

Spinach Pasta for Cerebral Palsy in Trinidad and Tobago

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Abstract: Portion controlled spinach pasta was developed for Cerebral Palsy (CP) patients. This paper presents the findings from a pre-study that was conducted to determine whether caregivers of CP children in Trinidad were willing to use nutrient dense spinach pasta. Spinach pasta was developed for oral and tube fed persons. Sensory evaluation was conducted on members of the Cerebral Palsy Society of Trinidad and Tobago (T&T). Chemical, nutritional and statistical analysis was also conducted. It was found from a survey that 95.8% stated there was inadequate information on CP to Trinidadians and Tobagonians which negatively impacted support through Government funding and quality of life for patients and caregivers. Most parents, 62.5% were unemployed and 25% were single or divorced. Most persons, 79.2% would buy the product while 85.7% liked the product. A novel finding was that the influence on purchasing behaviour was nutritive value and not price, usually determined in consumer studies. Spinach pasta is an easy, nutrient dense option for inclusion in the diet. Also, marketing of products for this community should emphasise nutritional content.

Keywords: Cerebral palsy, spinach pasta, feeding difficulty, Trinidad and Tobago

1. Introduction

Cerebral palsy (CP) is caused by faulty development or damage by oxygen deprivation, to the part of the brain that controls movement and posture. It occurs in 3.3 persons per every 1000 live births in the western hemisphere (NINDS 2013). Consequently, it is important to consider the lifestyle of children affected by cerebral palsy and improving their quality of life, rather than simply neglecting their individual needs. Quality of life deals with many factors including perception of an individual's status and participation in normal activities. Fauconnier *et al.* (2009) dealt with assessing the variations in participation in activities by children with different stages of cerebral palsy.

Many studies agree that disabled children experience complications in simple activities in life such as eating, using the restroom and sleeping. However, pain most often affects participation in normal activities than any other factors, followed by poor nutritional status. Fauconnier *et al.* (2009) also proved that children with abnormal feeding exhibited lower participation in activities. CP caused patients to have varying difficulties in chewing, sucking, and swallowing and depending on severity, digesting foods. Furthermore, children aged 1.5 – 17 years old with CP were found to have low serum concentrations of micronutrients, despite receiving supplementation (Hillesund, 2007). These micronutrient deficiencies are associated with poor health status, with one of the major concerns being vitamin D and calcium deficiencies; due to the effect on bone growth (Pruitt and Tsai, 2009).

Many children with CP also have eating and/or swallowing difficulties. Minor difficulties range from slow eating with excessive spillage, while severe difficulties include ill health and/or life threatening conditions (Kriger, 2006, Himmelmann and Uvebrant, 2011). Feeding difficulties often lead to poor nutritional status, growth failure, and esophagitis. It is therefore critical to consider the adequate nutrition and assessment of persons with CP, particularly children, so that their quality of life can match that of a person unaffected by this condition. An abundance of material is available on CP and its implications as well as classifications, however treatments are mainly limited to clinical and physiotherapeutic forms of research (Kriger, 2006). Furthermore, to these authors' knowledge there is a dearth of national, regional and international studies of this nature, where a product is specifically developed for CP, with the aim of providing a nutrient dense product where both macro and micro nutrients are considered. Most studies instead focus on the types of foods one should consume with CP, food consistency and menu planning for this condition.

A fact that is sometimes neglected is CP is a term used to describe a group of individuals whose primary handicap is physical, as opposed to mental. It is a non-progressive disorder of posture and movement caused by a defect or insult to the central nervous system. CP can be classified as 1) Mild: where patients can move without assistance and daily activity is not limited, 2) Moderate: where patients need braces, medication and or adaptive technology for normal daily activity, or 3)

Severe: where patients require a wheelchair and are severely challenged in accomplishing daily activities by themselves (NINDS, 2013).

Many researchers outlined the implications of varying impairments of children and young persons living with CP. A cross sectional study by Gates *et al.* (2010) showed that CP was the most common childhood congenital disorder of movement and posture causing activity limitation, attributed to non-progressive disturbances that occurred in the developing fetal or infant brain. This study focused on the quality of life or wellbeing of the child and functionality or capabilities of the child, as well as health related quality of life. Gates *et al.* (2010) indicated parents' perceptions and patients' perceptions of their condition differed greatly, where the adolescents were more positive overall about their wellbeing and ability to improve. Patients with cerebral palsy may perceive their differences to that of other unaffected children to be less drastic than others. Therefore, when seeking information about the individual, it is recommended that both the parents and adolescents be interviewed, for the assessment of abilities.

Cerebral Palsy in Trinidad and Tobago has a prevalence of more than 1,000 cases (Metivier, 2013). There are 630 members of the Cerebral Palsy Society of Trinidad and Tobago (CPSTT) (Jones, 2013). However, many cases go unreported, which is due partly to the "shame" people associate with having a family member that has CP (Metivier, 2013). The management of this condition is further complicated by the absence of a structured, consistent Government programme to aid caregivers and those affected. Consequently, caregivers are usually parents of CP patients, who may need to stop working in order to facilitate the management of the disease. Moreover, there is little knowledge of the condition across the nation. Since CP patients require special nutritional attention and care, it poses difficulty to both the patients themselves and their parents.

Fung *et al.* (2002) argue that malnutrition is common in children with moderate to severe CP which is associated with poorer health status and limitations in societal participation. Mc Cullougha *et al.* (2013) described health status of 4-17-year-old CP patients and compared them with the general population through a longitudinal, clinical survey. The participants were able to independently walk 10 meters. The study further showed that young persons with CP had significantly poorer health status. Reilly *et al.* (1996) studied the prevalence of feeding problems and oral motor dysfunction in CP children, through a community survey. The study found that of the sample, 57% and 38% experienced sucking and swallowing problems respectively, in the first year of life. The study concluded that brief meal times together with oral dysfunctions made it difficult to obtain an adequate nutrient intake. Bell *et al.* (2010) also studied the relationships between growth, body composition, oral

motor and feeding dysfunctions, diet intake, sedentary lifestyles, quality of life and health care. In contrast, evidences show that CP patients are also at risk of obesity due to sedentary lifestyles and disordered eating (overfeeding due to over estimation of energy needs).

No culturally relevant product has yet been developed in the Trinidad and Tobago market to cater for patients with CP. Furthermore, internationally there is a dearth of information on re-engineered foods for this condition. Spinach which is consumed internationally was used to produce pasta to allow for easy chewing and swallowing while maintaining jaw movement to ensure muscle exercise. The benefits of this included the texture and size of the pasta along with the fact that spinach is nutrient dense, as it provides many nutrients in a serving. Fauconnier *et al.* (2009) dealt with assessing the variations in participation in activities by children with different stages of cerebral palsy. These authors proved that children with abnormal feeding exhibited lower participation in activities. Therefore, it is prudent to provide CP patients with nutrient dense foods to facilitate an increased chance for health and participation in activities.

Given the difficulty in feeding and the nutritional requirements that these patients have, this study aimed to develop a product to cater the nutritional needs of patients with CP or patients with difficulty in chewing and/or swallowing. It was also developed to provide a simple meal preparation alternative for parents of the children with CP.

2. Materials and Methods

2.1 Formula / Recipe and Procedure

A formula / recipe for making the Spinach Pasta was used, comprising the ingredients below

1. 3 eggs
2. 2 ¾ cups white flour
3. 5 ounces Spinach (leaves and soft stems)
4. Salt to taste
5. Water to combine

A standard 6-steps procedure was adopted. These steps are:

1. Blanch Spinach leaves for 1 minute in hot boiling water.
2. Remove leaves from boiling water and blend in blender until mixture is smooth and leaves are pureed (additional water may be added up to a tablespoon)
3. Place spinach, eggs, flour and water into mixer with paddle attachment and mix until dough sticks together.
4. Remove dough from mixer and form into a ball and let rest for 15 minutes.
5. On floured surface, roll dough to 1/8 of an inch thick, using a knife or pastry cutter.
6. Cut strips of dough 0.5 cm thick into noodle shapes.

Moreover, for dealing with baked/dried pasta versus unbaked pasta for tube fed persons, additional steps are used. These are:

For baked/dried pasta

1. Place strips onto baking sheet (ungreased) without each noodle touching.
2. Bake in oven at 375^oC for 30 minutes until dried.
3. Cool, store in freezer, or boil for 10 minutes until desired al dente texture is achieved.

For unbaked pasta for tube fed persons

1. Boil Strips for 8 minutes until cooked throughout.

2.3 Sensory Evaluation

In an effort to ensure that the product meets the needs of the intended target population, it was pretested using a standardised sensory evaluation form. The product was first tested by the Staff and students of the Dudley Huggins building of The University of the West Indies. Based on this first pre-test sensory evaluation adjustments were made to both the sensory evaluation form and the pasta formula. Following this it was decided that two variations of the product should be produced. The first would cater for children who displayed minimum to mild chewing abilities while the second would address children who required tube feeding.

A sensory evaluation questionnaire was developed to evaluate participant ratings for appearance, texture, odour, taste, product preference, factors influencing purchase, purchase intention and overall liking for the product by way of a yes or no response.

On the day of the interview the products were pre-boiled with salt packaged in sealed labeled containers and transported to the Cerebral Palsy Society of Trinidad and Tobago (CPSTT) monthly meeting at the Caroni Food Production office on the Old Southern Main Road in Caroni. In attendance was the executive of the CPSTT and members along with their children. The parents (24 persons) were asked whether they would be able to determine and purchase the product for their children. Products were distributed without any condiments or accompaniments, along with questionnaires so persons could record their answers. Besides, a small number of caregivers showed up to the meeting to participate in the study. All members of the Cerebral Palsy Society were not able to attend as this was a monthly meeting to schedule the Society's events for the following week.

Participants were included within the study once they were the respective caregivers of children with CP and were able to provide oral consent. Persons were excluded if they were unable to provide consent, were vegetarian or were under the age of 18 years.

2.4 Chemical Analysis

Moisture content, crude protein and total fat were determined in the pasta following analysis procedures from the AOAC Official Methods of Analysis (Helrich,

1990). Moisture content was determined based on the AOAC Method 926.07, protein was determined based on AOAC Method 930.25, while fat was determined based on AOAC Method 925.12.

2.5 Nutritional Labelling Analysis

Nutritional analysis for the recipe developed was analysed by ESHA software. The recipe was inputted and reports were generated based on a 100g serving size. Reports were generated for label display, recipe card with multicolumn per 100g and protein quality.

3. Results and Discussion

Cerebral palsy is a health concern among children in Trinidad and Tobago. This health condition has with it a number of nutritional complications that require urgent attention. The information collected from the sensory analysis was then analysed using SPSS 12.0. It was found from the study that a large portion of children diagnosed with CP experience feeding difficulties as the condition results in the impairment of facial muscles, which further diminishes the child's ability to chew, suck or swallow. These critical impairments can place the child at increased risks for under nutrition, failure to thrive, malnutrition, growth retardation and digestive difficulties (Kriger, 2006; Himmelmann and Uvebrant, 2011).

The sensory evaluations conducted on parents was the first step to address the nutritional needs of children diagnosed with CP. Individuals with CP often have poor nutritional status caused by inadequate intakes, oral dysphagia, gastrointestinal reflux and chronic aspiration. Feeding difficulties range from self-feeding challenges, to those with severe disabilities who must be assisted during feeding. CP patients have trouble with sucking, chewing and swallowing. CP feeding of nutrient dense foods would assist with the management, and could improve the quality of life for these patients (Schoendorfer *et al.*, 2011).

This condition is stressful on both the caregiver and children alike. However, having a stable support system is critical in managing this condition; it is therefore not alarming that the majority of participants within the study population although married were unemployed. Table 1 illustrates the marital status of participants where 55% of participants were married, 25% reported being single, while 15% resided within a common law relationship and a minority (i.e., 5%) divorced. Table 2 shows the employment status of participants of which a total of 65.2% were unemployed, only 30.4% of caregivers were employed and 4.3% were students. Studies have indicated that mothers of children with cerebral palsy, whose children showing mild to severe motor impairment are vulnerable to parental stress. However, this was not reported among the study population.

Table 1. Marital Status of Respondents

Marital Status	Frequency	Valid Percent
Single	5	25
Married	11	55
Divorced	1	5
Common Law	3	15
Total	20	100
Missing	4	

Table 2. Employment Status of Respondents

Employment	Frequency	Valid Percent
Employed Full Time	7	30.4
Unemployed	15	65.2
Student	1	4.3
Total	23	100
Missing	1	

Low self-esteem, lack of family and social support, limited financial resources, feelings of frustration, and the daily overload of tasks caused by anxiety, stress and repercussions are common complaints of caregivers of children with CP. Due to the demanding nature of this condition parents/ caregivers are often forced to care for persons with CP as their principal activity and are often forced to work from home or in extreme cases not work at all. These findings were very compatible to those within our study population in which a high percentage of participants were unemployed.

These difficult but necessary decisions are often attributed to the lack of proper daycare and school facilities for CP children, in addition to the fact that caring for a child with CP requires much time and devotion which often does not afford parents the privilege of a full time job. The high rate of unemployment among this population often results in a financial burden to the government who may provide the caregivers of children with this condition a monthly stipend.

The concern for most parents and caregivers is what foods are acceptable for their children with this condition. Few parents have received training on methods to care for their children, including appropriate diet interventions. As shown in Table 3, it is therefore not surprising that the majority of respondents indicated that there is a lack of information in this area in Trinidad and Tobago. This not only has implications to the parent’s ability to effectively care for their children, but also addresses the need for education relating to this health condition.

Table 3 addressed knowledge adequacy relating to Cerebral Palsy in Trinidad and Tobago. The majority of participants (95.8%) reported that there was a lack of information relating to this condition while 4.2% found that there was adequate information on the condition. The caregivers felt there was a lack of communication of information, to support their efforts to care for their charges, was of great importance.

Table 3. Respondents Views about Whether There is Adequate Information about Cerebral Palsy in Trinidad and Tobago

Enough Info on CP	Frequency	Valid Percent
No	23	95.8
Yes	1	4.2
Total	24	100

Therefore, when disseminating the product, information about the product was communicated to those participating in the product evaluation. Parents were given products in containers, as shown in Figure 1, except the product had been pre-cooked. Surveys were distributed with the product and parents were asked to indicate liking for appearance, texture, odour, taste, and factors that influence purchase, purchase intention and overall product rating.

Most of the participants found the product firm as shown in Figure 2 and the texture greatly reflected that of regular pasta. However the texture was in accordance to that of the recommendations for persons with CP. Dietary practitioners recommend textures and consistency of food be maintained at all times either by pureeing, chopping and grinding foods for a more palatable experience. Foods can be softened by adding broth, gravy, milk, or juices to accommodate constipation issues, while liquids can be thickened for ease in swallowing.



Figure 1. Picture of Spinach Pasta before Cooking

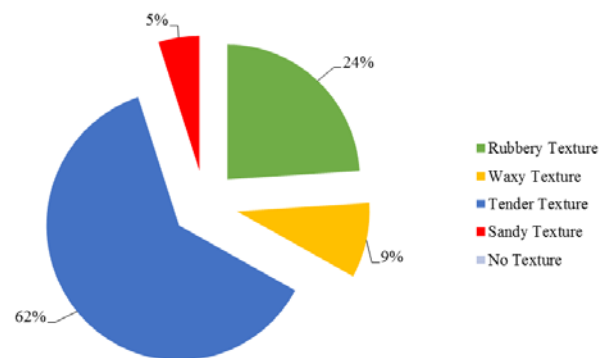


Figure 2. Responses about Texture of Spinach Pasta

Texture is a key component when preparing meals for children diagnosed with cerebral palsy. The majority of participants 62% found the product to be tender, 24% found it to be rubbery, another 9% reported the product had a waxy texture and 5% of participants found the product had a sandy texture.

According to the survey, the product was very well received by the caregivers of the children where 87.5% of participants stated they liked the product overall as shown in Figure 3. It can be concluded that participants generally enjoyed the products based on the needs of their children. Despite this, there seems to be a need for the improvement of the formula, especially where processing or characteristics affecting cooked appearance is concerned, as 56% of participants found the product had a firm appearance; another 20% found the product presented a mushy appearance, 14% indicated it was clumpy while 10% found the product to have a dry appearance (see Figure 4). However, major improvements do not seem to be required where product taste and odour are concerned.

This level of participant satisfaction was further deduced as the majority of participants stated they were willing to purchase the product if they were made available for purchase (data not shown).

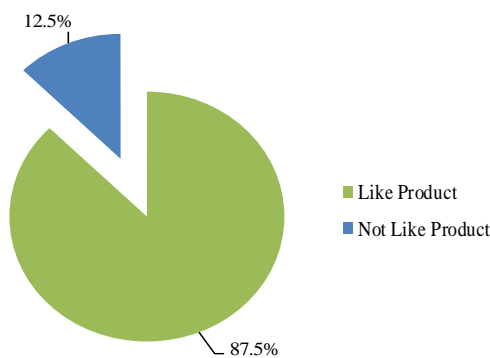


Figure 3. Responses about Overall Rating of Spinach Pasta

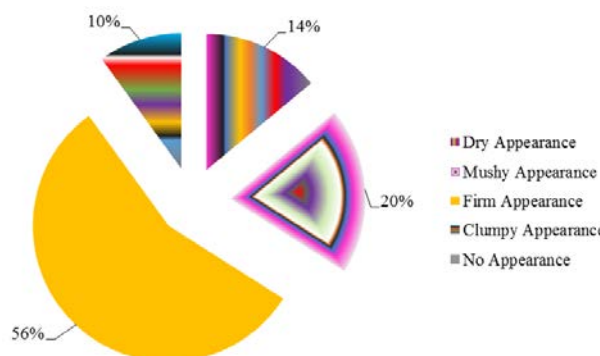


Figure 4. Responses about Appearance of Spinach Pasta

According to Figures 5 and 6, there were positive associations for product taste and odour respectively.

This evaluated taste may serve as encouragement to CP patients, especially given the aforementioned challenges with feeding. For caregivers, using this product may translate to convenience and time management as the entire family may consume the product. Odour also received ratings which support the possibility of the spinach pasta being used by the CP patients and their caregivers.

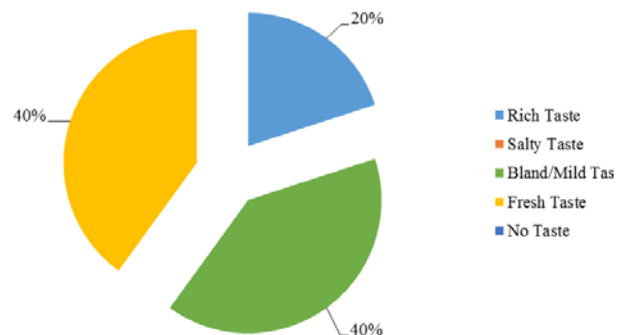


Figure 5. Responses about Taste of Spinach Pasta

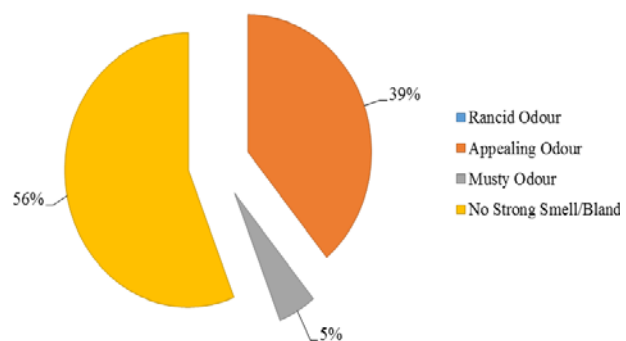


Figure 6. Responses about Odour of Spinach Pasta

Forty percent (40%) of participants found the product to have a bland or mild taste as well as a fresh taste. Twenty percent (20%) found the product to have a rich taste, while none of the participants reported the product as having a salt taste or no taste. The majority (56%) of participants found the product to lack a strong smell or odour and found there was a bland odour; 39% reported the product had an appealing odour and 5% found the product to have a musty odour.

This product may be beneficial to caregivers of children with CP to aid in providing nutritious meals, despite the difficulties experienced during feeding. The caloric intake of patients with CP is very important especially in children, as deficient dietary intakes may lead to growth impairments or development retardation. According to Soylu *et al.* (2008) malnutrition is in fact a major concern for CP patients. They evaluated the effect of nutritional support on clinical findings by analysing questionnaire responses and anthropometric measurements (skinfold, weight, and height).

The study found that after being on nutritional support for 6 months, there was no evident difference in the first and last height in those who completed the follow-up process. However, skinfold measurements and height and weight parameters improved; also there was a significant decrease in infections and constipation. This may indicate that although nutritional support may have provided adequate calories, the protein quality may have required improvement in order to significantly affect height improvements. Therefore, both good protein quantity (as shown in Table 4) and good protein quality are required for CP persons.

Table 4. Protein and Fat Values for an Average 100 grams of Sample (Dried)

	Crude Protein on DM basis	Fat
Totals:	6.86 g	1.99 g
% Daily Value (FDA)	13.72 %	3.06 %

ESHA evaluation shown in Figure 7 found the protein quality was good. For persons with CP, the provision of all these amino acids in only 100 grams of the spinach pasta as well as the protein efficiency ratio affords this population to have an inexpensive product that caters to their nutritional requirements. Also pasta is rarely consumed alone, and is frequently consumed with animal protein. Therefore, the protein complementarity from a meal of spinach pasta and meat will provide the essential amino acids. Adequate protein intake is essential for the building and repair of tissue, for adequate growth and development in childhood and to promote lean tissue gain. There is currently no evidence to suggest that protein requirements of children with CP differ to those of typically developing populations, and therefore recommendations for typically developing children can be applied (Bell and Sampson-Fang, 2013). Protein efficiency ratio also referred to as protein utilisation gives a ratio of the weight gained from consumption of the amino acids. Therefore, the gain of body mass through muscle requires the provision of high

quality proteins, like those found in the spinach pasta.

A total of 13.72% of the product contained protein, indicating it is a good source of protein and 3.06% contained fat, which indicated the spinach pasta is a low source of fat.

Protein intake is an important part of the dietary intake of CP children, the amino acid ratios for spinach pasta was high at 181% for Tryptophan, 180% for Phenylalanine and Tyrosine, 163% for Isoleucine, Methionine and Cystine. Other scores included 154% for Valine, 133% for Leucine, 125% for Histidine, 120% for Threonine and 77% for Lysine. Therefore this spinach pasta scored high for the ratios of the amino acids.

Based on nutritional analysis conducted for the spinach pasta 100 grams provided just 190 calories, 2 servings of carbohydrates, 0 simple sugars and was low in fat, while being high in fibre, vitamin A and iron as shown in Tables 4 and 5. Walker *et al.* (2012) showed in their study which determined the relationship between Energy Intake (EI), macronutrient intake and body composition in preschoolers with CP compared to those of typical developing children (TDC) that a significant relationship between EI and fat free mass existed as fat free mass was larger in TDC than those with CP. Consequently, low fat nutrient dense products may be required. Moreover, it has been found that constipation is a frequent condition in persons with CP due to inadequate dietary fibre intake. The spinach pasta is both low in fat and a good source of fibre (see Figure 8). The nutritional content of the product is to be placed on the product label, following its analysis by ESHA.

This product can therefore provide nutritional support for minimum calories at both the macronutrient and micronutrient levels. Grammatikopoulou *et al.* (2009) investigated growth and nutrition in children and adolescents with CP in comparison with their healthy siblings. Those with CP were presented with lower intakes of Vitamin A, Biotin, Folate, Vitamin K and Copper compared to siblings. Asmah *et al.* (2015) further stated a deficiency of the micronutrients copper, zinc and selenium may result in disorders of the nervous system, while care must also be taken with supplement

Number of Servings: 7.95 (100 g per serving)
Weight: 795.25 g

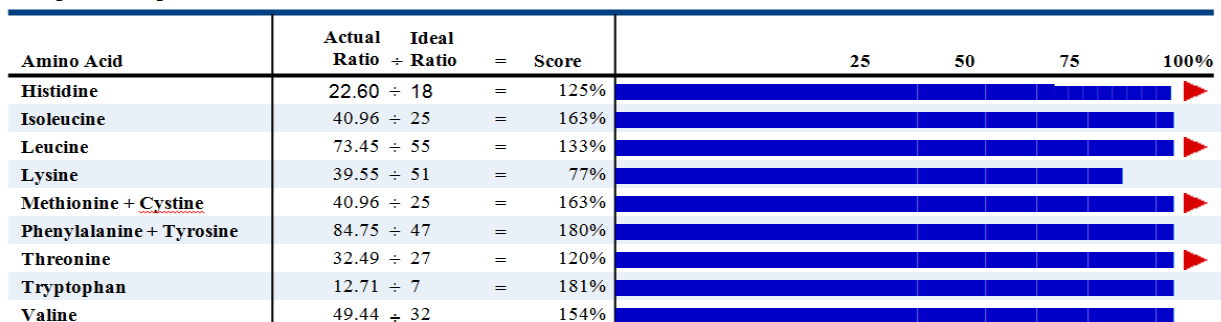


Figure 7. ESHA Protein Quality Analysis for Cerebral Palsy Spinach Pasta

Table 5. Nutrient Analysis for 100 grams of Spinach Pasta

Amount	Measure	Ingredient	Comments
3.00	Med	Eggs, raw	
2.75	Cup	Flour, all purpose, white, unbleached,	
5.00	Oz	Spinach, cooked, with salt, drained	
0.75	Cup	Water, tap	

Nutrient Analysis			
Nutrient	Per 100g	Nutrient	Per 100g
Gram Weight (g)	100.00	Vitamin C (mg)	1.75
Calories (kcal)	185.18	Vitamin D - IU (IU)	13.61
Calories from Fat (kcal)	18.44	Vitamin D - mcg (mcg)	0.33
Calories from SatFat (kcal)	5.34	Vitamin E - Alpha-Toco (mg)	0.64
Protein (g)	7.08	Folate (mcg)	112.93
Carbohydrates (g)	33.77	Folate, DFE (mcg)	159.61
Dietary Fiber (g)	1.59	Vitamin K (mcg)	88.16
Soluble Fiber (g)	0.53	Pantothenic Acid (mg)	0.47
Total Sugars (g)	0.25	Calcium (mg)	40.69
Monosaccharides (g)	0.06	Chromium (mcg)	0.07
Disaccharides (g)	0	Copper (mg)	0.11
Other Carbs (g)	31.92	Fluoride (mg)	0.02
Fat (g)	2.05	Iodine (mcg)	8.80
Saturated Fat (g)	0.59	Iron (mg)	2.93
Mono Fat (g)	0.65	Magnesium (mg)	27.23
Poly Fat (g)	0.52	Manganese (mg)	0.47
Trans Fatty Acid (g)	0.01	Molybdenum (mcg)	2.82
Cholesterol (mg)	61.75	Phosphorus (mg)	89.53
Water (g)	56.38	Potassium (mg)	152.22
Vitamin A - IU (IU)	1958.67	Selenium (mcg)	20.02
Vitamin A - RAE (RAE)	120.07	Sodium (mg)	79.87
Carotenoid RE (RE)	187.03	Zinc (mg)	0.65
Retinol RE (RE)	26.56	Omega 3 Fatty Acid (g)	0.04
Beta-Carotene (mcg)	1121.23	Omega 6 Fatty Acid (g)	0.46
Vitamin B1 (mg)	0.36	Alcohol (g)	0
Vitamin B2 (mg)	0.33	Caffeine (mg)	0
Vitamin B3 (mg)	2.65	Choline (mg)	52.28
Vitamin B3 - Niacin Equiv (mg)	4.14		
Vitamin B6 (mg)	0.09		
Vitamin B12 (mcg)	0.15		
Biotin (mcg)	3.76		

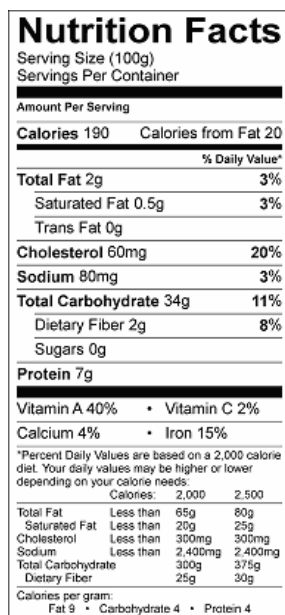


Figure 8. ESHA Label for Cerebral Palsy Spinach Pasta

use and nutrient - nutrient interactions as the overuse of zinc may reduce copper utilisation, leading to oxidative stress. Nutrition information to caregivers of persons with CP should facilitate the provision of dietary nutrients and not focus on the intake of supplements. Table 5 also shows the micronutrient benefits of the spinach pasta.

Malnutrition, including micronutrient deficiencies may lead to increased risk of infection, diminished cerebral growth and other conditions which may result in the CP person exhibiting lowered cognitive development, as well as abnormal behaviour (Kuperminc and Stevenson, 2008). The provision of micronutrients commonly associated as deficient in CP may reduce the risk of these developmental challenges in children. The spinach pasta (based on Table 5) is a good source of Vitamin A, Biotin, Folate, Vitamin K and Zinc, which were found to sometimes be deficient in CP children and therefore nutrients of concern.

Vitamin A which is important for immune function has a recommended intake (RI) of 700-900 mcg RAE, while the US FDA suggests a daily value of 5000 IU.

The spinach pasta provided 120.7 RAE and 1958.67 IU per 100 grams. Biotin has a suggested AI of 5-25 mcg depending on age and sex, while the spinach pasta provided 3.76 mcg per 100 grams. The RDA for folate is 200-300 mcg per day depending on sex and age with the pasta providing 112.93 mcg per 100 grams. Zinc which is important for immune function and required for normal growth and development during childhood and adolescence has an RDA of 2-11 mg, depending on age and sex, with the spinach pasta providing 0.65 mg. Also Vitamin K which is important for bone metabolism has adequate intakes of 30 mcg for children 1-3 years, 55 mcg for children 4-8 years and 75 mcg for persons 14-18 years, with the spinach pasta providing 88.16 mcg per 100 grams. This spinach pasta can provide micronutrients of concern at levels which may reduce the risk for deficiencies.

Nutritional stunting caused by macro and micro nutritional deficiencies can lead to short stature according to Wittenbrook and Parrish (2011). These authors stated that once adult size is reached, increasing energy and protein intake will have no effect on increasing height. In this study energy intake based on the needs of the individual was recommended, as no two persons with CP display the same characteristics. However, admittedly the nutritional needs for children with CP are difficult to estimate. Bell and Sampson-Fang 2013 emphasised the need to evaluate body composition, physical activity levels etc, when planning meals for this group. It was also advised that protein intake be estimated using the Recommended Daily Allowance (RDA) and Dietary Reference Intake (DRI) and the actual weight or appropriate weight for height used. This means 1.5-2g protein per kilogram body weight per day. The RDA and DRI are also relevant for micronutrients.

Arrowsmith *et al.* (2012) published a study which aimed to measure Resting Energy Expenditure (REE) and nutritional intake in children with severe CP in relation to body composition, as well as effects increased intake had on REE. It was stated that altered body composition and growth abnormalities are usually associated with cerebral palsy but equations to estimate energy requirements (REE) using body composition based on normal mentally healthy children tend to over-estimate needs for children with cerebral palsy.

Their study showed that once children are fed by gastrostomy and by oral means, the resting energy expenditure increased due to weight gain. It signified that most children with CP have too low an intake and their bodies adapt to low intake and therefore resulting in a low REE. It was also established that this is reversible in most children, so the use of a nutrient dense product like spinach pasta may have the ability to not only meet current nutritional needs of persons with CP, but also attenuate the negative effects which may have resulted from a previous nutrient poor diet. However, Arrowsmith *et al.* (2012) found weighed food records

overestimated the intake by approximately one hundred and seventy percent for orally fed children. It may be difficult to monitor intakes in these patients but it is worth pursuing in order to maintain a healthy quality of life.

When sensory evaluation tests were conducted, the preferences and factors influencing purchase of a product were assessed with respect to the caregivers of the CP patients, as shown in Figure 9. The majority of respondents stated that nutritive value of the product was more of a concern than the price and availability. This is in contrast to consumer studies that consistently showed price to be a major concern and not nutrient content as the main factor in purchasing decisions.

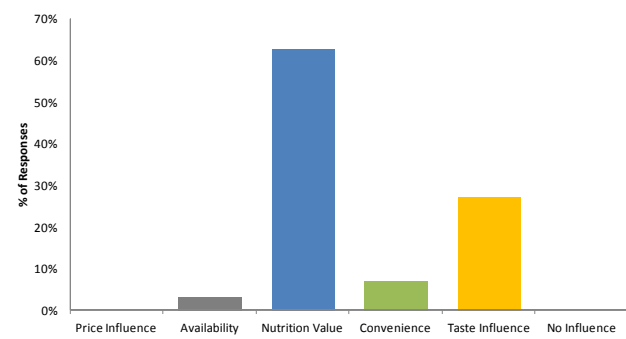


Figure 9. Factors Affecting Respondents Choice of Products

In addition to this taste was the second most important factor to respondents, followed by availability and convenience respectively. Marketing of products for this population must therefore emphasise nutritive value. This may be due to the fact that poor nutrition is associated with the inability of CP patients to participate in activities as well as negative effects on health.

The spinach pasta was found to be generally satisfactory and well rated by the caregivers who participated in the survey. There is therefore a need for future studies among this population as there is an evident gap in the information available to caregivers and patients as well as in the types of products that can be available to them. According to Schoendorfer *et al.* (2011), there is a paucity of information and studies on micronutrient deficiencies and appropriate interventions to mitigate dietary imbalances and the corresponding physiological effects to persons with CP.

4. Conclusion and Recommendation

This all natural spinach pasta was tested with parents and care givers of persons with CP who were in attendance at the meeting of the CPSTT. Of the persons in attendance, the majority stated they would purchase the product while others indicated they liked the product. From this evaluation, it can be concluded once this product is fully engineered to consider both organoleptic and postprandial glycemia there is grounds for a high

acceptance rate among the CP community. Parents and Caregivers are responsible for food choice for CP patients so their acceptance of the product is critical to the product being introduced to the CP community.

Future studies can be conducted using this spinach pasta, as it is both acceptable organoleptically and nutritionally, furthermore it has the potential to attenuate nutritional micronutrient and macronutrient deficiencies, once part of a well-constructed meal plan. In producing the pasta, the dough was rolled and cut by hand which prevented uniformity of the product and therefore, becomes an area for improvement, especially as this artisan method of production may affect product texture. In producing the product, the packaging which was originally determined, was replaced to accommodate a cheaper, more feasible alternative as this research was self-funded.

Some limitations of analysing the study include that no children with Cerebral Palsy were able to sample the product at the meeting due to ethical concerns and time concerns. The parents who are responsible for purchasing food and preparing meals for the CP persons were instead asked to sample, as they would be able to determine whether they would purchase the product for their children. Additionally, only a small number of caregivers showed up to the meeting to participate in the study. All members of the Cerebral Palsy Society were not able to attend as this was a monthly meeting to schedule the Society's events for the following week. Therefore the results do not express the views of the entire Cerebral Palsy Society of Trinidad and Tobago, but a few members.

In laboratory analysis of the product, the procedures used assumed that total Nitrogen of the sample reflected protein nitrogen, which may not necessarily reflect protein nitrogen alone. However, ESHA analysis found the protein quality to be high, with the protein efficiency ratio for 8 of the 9 amino acids above 100%. Furthermore micronutrients that are frequently a challenge in the diet of persons with CP were well represented in this product. Therefore this pasta is nutrient dense and may facilitate disease management and support an improved quality of life through enhanced nutritional status.

One of the main concerns that were presented in this study was the lack of information to parents and caregivers, which is necessary to ensure a good quality of life for persons with CP. It is recommended that diet sheets be developed for this population, similar to those given to persons with type 2 diabetes mellitus and hypertension. Parents can be presented with a recommended list of nutrient dense foods, from medical professionals. Also because the actual food intake to ensure health is specific to the individual with this condition, there should be a scheduled dietary intervention where parents are instructed on actual quantities and types of foods to be fed for example every 3 months. This dietary intervention should be based on

the person with CP weight, height, body composition and specific factors on their condition. These types of interventions will not only aid both parents and CP persons to have a better quality of life but may also address the high unemployment issue, as CP patients will have an improved chance of functioning reducing the burden on parents.

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