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Low-cost superfoods in the Caribbean

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Abstract

Commonly consumed foods in the Caribbean were ranked according to a wide range of classical nutritional criteria. The costs of those foods in relation to their rank were also highlighted. Some foods, however, have other natural beneficial effects on body function and maintenance that go beyond the classical nutritional criteria and are relevant to an improved state of health or reduction of the risk of disease. This paper also presents those additional health benefits in the context of the classical ranking and cost of commonly consumed Caribbean foods. The challenges and requirements for the expansion of such foods are presented.

Introduction

Consumption of a healthy diet is vital to reduce obesity and its consequences such as diabetes, cardiovascular diseases and cancers. A healthy diet has traditionally been defined by the classical criterion of appropriate proportions of macronutrients and micronutrients. While most foods are good to maintain a healthy diet, not all contain powerful components that can further fight disease and improve the immune system - noted characteristics of "superfoods". The "superfood" label is therefore not used here to undermine the nutritional quality of other foods but to highlight their additional active compounds.

In recent decades it has become clear that plant-based diets in particular have components other than traditional nutrients that can reduce the risk of several chronic diseases. More than a dozen classes of these biologically active plant chemicals, known as phytochemicals, have been identified [1]. For example, on cancers, overwhelming evidence from hundreds of studies indicates that cancer risk in people consuming diets high in fruits and vegetables was only one-half that in those consuming few of these foods [2]. For over two decades health professionals have recognized the role of phytochemicals in health enhancement [3]. Beyond cancer, some key phytochemicals have several other benefits: Isoflavones are known to have antidiabetic, antioxidant and anticancer effects. Flavonols in general promote heart health and may help reduce stroke risk. Flavonols such as quercetin decrease oxidative stress and have anti-cancer activity. Catecholamines help with anti-inflammatory activity [4,5].

The recognition of the importance of these phytochemicals has ushered in several new challenges: should nutrition labels include these phytochemicals? Should the food industry be allowed to advertise disease- or health-related messages for their food products which contain them? But the challenge is more complex because in addition to natural phytochemicals, food manufacturers have been manipulating and modifying foods in an attempt to enhance their bioactivity. Consequently, in the last two decades there has been an explosion of consumer interest in the health enhancing role of specific foods or physiologically-active food components, now known as functional foods [6]. The emergence of these functional foods has added new challenges to the food regulators with respect to safety and health claims.

To better appreciate these challenges in the Caribbean this study examined seventeen commonly consumed foods in the region using both classical health criteria and also their phytochemical profiles. The foods studied therefore included only those that have not been modified-*i.e.,* the natural functional foods. The study also considered the cost of these foods as this is another key factor that influences food choice. The aim is to identify the food crops, "superfoods", that can be priorities for production by the agriculture sector in the Caribbean.

Methods

The prices of one hundred and fifty eight commonly consumed foods were obtained from six parishes in Jamaica during the month of June 2014. These prices were collected from popular supermarkets, wholesale and open markets. To increase the applicability of the findings, prices were obtained from densely populated areas and from vendors which were most popular among consumers in each parish. These foods were then ranked according to their health benefits using classical criteria. Unlike other studies that merely compared high and low energy dense foods [7], this study included type of fat, vitamin, mineral and fiber content, and others, in classifying foods as healthy and less healthy. Table 1 shows the criteria used to classify foods that were ranked. The criteria utilized were associated with major chronic diseases prevalent in the Caribbean [8]. Food composition data were used to determine the quantities of the relevant nutrients contained therein. Scores were allocated for each nutrient and then totaled to develop a Cumulative Rank Score (CRS). Note that several criteria items were combined to develop the score. This score was translated into the rank of the food within all food groups. The average cost was calculated using the costs of the commodity in each parish. This approach also avoided the methodological weakness of comparing energy density with energy cost [7]. The food commodities were arranged according to their CRS, with the highest score being first and the lowest score last.

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In addition to the classical criteria, selected foods were also assessed according to their phytochemical content. Fruits and vegetables are well known for their high phytochemical profiles [9,10]. Hence, fruits and vegetables were not included in this analysis. For this paper 17 of the top ranked staples and other plant foods were analyzed.

Results

The main phytochemicals identified in the literature for the selected foods and their relationships to health are presented in Table 2.

Table 3 shows the ranking of the selected foods according to classical criteria in Table 1. The legumes such as pigeon peas and kidney beans are highly ranked whereas the plant fats such as ackee and avocado are lower in the ranking. Tubers such as dasheen and cassava are lower ranked than yam and sweet potato. It is important to note that banana/plantain, sweet potato, breadfruit, yam, dasheen and cassava are among the cheapest foods on the market, whereas the legumes are among the most expensive.

Table 3 also shows the potential added health benefits from these foods. The rating of potential health benefit is based on the strength of the scientific evidence and the range of therapeutic action. Strikingly, some expensive foods such as pigeon peas, kidney beans and rolled oats have good added potential. But cheap foods such as breadfruit and sweet potato also provide good options.

Discussion

It is important to note that thousands of phytochemicals have been identified and there may be many more yet undiscovered. The powerful phytochemical benefits from vegetables and fruits are well established [9,10]. This paper highlights the lesser known phytochemical benefits in staples and other common plant foods in the Caribbean.

Table 2 shows that phytochemicals have the potential to stimulate the immune system; slow the growth of cancer cells, activate insulin receptors, prevent substances from becoming carcinogenic, reduce oxidative damage to cells, among others (World Cancer Research Fund, 2007). The key word however is potential - because identifying which compounds are responsible for the benefits is difficult due to interactions with vitamins and minerals. Further, the bioavailability and storage ability of phytochemicals varies considerably. Moreover, their antioxidant activity is reduced during metabolism [11]. Despite these drawbacks there is clear evidence that phytochemicals can help to prevent disease [12-16].

Table 3 highlights the health benefits of several Caribbean staples such as breadfruit, sweet potato, yam, banana, plantain, among others. These foods are low-cost and excel in terms of various health criteria [17]. We contend that Caribbean agriculture and food security strategy must include cost and health as imperatives in advancing the food policy in the region. The variety of health gains that can be exploited from foods that are ranked high with both the classical and non-classical criteria suggests that these can be regarded as "superfoods". But this

Table 1. Classical Criteria for ranking commodities and the associations with major public health diseases.

Classical criteria for grading	Associations with major sub-regional public health diseases
High in Complex Carbohydrates	❖ Greater glycaemic control due to lower glycaemic index, reducing risk of impaired glucose tolerance (precursor to diabetes) ❖ More satiety for fewer calories, allowing for better weight management
High in Dietary Fibre	❖ Reduces plasma total and LDL cholesterol levels, reducing risk of cardiovascular diseases (CVDs) ❖ Reduces transit time through gut, possibly lowering absorption of carcinogens
Low in Total Fat	❖ Reduces the build-up of excess adipose tissues that contribute to body weight
Low in Cholesterol	❖ Reduces the risk of vascular disease which causes plaque build-up on blood vessel walls ❖ Reduces impaired glucose tolerance and dyslipidaemia
Low in Saturated Fats	❖ Reduces risk of elevated total and LDL cholesterol levels ❖ Reduces risk of fat-induced impaired glucose tolerance and insulin sensitivity ❖ Reduces risk of obesity and co-morbidities
High in Monounsaturated Fats	❖ Reduces risk of elevated total and LDL cholesterol ❖ Reduces risk of impaired glucose tolerance
High in Polyunsaturated Fats	❖ Reduces the risk of coronary heart disease (CHD)
High in Iron	❖ Reduces risk of iron-deficiency anaemia ❖ Reduces the risk of impaired cognitive function
Low in Sodium	❖ Reduces risk of elevated blood pressure and CHD
High in Potassium	❖ Reduces risk of elevated blood pressure and CHD
High in Calcium	❖ Reduces risk of osteopenia and osteoporosis
High in Vitamin A	❖ Promotes the body's use of iron ❖ Reduces the risk of blindness and ocular injury ❖ Reduces the risk of impaired growth and development and of impaired immunocompetence
High in Vitamin C	❖ Facilitates iron-absorption ❖ Possibly lowers risk of cancer and CVDs
High in Vitamin B_6	❖ Assists release of glycogen for energy from the liver ❖ Enables the body to manufacture and convert amino acids and metabolize proteins
High in Folate	❖ Promotes DNA synthesis and cell replication to probably decrease the risk of certain cancers and CVDs. ❖ Aids in reducing blood homocysteine levels

Table 2. Common Caribbean food commodities showing potential health benefits.

Foods	Scientific name	Some phytochemical constituents	Overall therapeutic indications
Ackee	*Blighia sapida*	Alkaloids, tannins, saponins, flavoniods and phenols	Antioxidant activity
Avocado	*Persea americana*	Isoflavones, lutein, zeaxanthin, saponin, genestein	Helps support cardiovascular health; anticancer activity; boost immune system
Banana-Green/Ripe	*Musa acuminata, Musa sapientum*	Catecholamines, tannin, albuminoids, glycosides, alkaloids, flavonoids;quercetin, sterols	Antidiarrhoeal; Ulcer protective antimicrobial activity; wound healing, kidney cancer activities
Breadfruit	*Artocarpus altilis*	Flavonoids including geranyl	Cytoprotection; Anti-cancer; antioxidant activities
Cassava	*Manihot esculenta*	Alkaloids, saponins, steroids, flavonoids; flavonols	Cytoprotection; wound healing
Coconut	*Cocos nucifera*	Terpenoids, alkaloids, lauric acid, glycosides and steroids; flavanoids, phenols, steroids	Glucose homeostasis and antioxidant activity; controls severe hyperglycemia
Corn	*Zea mays*	Phenols; lutein, zeaxanthin, free stanols/sterols; anthocyanins	Controls diabetes, lowers blood pressure; anticancer activities
Dasheen	*Colocasia esculenta*	Thiamin, folate, calcium oxalate	Management of diabetic nephropathy.
Kidney bean-red	*Phaseolus vulgaris*	flavonoids, unsaturated sterols saponins	Hypoglycaemic, antidiabetic properties, appetite control
Oats-rolled	*Avena sativa*	Phenolic compounds, flavonoids, sterols	Lowers LDL cholesterol and blood pressure; improved insulin sensitivity
Peas-Pigeon (gungo)	*Cajanus cajan*	Sitosterol, isoquercitrin, quercetin	Anti-inflammatory , antioxidant, Immuno-modulatory activities
Peas-split	*Pisum sativum*	phenolic acids, flavone and flavonol glycoside	Antioxidant activity
Plantain-Green /Ripe	*Musa paradisiaca*	Serotonin; flavonoids, acyl steryl glycosides	Gastroprotective; lowers cholesterol; antioxidant; mutagenic effect
Potato, Irish	*Solanum tuberosum*	Phenols,carotenoids; anthocyanins	Reduces blood pressure and cancer cell growth
Potato, sweet-purple	*Ipomoea batatas*	Anthocyanin; quercetin, steroids, flavonoids, ploy phenols	Antioxidant; anticancer activities
Rice, brown	*Oryza sativa*	Phenols; phytic acid	Cancer prevention
Yam	*Dioscorea spp*	Phenols	Lowers LDL cholesterol and colon cancer risk

Table 3. Ranking and cost of selected foods based on classical criteria and other health benefits.

Food	Classical rank	Cost US$/Kg	Potential for added health benefits*
Pigeon (gungo) peas	1	4.06	xxxx
Red Kidney beans	2	2.34	xxx
Green /ripe Plantain	3	1.38	xx
Green / ripe Banana	4	0.45	xx
Yam	5	1.33	xx
Split peas	6	3.29	xx
Brown Rice	7	2.49	xx
Rolled Oats	8	3.32	xxxx
Sweet Potato-purple	9	0.99	xxx
Breadfruit	10	1.10	xxx
Irish Potato	11	1.53	xx
Avocado	12	3.36	xxx
Dasheen/Eddo	13	1.24	x
Cassava	14	1.28	x
Coconut	15	1.34	xx
Corn	16	1.80	xxx
Ackee	17	1.90	x

*Potential health benefits based on strength of evidence and range of activity

xxxx = convincing; xxx = very strong; xx = strong; x = probable

notion of superfoods has led the global food industry to capitalize on these additional benefits in their production and marketing. Further, the food industry has dramatically expanded this phenomenon and has manipulated several foods in its attempt to make wide-ranging health claims for their modified products. The result of this expansion has led to what is known as functional foods [3,6]. These functional foods have raised several challenges: Should these foods form a distinct category within the Caribbean food supply system? Should they be distinguished from foods simply fortified with vitamins or minerals?

We contend here that the law in Caribbean countries should allow health claims for nutrients naturally contained in conventional foods which have proven health benefits. For foods manipulated by food manufacturers, a different process should obtain. Many of these functional foods are little more than marketing gimmicks that attempt to gain a competitive advantage and to justify an increase in price rather than genuine efforts to improve the health of consumers.

The explosion of functional foods with these false claims clearly warrants regulation so that it maximizes health benefits and minimizes health risks. Caribbean regulators should ensure that only safe and effective products are marketed and that health claims are supported by adequate scientific evidence.The research should show that the product is safe for the general public, for both well and ill persons who might unintentionally consume the product. We already have regulations on ingredients added to preserve, flavor, and color foods. It is suggested here that similar regulations should apply to functional ingredients added to foods to provide a physiological effect. Failure to regulate these functional foods will provide no protection of the public

from potentially hazardous ingredients and will lead to information confusion and misleading claims.

The advent of functional foods should therefore not detract from or reduce attention to the well-established classical criteria for healthy diets. So while the regulators evaluate the safety of various functional foods, the key to improved diets will remain with effective nutrition labeling using classical criteria. Foods with added beneficial ingredients that are supported by sufficient scientific substantiation have the potential to be an increasingly important component of a healthy lifestyle and will be beneficial to the public and the food industry. The demand and market value for health-promoting foods and food components will continue to grow. The next challenge will then be to develop meals with functional foods for healthy persons; demonstrate that they can prevent the risk of disease; and prepare meals appropriate for persons diagnosed with disease.

While the debate will continue about the efficacy of functional foods this study shows that the naturally occuring compounds which confer added health benefits to low-cost Caribbean foods should be compelling enough to bolster the food security strategy in the region.

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