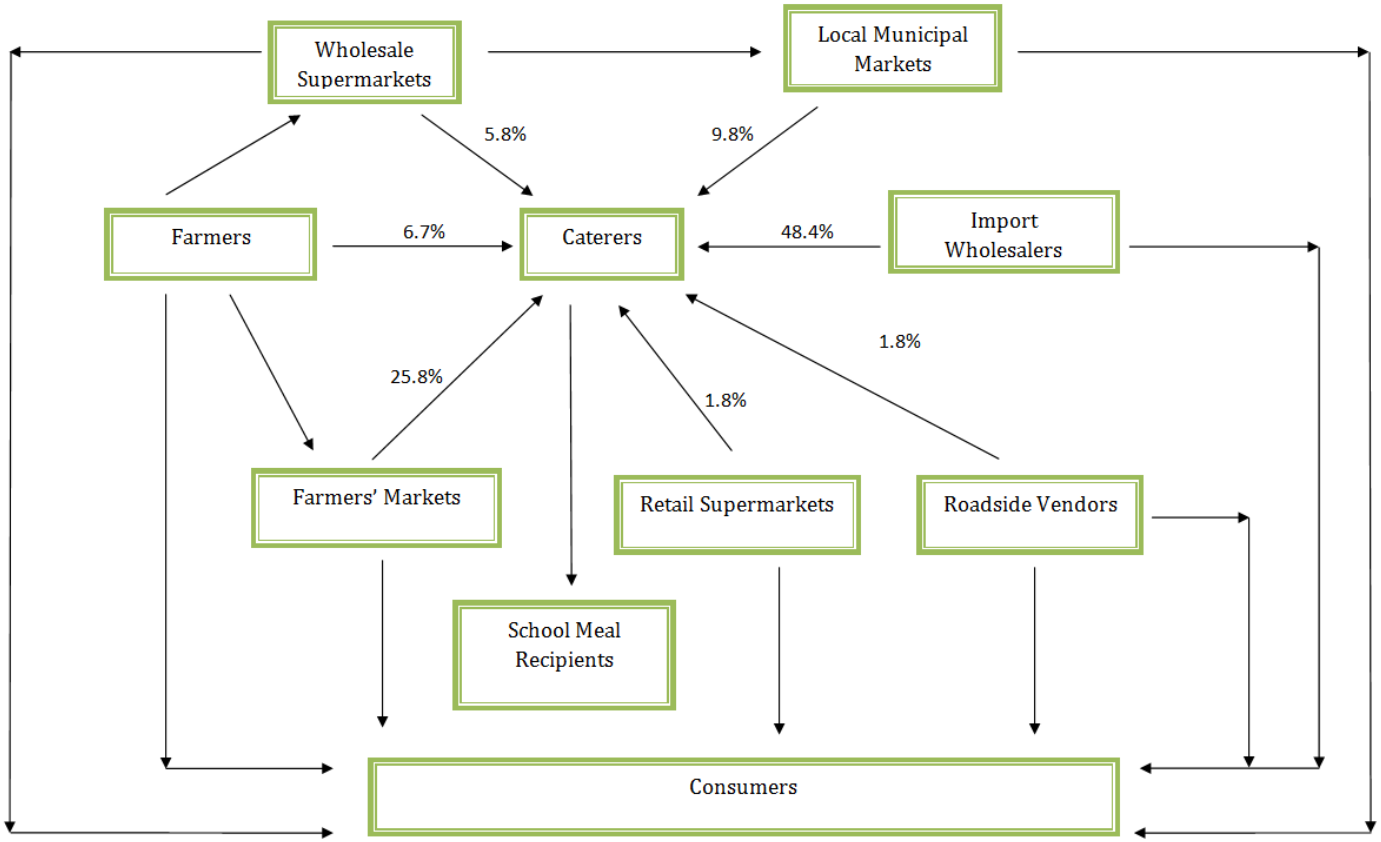


Figure 5: Commodity Farm to Fork linkages, school meal caterers in Trinidad: Relative importance of points of purchase to caterers.

7 Analysis of the supply and demand conditions in the markets studied in Trinidad.

A. Relationship between food expenditures and income and other factors

Regression analyses were performed to identify the factors associated with the level of household expenditures on food commodity groups for households of the children involved in the study in Trinidad. This analysis of the CHS baseline survey was designed to determine the factors that could influence a greater demand for local commodities by these and similar households.

The results in Table 20 reveal that, with respect to the "staples" food group (rice, sweet potato, flour, etc.), the major factor affecting expenditure on this commodity group was that households of 'non- African' descent had a higher expenditure on staples than households of African descent. The results also showed that the more food insecure the household, the lower the expenditure on staples but income was not related to the purchase of staples. With respect to the food groups, fruits and vegetables and food from animals, the higher the household income, the higher the expenditure on these two commodity groups. As with the staples food group, the more food insecure the household, the lower the expenditures on fruits and vegetables and food from animals. For "Other Foods", which consisted of fats and oils, spices and condiments, beverages etc., in addition to income and food security 'non–African' descent had a higher level of expenditure than households of African descent, and the older the head of the household, the lower the expenditure on this commodity group.

With respect to Total Food Expenditure, higher levels were associated with higher income and greater food security. Household expenditures were not influenced by the following variables or characteristics of the head of household: marital status, gender or the level of education. The results obtained were also consistent with empirical economic generalizations, which suggest that normal goods like fresh fruits and vegetables and food from animals should have positive income elasticities.

Table 20: Regression Coefficients from the analysis of the correlates of household food expenditure on different food groupings.

	Constant	African/other	Income	Food security	Age household head
Staples	6.17**	-0.16*		-0.33**	
Fruits & Vegetables, Legumes & Nuts	5.43**		0.071*	-0.45**	
Food from Animals	5.81**		0.09**	-0.34**	
Other Foods	6.73**	-0.17*	0.11**	-0.34*	-0.42*
Total Household Food Expenditure	7.21***		0.07*	-0.33**	

*** p -<: 0.001, ** p -<: 0.01

These results imply that local farmers, since their main products are fresh fruit and vegetables and food from animals, would benefit from increases in incomes of the households, as well as improvements in their food security status. These data do not necessarily mean that income or food security status is related to nutritional intake, however, as spending more money on food does not necessarily imply better nutrition.

B. Optimal purchasing for school feeding

An analysis to determine whether school meal caterers can utilize greater quantities of farmer production within the constraints of the National School Meals Programme was carried out in Trinidad using a linear programming model to develop several scenarios or simulations. The use of linear programming to optimize food offerings has recently started to be applied in this domain. The objective of the exercise was to determine if caterers in the school meal programme can produce meals below the target cost of TT$ 8.15 per meal with an increased utilization of local foods, so as to increase the linkages between caterers and farmers in the Farm to Fork model.

A typical minimum cost situation obtained from the solution of the model is given in Table 21.The total raw material cost of the nutritionally balanced meal was TT$ 6.20*, allowing TT$ 1.95 per meal for preparation and profit. The meal consists of an imported source of food from animals (minced chicken) and bread made from imported flour. The model was further adjusted to only admit local ingredients in the ‘food from animal’ category. In the ‘Local Foods’ model,

minced local chicken increased the cost of the meal ingredients by 4 cents to $6.24 This modeling can be used to find the best local foods to use in appealing ways to meet the nutrient needs of children.

Table 21: Typical optimal solution obtained from linear programming meal selection model.

Typical Optimal Solution:	
Rice	2 ounces
Whole wheat bread	1 slice
Spinach	1.5 – 2 ounces
Minced chicken	2 ounces
Watermelon	3 ounces
Total raw material cost	TT$6.20

*The Trinidad and Tobago dollar is equivalent to 0.16 USD.

OUTCOMES

The school feeding aspect of the overall project was successful in showing how offering more fruits and vegetables to young children through a school meals program improves their dietary pattern. The menu change for 4 of the St Kitts' 17 primary schools has led to increased fruit and vegetable offerings in these schools through the provision of thousands of pounds of new fruits and vegetables offered each month. In St. Kitts, this extra food was provided exclusively by local farmers whose food production was enhanced by technological innovations and a greater market for food. The menu change resulted in improvements between the changed menus for approximately 1,000 children. Other children benefitted from indirect effects of the interventions as improvements were made to the food service system in terms of foods offered and food safety. While the intervention could do with further refinement, scaling up to all schoolchildren would be advisable. Given the protective effect of fruit and vegetable consumption on obesity in children (14), it is clearly of benefit to health in the long term if children continue to eat in this way. The SMC has had major improvements in the facility with improved washing facilities, new coolers, a new braising stove and improvements in food safety. Training for workers has been undertaken in collaboration with NSDSL in Trinidad so as to sustain improvements through better work practices.

To enhance nutritional education among primary school aged children and their households, eight instructional videos titled "Six Caribbean Food Groups CARICOM Food Security Project" were developed on the six Caribbean Food groups, food labels and school gardening. These videos are outputs from the lessons presented face to face to children in the following classes or grades: 2nd year to standard 4 or grades 1 to 5. The use of this technology will not only enhance student learning but will be a valuable resource for educators. A Manual of Sample Lesson Plans has also been complied to accompany the videos. The lessons presented build on the nutrition component of the Health and Family Life Education (HFLE) curriculum which was implemented by the Ministry of Education, Trinidad in 2006. For the academic year September, 2014, the Ministry of Education, Trinidad and Tobago has mandated all schools, both primary and secondary to implement the curriculum. Similarly, in St. Kitts the Ministry of Education has implemented the Health and Family Life Education curriculum. Presently, discussions are ongoing with the Curriculum Officers at the Ministries of Education, St. Kitts and Nevis and Trinidad and Tobago for the adoption of the project outputs to be utilized in the classroom so as to enhance and strengthen the nutrition component of the HFLE curriculum.

In addition to these educational activities for children, a Meal Planning and Purchasing Guide has been developed at UWI as a tool designed to improve consumer awareness when selecting and purchasing local fruits and vegetables, and to plan and prepare healthy meals to help reduce the incidence of chronic diseases in the Caribbean. The guide contains tips on menu planning, purchasing, preparing, storage and service of safe and wholesome meals and will assist consumers when selecting local produce. The guide is a major component of the caregiver/parent nutrition education outreach activities.

The percentage of overweight children rose significantly over the course of the study causing concern for their intake. The diet for these children who are increasingly overweight might be best addressed by encouraging water rather than fruit drink consumption and further increasing the fruit and vegetable component to the meal. Competing foods (candies and chips) sold in school or at the school gate offer no nutritional benefit except empty calories and limits to this practice should be considered.

The benefit to the local agricultural community is considerable. The purchase of imported foods decreased and farmers were provided with an opportunity to efficiently sell their produce. The average production in St Kitts and Nevis for the vegetables used in the school feeding program is 1,027,612 kg per year (from the Agriculture Development Strategy for 2013-2016, provided by the Ministry of Agriculture of St Kitts). For the study period, 1.25% of the total production for the entire country was used in just 4 schools. There is potential for increasing food production in St. Kitts where arable land is available. This new market for farmers is a strong incentive for local fruit and vegetable production.

Project Challenges Encountered

The major constraint would appear to be the slowness of change in dietary habits. This was encountered throughout the project. The changes in the school lunch are difficult to make as it takes time to convince people that fruit and vegetables are needed for health. Food service workers often do not consume the vegetables offered and do not seem to believe the children will eat them. Although increasing the quantity of fruits and vegetables served is challenging, providing more meat (which is not needed in any nutritional sense) is much better accepted.

The reticence to eliminate sugar drinks is strong, as is any move to reduce sales of non-nutritious snack foods in schools. The practice of selling candies and chips to schoolchildren by the principal or teachers is widespread. Other ways of funding school activities are needed. Without committed champions on this front, it is challenging to change the food environment in which children live. The restriction of extra energy from non-nutritious foods has not met with a great deal of support by leaders and will require considerable effort to change attitudes surrounding the wide use of sugar drinks and access to candies and chips at school. Decreasing the risk of children gaining excessive weight is challenging due to the food environment and there is a fine balance as one cannot decrease the food energy of the lunch meal without potentially causing harm to the large number of children who are healthy but thin (Figure 1).

Much more training in nutrition is needed to offer healthy and well accepted foods and to educate the population on the health consequences of obesity. There is a dearth of trained nutritionists working in obesity prevention at present although both the University of the West Indies and McGill are working to enhance the number of people in the Caribbean with this advanced training.

LESSONS LEARNT

New markets for farm produce can play an important role in encouraging more farmers to produce a variety of foods. It is very important to specify the quantities needed and have a person with agricultural expertise approach the farmers to help them supply the produce through improved technologies and ensure a steady supply over the school year. Higher food production does not easily translate into better diets in individuals. Labour-saving devices are needed in the food production centers in order to increase the use of local foods as more processing is involved in such activities as making juices from local fruits, etc. Light food processing is needed in order to preserve foods which are occasionally in oversupply. For example, cold storage or freezing of mango pulp can even out the supply. Mechanical processing of some foods can decrease labour involved in meal preparation.

Through collaborative efforts with many partners, one can successfully feed children more fruits and vegetables and increase local food production through efforts to buy locally. As farmers

produce more food for the schools, this opens up other markets and can cause price competition. Increasing prices result in a greater inducement to grow more produce.

There is a role for education in nutrition as it helps increase food acceptance among children. One can produce more fruits and vegetables and serve them to children but one also has to make sure the children will eat them. Education of those involved in meal preparation to make palatable meals and understand the importance of good nutrition to health is essential.

Finally, for school meals programs there is a role for each of the Ministries of Health Education and Agriculture to play. The Ministry of Health has a role in food inspection and an important role in health promotion by providing healthier environments to reduce the risk of obesity and NCDs. School policies are needed to help create a healthy food environment for children. As with tobacco control, environmental changes can have an impact on diet. It is clearly shown from our work and supported by research in other settings that by supporting school meals programs, fruit and vegetable intake will increase (15, 16).

The Ministry of Education has the lead role in offering a healthy meal and food environment. Good nutrition is important for optimal school performance (17, 18). In addition, children can get an opportunity to learn about food, agriculture and health. Incorporating nutrition education within the curriculum at all levels of primary and secondary schools and teacher education institutions should be prioritized.

For the Ministry of Agriculture, their role is to implement measures to strengthen the agricultural sector to ensure that there is a sustainable supply of locally produced fruits and vegetables and better marketing of local produce. The School is one market but increasing production can lead to other markets such as hospitals and prisons as well as the tourism sector. These three Ministries do not traditionally come together over the school lunch programs; however, working in concert they see the real advantages of supporting the provision of local produce for schoolchildren to increase health, school performance and domestic food production.

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APPENDICES

Appendix 1: Cooked Food Analysis Report 1

Beverly Sample #1 – Curried Channa and Potato, Mango, Pumpkin and Roti
Charles Sample # 1 – Curried Channa and Potato, Mango, Pumpkin and Roti
Ross Sample # 1 - Curried Channa and Potato, Mango, Pumpkin and Roti
Beverly Sample # 2 – Callaloo, Stew Chicken, Plantain and Rice

Attention: Dr. Isabella Granderson

CLIENT	:	The University of the West Indies, Faculty of Food and Agriculture.
CLIENT ADDRESS	:	Department of Agriculture, Economics and Extension, St Augustine
CLIENT ORDER NO./REF.	:	
PROJECT NO.	:	EC03890214/14
REPORT NO.	:	1
DATE RECEIVED	:	February 17, 2014
DATE OF REPORT	:	June 25, 2014
DESCRIPTION SAMPLE	:	Cooked Food

CARIRI SAMPLE NO.	**CLIENT SAMPLE ID**
A 0450/14	Beverly 4/12/13 – Curry Sample # 1
A 0451/14	Charles 4/12/13 - Curry Sample # 1
A 0452/14	Ross 4/12/13 – Curry Sample # 1
A 0453/14	Beverly 4/12/13 - Sample # 2

INTRODUCTION

The Client submitted four frozen food samples for the determination of Moisture, Ash, Protein, Fat, Saturated Fats, Trans Fats, Sugars (as invert sugars), Total Carbohydrates, Cholesterol, Calcium, Iron, Sodium, Dietary Fibre, Vitamin A, Vitamin C, Calories and Calories from Fat. The client requested the preparation of a USFDA Nutritional Label Panel Template for each sample analysed.

The samples were composite samples consisting of:-

Beverly Sample #1 – Curried Channa and Potato, Mango, Pumpkin and Roti

Charles Sample # 1 – Curried Channa and Potato, Mango, Pumpkin and Roti

Ross Sample # 1 - Curried Channa and Potato, Mango, Pumpkin and Roti

Beverly Sample # 2 – Callaloo, Srew Chicken, Plantain and Rice

METHODS

Moisture	:	AOAC[1] 920.175, 925.45 A
Ash	:	AOAC[1] 923.03
Protein	:	AOAC[1] – 954.01 Protein (Crude) in Animal Feed and Pet Feed -Kjeldhal method
Fat	:	AOAC[1] 2006.3
Saturated Fats, Trans Fats	:	AOAC[1] 969.33
Total Sugars	:	AOAC[1] 923.09 - Lane and Eynon Titration Method
Dietary Fibre	:	AOAC[1] 985.29
Total Carbohydrates	:	Determined by calculation from the Moisture, Ash, Fat and Protein values
Cholesterol	:	AOAC[1] 970.51
Sodium, Iron, Calcium	:	Digestion – AOAC[1] 935.13 Analysis - SMEWW[2] Method 3111

METHODS (continued)

Vitamin A	:	HPLC determination
Vitamin C	:	Iodometric titration[3]
Calories	:	Bomb calorimeter
Calories from fat	:	Determined by calculation from the Fat value

RESULTS

ANALYSIS	Beverly 4/12/13 Curry – Sample # 1 A 0450/14	Charles 4/12/13 Curry – Sample # 1 A 0451/14	Ross 4/12/13 Curry – Sample # 1 A 0452/14
Moisture, (g/100 g)	50.63	56.37	54.24
Ash, (g/100 g)	1.53	1.28	1.41
Protein, (g/100 g)	5.64	5.28	4.88
Fats, (g/100 g)	7.85	6.59	5.88
Saturated fats, (g/100 g)	4.43	4.67	4.01
Trans fats, (g/100 g)	Not Detected	Not Detected	Not Detected
Total Sugars, (g/100 g)	2.19	0.57	4.30
Total Carbohydrates, (g/100 g)	34.35	30.48	33.59
Dietary Fibre, (g/100 g)	2.85	2.27	4.60
Cholesterol, (mg/ 100 g)	Not Detected	Not Detected	Not Detected
Sodium, (mg/100 g)	311.81	254.13	332.69
Iron, (mg/100 g)	2.42	2.58	1.57
Calcium, (mg/100 g)	49.44	39.23	27.29
Vitamin A, (IU/100 g)	Not Detected	Not Detected	Not Detected
Vitamin C, (mg/100 g)	Not Detected	Not Detected	Not Detected
Calories, (kcal/100 g)	230.61	202.35	206.80
Calories from fat, (kcal/100 g)	70.65	59.31	52.92

Dates Analyzed: 2014-03-12 to 2014-05-13

RESULTS (continued)

ANALYSIS	Beverly 4/12/13 Sample # 2 A 0453/14
Moisture, (g/100 g)	71.24
Ash, (g/100 g)	1.30
Protein, (g/100 g)	6.21
Fats, (g/100 g)	2.73
Saturated fats, (g/100 g)	2.30
Trans fats, (g/100 g)	Not Detected
Total Sugars, (g/100 g)	0.33
Total Carbohydrates, (g/100 g)	18.52
Dietary Fibre, (g/100 g)	2.86
Cholesterol, (mg/ 100 g)	Not Detected
Sodium, (mg/100 g)	348.20
Iron, (mg/100 g)	0.82
Calcium, (mg/100 g)	27.63
Vitamin A, (IU/100 g)	Not Detected
Vitamin C, (mg/100 g)	Not Detected
Calories, (kcal/100 g)	123.49
Calories from fat, (kcal/100 g)	24.57

Dates Analyzed: 2014-03-12 to 2014-05-13

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APPENDIX

Client: The University of the West Indies
Project Code: EC03890214/14
Name of Product: Beverly 4/12/13 – Curry Sample # 1
Net Wt: 291g

Nutrition Facts

Serving Size 291g
Servings Per Container 1

Amount Per Serving
Calories 670 Calories from Fat 210

	% Daily Value*
Total Fat 23g	35%
Saturated Fat 12g	64%
Trans Fat 0g	0%
Cholesterol 0mg	0%
Sodium 907mg	38%
Total Carbohydrates 100g	33%
Dietary Fiber 8g	33%
Sugars 6g	
Protein 16g	

Vitamin A 0%	•	Vitamin C 0%
Calcium 15%	•	Iron 40%

* Percent Daily Values are based on a 2000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

	Calories	2,000	2,500
Total fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrates	Less than	300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrates 4 • Protein 4

Note: This label format is a guide only and not a camera-ready specimen

APPENDIX

Client: The University of the West Indies
Project Code: EC03890214/14
Name of Product: Charles 4/12/13 – Curry Sample # 1
Net Wt: 374.3g

Nutrition Facts

Serving Size 374.3g
Servings Per Container 1

Amount Per Serving
Calories 760 Calories from Fat 220

	% Daily Value*
Total Fat 25g	38%
Saturated Fat 18g	87%
Trans Fat 0g	0%
Cholesterol 0mg	0%
Sodium 951mg	40%
Total Carbohydrates 114g	38%
Dietary Fiber 9g	34%
Sugars 2g	
Protein 20g	

Vitamin A 0%	•	Vitamin C 0%
Calcium 15%	•	Iron 55%

* Percent Daily Values are based on a 2000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

	Calories	2,000	2,500
Total fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrates	Less than	300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrates 4 • Protein 4

Note: This label format is a guide only and not a camera-ready specimen

APPENDIX

Client: The University of the West Indies
Project Code: EC03890214/14
Name of Product: Ross 4/12/13 – Curry Sample # 1
Net Wt: 355g

Nutrition Facts

Serving Size 355g
Servings Per Container 1

Amount Per Serving
Calories 730 Calories from Fat 190

	% Daily Value*
Total Fat 21g	**32%**
Saturated Fat 14g	**71%**
Trans Fat 0g	0%
Cholesterol 0mg	0%
Sodium 1181mg	49%
Total Carbohydrates 119g	**40%**
Dietary Fiber 16g	**65%**
Sugars 15g	
Protein 17g	

Vitamin A 0%	•	**Vitamin C 0%**
Calcium 10%	•	**Iron 30%**

* Percent Daily Values are based on a 2000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

	Calories	2,000	2,500
Total fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrates	Less than	300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrates 4 • Protein 4

Note: This label format is a guide only and not a camera-ready specimen

APPENDIX

Client: The University of the West Indies
Project Code: EC03890214/14
Name of Product: Beverly 4/12/13 – Sample # 2
Net Wt: 319g

Nutrition Facts

Serving Size 319g
Servings Per Container 1

Amount Per Serving
Calories 390 Calories from Fat 80

	% Daily Value*
Total Fat 9g	**13%**
Saturated Fat 7g	**37%**
Trans Fat 0g	0%
Cholesterol 0mg	0%
Sodium 1111mg	46%
Total Carbohydrates 59g	**20%**
Dietary Fiber 9g	**36%**
Sugars 1g	
Protein 20g	

Vitamin A 0%	•	**Vitamin C** 0%
Calcium 8%	•	**Iron** 15 %

* Percent Daily Values are based on a 2000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

	Calories	2,000	2,500
Total fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrates	Less than	300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrates 4 • Protein 4

Note: This label format is a guide only and not a camera-ready specimen

Appendix 2: Cooked Food Analysis Report 2

Charles Sample # 2 – Pink Beans, Rice, Hot Slaw and Pumpkin Roast Ross Sample # 2 – Callaloo, rice, Stew Chicken and Plantain Beverly Sample # 3 – Lentil Peas, Saffron Rice and Stew Chicken

Attention: Dr. Isabella Granderson

CLIENT	:	The University of the West Indies, Faculty of Food and Agriculture.
CLIENT ADDRESS	:	Department of Agriculture, Economics and Extension, St Augustine
CLIENT ORDER NO./REF.	:	
PROJECT NO.	:	EC03890215/14
REPORT NO.	:	1
DATE RECEIVED	:	March 05, 2014
DATE OF REPORT	:	June 25, 2014
DESCRIPTION SAMPLE	:	Cooked Food

CARIRI SAMPLE NO.	**CLIENT SAMPLE ID**
A 0454/14	Charles - Sample # 2
A 0455/14	Ross – Sample # 2
A 0456/14	Beverly Sample # 3

INTRODUCTION

The Client submitted three frozen food samples for the determination of Moisture, Ash, Protein, Fat, Saturated Fats, Trans Fats, Sugars (as invert sugars), Total Carbohydrates, Cholesterol, Calcium, Iron, Sodium, Dietary Fibre, Vitamin A, Vitamin C, Calories and Calories from Fat. The client requested the preparation of a USFDA Nutritional Label Panel Template for each sample analysed.

The samples were composite samples consisting of:-

Charles Sample # 2 – Pink Beans, Rice, Hot Slaw and Pumpkin Roast

Ross Sample # 2 – Callaloo, rice, Stew Chicken and Plantain

Beverly Sample # 3 – Lentil Peas, Saffron Rice and Stew Chicken

METHODS

Moisture	:	AOAC[1] 920.175, 925.45 A
Ash	:	AOAC[1] 923.03
Protein	:	AOAC[1] – 954.01 Protein (Crude) in Animal Feed and Pet Feed -Kjeldhal method
Fat	:	AOAC[1] 2006.3
Saturated Fats, Trans Fats	:	AOAC[1] 969.33
Total Sugars	:	AOAC[1] 923.09 - Lane and Eynon Titration Method
Dietary Fibre	:	AOAC[1] 985.29
Total Carbohydrates	:	Determined by calculation from the Moisture, Ash, Fat and Protein values
Cholesterol	:	AOAC[1] 970.51

METHODS (continued)

Sodium, Iron, Calcium : Digestion – AOAC[1] 935.13
Analysis - SMEWW[2] Method 3111

Vitamin A : HPLC determination

Vitamin C : Iodometric titration[3]

Calories : Bomb calorimeter

Calories from fat : Determined by calculation from the Fat value

RESULTS

ANALYSIS	Charles Sample # 2 A 0454/14	Ross Sample # 2 A 0455/14	Beverly Sample # 3 A 0456/14
Moisture, (g/100 g)	70.45	69.72	68.11
Ash, (g/100 g)	0.44	1.42	1.05
Protein, (g/100 g)	3.40	8.79	8.79
Fats, (g/100 g)	1.47	4.52	4.52
Saturated fats, (g/100 g)	1.20	1.51	1.75
Trans fats, (g/100 g)	Not Detected	Not Detected	Not Detected
Total Sugars, (g/100 g)	3.31	5.90	1.32
Total Carbohydrates, (g/100 g)	24.24	15.85	17.53
Dietary Fibre, (g/100 g)	2.85	4.43	0.35
Cholesterol, (mg/ 100 g)	Not Detected	Not Detected	Not Detected
Sodium, (mg/100 g)	474.32	325.49	218.70
Iron, (mg/100 g)	2.36	0.71	1.06
Calcium, (mg/100 g)	42.97	22.98	24.09
Vitamin A, (IU/100 g)	Not Detected	Not Detected	Not Detected
Vitamin C, (mg/100 g)	Not Detected	Not Detected	Not Detected
Calories, (kcal/100 g)	37.07	139.24	145.96
Calories from fat, (kcal/100 g)	13.23	40.68	40.68

Dates Analyzed: 2014-03-12 to 2014-05-13

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3. Hoffmann F. *Analytical Procedures for the Determination of Vitamins in Multivitamin Preparations;* La Roache & Co. Limited.

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APPENDIX

Client: The University of the West Indies
Project Code: EC03890215/14
Name of Product: Charles – Sample # 2
Net Wt: 322.8g

Nutrition Facts

Serving Size 322.8g
Servings Per Container 1

Amount Per Serving
Calories 120 Calories from Fat 45

	% Daily Value*
Total Fat 5g	7%
Saturated Fat 4g	19%
Trans Fat 0g	0%
Cholesterol 0mg	0%
Sodium 1531mg	64%
Total Carbohydrates 78g	26%
Dietary Fiber 9g	37%
Sugars 11g	
Protein 11g	

Vitamin A 0%	•	Vitamin C 0%
Calcium 15%	•	Iron 40%

* Percent Daily Values are based on a 2000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

	Calories	2,000	2,500
Total fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrates	Less than	300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrates 4 • Protein 4

Note: This label format is a guide only and not a camera-ready specimen

APPENDIX

Client: The University of the West Indies
Project Code: EC03890215/14
Name of Product: Ross – Sample # 2
Net Wt: 400g

Nutrition Facts

Serving Size 374.3g
Servings Per Container 1

Amount Per Serving
Calories 560 Calories from Fat 160

	% Daily Value*
Total Fat 18g	**28%**
Saturated Fat 6g	**30%**
Trans Fat 0g	0%
Cholesterol 0mg	0%
Sodium 1302mg	54%
Total Carbohydrates 63g	**21%**
Dietary Fiber 18g	**71%**
Sugars 24g	
Protein 35g	

Vitamin A 0%	•	**Vitamin C 0%**
Calcium 10%	•	**Iron 15%**

* Percent Daily Values are based on a 2000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

	Calories	2,000	2,500
Total fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrates	Less than	300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrates 4 • Protein 4

Note: This label format is a guide only and not a camera-ready specimen

APPENDIX

Client: The University of the West Indies
Project Code: EC03890215/14
Name of Product: Beverly – Sample # 3
Net Wt: 211.8g

Nutrition Facts

Serving Size 211.8g
Servings Per Container 1

Amount Per Serving
Calories 310 Calories from Fat 85

	% Daily Value*
Total Fat 10g	**15%**
Saturated Fat 4g	**19%**
Trans Fat 0g	0%
Cholesterol 0mg	0%
Sodium 463mg	19%
Total Carbohydrates 37g	**12%**
Dietary Fiber 1g	3%
Sugars 3g	
Protein 19g	

Vitamin A 0%	•	**Vitamin C 0%**
Calcium 6%	•	**Iron 15 %**

* Percent Daily Values are based on a 2000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

	Calories	2,000	2,500
Total fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrates	Less than	300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrates 4 • Protein 4

Note: This label format is a guide only and not a camera-ready specimen