

Functionality of *Aframomum Danielli* Seed Powder Extract in Glycemic Load of Soymilk-Based Juice

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Received April 12, 2014; Revised June 03, 2014; Accepted July 04, 2014

Abstract Spices are important supplements added to food as flavouring agents and/or a preservative and have been in use all over the world for thousands of years. Various additives have been utilised over the years to spice our food products. Synthetic additives, which have been in use, have come with various side effects, hence the need to shift focus to the use of natural ones. Research into the production and utilization of indigenous food additives on a large scale has not been undertaken in Nigeria. Even its utilization in food products to prevent or reduce food related ailments or diseases have not really been done. This present work investigates the health benefits of the spice's extract on the glycemic load (GL) of the juice to consumers. Standard method was used for extraction of juice from carrot, watermelon and pawpaw. Standard method [8] was equally used for the proximate composition (moisture content, protein, fat, carbohydrate, crude fibre and ash), while soymilk was made from soybeans under laboratory condition. The juices from the vegetable (carrot), fruits (watermelon and pawpaw), and soymilk were blended in equal ratios and thereafter treated with *A. danielli* extract (1g-3g). Glycemic load (GL) of the samples was determined by multiplying the weighted average of the glycemic indexes (GIs) of the mixed meal by the available carbohydrate and dividing the product by 100. Available carbohydrate was determined by subtracting the fibre content from the total carbohydrate. GL of untreated samples was 10.26, while treated samples recorded low values (6.11-7.20). Standard values were 1-10, low GL; 10.1-20, medium GL; above 20.1 and above, high GL. The outcome of the work could assist in utilising local spices for the full benefit of consumers.

Keywords: *A. danielli*, soymilk-based juice, glycemic load, proximate analysis

Cite This Article: A.O. Dauda, and G.O Adegoke, "Functionality of *Aframomum Danielli* Seed Powder Extract in Glycemic Load of Soymilk-Based Juice." *American Journal of Food Science and Technology*, vol. 2, no. 3 (2014): 98-102. doi: 10.12691/ajfst-2-3-4.

1. Introduction

Fruits and vegetables are among the most important foods of mankind as they are not only nutritive but are also indispensable for the maintenance of health. They are able to decrease the risk of cardiovascular diseases and cancer [5]. Apart from their nutritional and sensory properties, fruits and vegetables are currently recognised as active and protective agents [49].

Fruits and vegetables are low in calories and fat. Consumers relish juice drinks, and in a bid to meet consumer's demands, fruit and vegetable juices are produced in large quantities and mostly preserved and sweetened with sweeteners such as Sucrose, Honey etc which tends to increase the blood sugar of consumers. As a result of this, consumers of fruit and vegetable juices are prone to diabetes or other similar ailments when juices are consumed frequently and over time. The assertion was corroborated by [53,54] when they reported high level of obesity amongst children, as a result of consuming fruit juices.

Soymilk (also called soyamilk, or soybean juice and sometimes referred to as soydrink/beverage) is a beverage made from soybeans (*Glycine max*). It is a stable emulsion

of oil, water, and protein. Soymilk is produced by soaking dry soybeans and grinding with water before cooking at boiling point for about 20 minutes. Soymilk contains similar proportion of protein as cow's milk; around 3.5% and 2% fat, 2.9% carbohydrate, and 0.5% ash. They have been blended with other food products to produce other products, most likely, with better nutritional qualities. Milk-based products all contain actual milk (and/or soymilk) or different combinations of modified proteins. Most of the popular milk-based beverages are good sources of protein, containing 10 to 40 grammes per serving.

Carbohydrates fall into two categories: simple (including sugar, honey and maple syrup) and complex (including whole grains, starchy vegetables and legumes). Carbohydrates will turn into sugar and raise blood sugar (glucose) levels the body's source of energy for most activities [31]. Not all carbohydrate foods are created equal; in fact they behave quite differently in our bodies. The GI describes this difference by ranking carbohydrates according to their effect on our blood glucose levels. Choosing low GI carbohydrate, the one that produce a very small fluctuation in our blood glucose and insulin levels, is the secret to long term health reducing your risk of health diseases and diabetes and is the key to sustainable weight loss.

Glycemic index (GI) or glycemic load (GL) is a measure of the rate of surge of blood sugar of consumers. GI is a specific indicator of blood glucose response, but not the only parameter that affect blood sugar. Blood sugar can either be low, medium or high in value. Foods with low GI provide a variety of healthy benefits. Low GI modestly decreased serum triglycerides and cholesterol in non-diabetic as well as those with non insulin dependent diabetes mellitus [32,44]. Control of blood sugar help in the management of diabetes mellitus, especially Type 2 Diabetes Mellitus (T2DM) and reducing chronic complications associated with the disease [6,35,52].

Spices are flavour imparting plant materials and contribute greatly to the daily antioxidant intake in most diets [15]. Spices are derived from different parts of specific plants such as the barks, flowers, roots, seeds and fruits. *Aframomum danielli* seeds are smooth, shining olive-brown with a turpentine-like taste and are used medicinally. Spices have been shown to confer health benefits and have been proven to counteract oxidative stress in vitro and in vivo [2,45,46,47,61,68]. The nutritional profile of *A. danielli* had been reported by [4], essential oils of the seed reported by [3], antimicrobial activities of the crude extracts of *A. danielli* against a number of micro-organisms have also been reported [4,21].

As a result of the reported numerous properties of *A. danielli*, and the need to curb or seriously reduce the prevalence of diseases associated with the consumption of sweetened juices and other food products, this paper reports on the findings of the effect of powder extract of *A. danielli* seeds on the glycemic load of consumers of soymilk-based juice.

2. Materials and Methods

A. danielli pods were purchased from a local market in Ibadan. The seeds were removed from the pods and cleaned of the extraneous materials. The seeds were winnowed and milled into powder using hammer mill. The powder was then sieved with a wire-mesh to obtain fine powder and stored at room temperature for use.

*Beverage Preparation

Fresh pawpaw was collected from a farm at Ajibode Village in Ibadan. Carrot and watermelon were purchased from Sabo in Ibadan, while the soybean used in producing the soymilk were sourced from International Institute for Tropical Agriculture (IITA) in Ibadan.

Fresh, juicy, good quality fruits (watermelon and pawpaw) and vegetable (carrot) were sorted for processing. The fruits and vegetable were washed thoroughly under tap water to remove foreign materials before juices were extracted from them. The sourced soybeans were cleaned properly, soaked in water (at 30°C for 5 hours), grinded (with hammer mill), slurry cooked (at boiling point for 20 minutes), separation of the cooked soymilk from fibre and boiling of the resulting filtrate to obtain the soymilk. Juices from pawpaw, watermelon and carrot and soymilk were blended in equal ratios and then treated with powdered extract of *A. danielli* (1.0-3.0g).

Proximate Analyses: The moisture, protein, carbohydrate, fat, crude fibre and ash contents of the samples were determined using standard methods.

Determination of Glycemic Load

Glycemic index (GI) is a new method of classifying foods based on the blood glucose response after food consumption. Published GI ranking are: GI of 70+ (high), GI of 56-69 (moderate) and GI of 55 and less (low) [69]. Glycemic load (GL) on the other hand is the weight of glucose which raises blood glucose by the same amount and defined mathematically as $g \times GI/100$ [57], [24]. High GL food (GL of 20+), moderate GL (11-19) and low GL (10 and less).

The published GI figures were used in combination with the proximate composition of the samples. The available carbohydrate (AC) less fibre in serving of the samples was known by determining the proximate analysis of the various samples. The figure (AC value) was multiplied by the standard GI value (published GI estimates) for that particular food and divided by 100.

Available Carbohydrate = Total Carbohydrate – Fibre

$$GL = \frac{GI \times \text{Available Carbohydrate}}{100}$$

GI of mixed meal is assumed to be the weighted average of the GI's of the individual food in the meal.

3. Results and Discussion

Proximate Composition of the Samples

Table 1 shows the proximate composition of the treated and untreated samples. The values were used in calculating the glycemic load of the treated and untreated samples.

Table 1. Proximate Composition of Blends of Carrot, Watermelon, Pawpaw and Soymilk

Sample	Moisture (%)	Crude Protein (%)	Fat (%)	Carbohydrate (%)	Crude Fibre (%)	Ash (%)
R	70.9	2.12	0.496	22.144	2.12	2.22
CWPS _{3.0}	70.3	2.77	0.110	18.860	4.82	3.14
CWPS _{2.0}	71.4	2.52	0.121	18.752	4.927	2.28
CWPS _{1.0}	71.2	2.56	0.113	16.455	4.54	5.14

CWPS: Blend of Carrot, Watermelon, Pawpaw and Soymilk

R: Indicated the Control Sample

Subscript (3.0 – 1.0): Indicated the *A. danielli* treatments.

Glycemic Load of the Samples

Table 2 shows the results of the glycemic load of the samples. The treated sample recorded low glycemic load, while the untreated samples recorded medium glycemic load. Report has it that the higher the glycemic load, the more a serving will trigger blood sugar to rise and that

frequent consumption of high glycemic load meals can result in perpetual high insulin levels and when insulin levels are high, the hormone responsible for triggering sugar breakdown, glucagons, would be suppressed, as well as the breakdown of fats for energy [31].

Table 2. Glycemic Load of the Treated Samples

Sample	Treatment and Glycemic Load of Samples		
	3g	2g	1g
CWPS	7.20	7.09	6.11
R	10.26	10.26	10.26

R -Untreated Samples
 CWPS -Blend of carrot, watermelon, pawpaw and soymilk
 1g -Samples treated with 1g *A. danielli* extract
 2g -Samples treated with 2g *A. danielli* extract
 3g -Samples treated with 3g *A. danielli* extract

Soy protein is a high quality protein that has been extensively studied. The quality of soyprotein has been assessed through several metabolic studies of nitrogen balance [12,41,71], which have demonstrated that soy protein supports nitrogen balance on par with beef and milk proteins. On recent study reported that amino acids from soy protein appear in the serum sooner, but that this may lead to a more rapid breakdown of the amino acids in the liver [14]. Dietary soy consumption has been shown to have beneficial effects on several aspects of human health, including the diseases potentially influenced by dietary GI levels [13,27,58]. Soy consumption has been reported to modestly improve plasma lipid profiles [42,72], improve bone health [43], helps reduce menopausal symptoms [29], and slightly reduce the risk of breast [65] and prostate cancers [70]. The health benefits of dietary soy have been attributed to its isoflavones as well as to the biological actions of its constituent proteins.

However, an additional means of providing health benefits may be through the low GI of soy and soy foods. Soy based foods may be an appropriate part of diets intended to improve control of blood glucose and insulin levels. Consumption of low GI foods rather than high GI foods appears to modestly improve glycemic control by reducing plasma cholesterol, fructosamine, and haemoglobin [55]. It was reported that high GI diet may have adverse health consequences by increasing the risk of chronic diseases through the stimulation of hyperglycemia and hyperinsulinemia [37], risk of cardiovascular disease (CVD) [7,39,64] and type 2 diabetes [10,28,37,56,57,59]. A low GI is reported to have health benefits [10,16,37,51], shown to improve glycemic control in diabetic and non-diabetic subjects [25,26,30,33], and reduce some CVD risk factors [7,23,30,33,38,40].

It was reported that GI values are determined experimentally by feeding human test subjects a fixed portion of the food (after an overnight fast), and subsequently extracting and measuring samples of their blood at specific interval of times. Report also has it that clinical trials are expensive and difficult to conduct, and valuable to obtain further insight into the impact of glycemic index and total carbohydrate intake on body mass index (BMI) from existing data sets derive from carefully conducted observational studies [37,67].

Numerous studies have shown spices to be good source of natural antioxidant possessing digestive stimulant action, bioavailability enhancement nature, carminative, antidiabetic influence, anti-inflammatory ability, anticarcinogenic potential and neuroprotective effect [1,61,62,63]. They have equally been reported to have high phytochemicals utilised in preventing diseases and to promote health [18,20,22,50,66,68].

Fruits and vegetables contain simple sugars with a faster rate of absorption into the blood stream than complex ones. The absorption of these sugars into the blood stream probably triggers a great increase in the blood sugar level, which necessitated the determination of the glycemic load of the samples using the values of glycemic index obtained from the published GI figures. Consumers of juice or carbohydrate food with diseases such as diabetes and other health problems have been placed on synthetic drugs for control of the health problems. These synthetic drugs have always come with various attendant problems and are equally expensive and has led to the use of natural plant foods which are not only sources of nutrients and energy provider, but may equally confer health benefits [2,45,46,47,60,61,68]. Low glycemic index/low glycemic load helps people lose and control weight, increase body's sensitivity to insulin, improves diabetes control, reduces the risk of heart disease, and reduces blood cholesterol levels. It equally helps to reduce hunger and keep you fuller for longer, prolong physical endurance and help re-fuel carbohydrate stores after exercise.

Scientific evidence suggests that antioxidants reduce the risk of chronic diseases including cancer and heart diseases [9]. In line with this and coupled with the reported properties of components of soy-based products, spices and fruits, it became imperative to utilize these qualities in the various food products in finding ways of ameliorating the myriads of diseases associated with food consumption. From the research work, it was observed that consumers of samples treated with 1g-3g of *A. danielli* extract had low blood sugar when measured compared to when the untreated samples were consumed. The low glycemic load recorded for the treated samples could be attributed to the effectiveness of the spice in regulating the rate of utilisation of the blood sugars i.e inhibiting the hydrolysis of carbohydrate. The hindrance could be attributed to the effectiveness of the active components of the *A. danielli* inhibiting the activities of the enzymes (α -amylase and α -glucosidase) responsible for the breakdown or hydrolysis of carbohydrate to simpler sugars, especially breaking it down to oligosaccharides and disaccharides before being converted to monosaccharide, thus regulation and stabilising the release and absorption of sugars into the blood stream [36,48].

It could then be inferred from the results obtained in this research work and other reports on the activities of spices that *A. danielli* extract conferred medicinal benefit on the products.

4. Conclusion

Consumption of spice-rich foods and their ingredients could be a more effective way of preventing the various ailments that could occur as a result of consuming fruit juices and other carbohydrate foods. This indigenous products or spices are advantageous because of the absence of side effects, accessibility and cheapness when compared with synthetic ones. I therefore recommend an increase in the consumption of *A. danielli* spiced food products in order to prevent/minimise to the bearest

minimum the incidence of and/or prevalence of several degenerative diseases.

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