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Zingiber Officinale and Curcuma Longa as Potential Functional Foods/Ingredients

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Abstract Background: Zingiberofficinale and Curcuma longa are rhizomes used as traditional medicine for gastrointestinal illnesses, motion sickness and inflammatory diseases. However, there is scarcity of data regarding its nutritional composition and functions. Objective:To characterize Zingiberofficinale and Curcuma longa as potential functional food/ ingredients Materials and Methods: Zingiberofficinale and Curcuma longa were analyzed for proximate composition, minerals, dietary fiber and phytonutrients. Mineral availability and fermentability in vitro, and antioxidant activity was also determined. Results: Curcuma longa has greater ash, fat, protein, carbohydrates and dietary fiber while Zingiberofficinale has greater moisture and ß-carotene. Both samples were good sources of dietary fiber and when fermented in vitro, the only short chain fatty acid produced was propionate. Zingiberofficinale has significantly greater iron and calcium content.The availability of zinc (11.9±0.4%) and calcium (56.9±4.7%) for absorption was significantly higher in Curcuma longa but not iron (1.7±0.1%; $P<0.05$). Iron availability was significantly greater in Zingiber officinal (21.5±3.3%). Curcuma longa has significantly greater total polyphenols, flavonoids, anthocyanidins and anti-oxidant activity. Conclusion: Zingiberoficinale and Curcoma longa are potential functional food/ingredients Food supplementation with Zingiberofficinale and Curcumin longa may be considered as a novel nutritional approach to reduce chronic diseases and mineral deficiency.

Keywords ZingiberOfficinale, Curcuma Longa, Functional Foods

1. Introduction

The spice ginger is the underground rhizome of the ginger plant, known botanically as Zingiberofficinale. The flesh of the ginger rhizome can be yellow, white or red in color, depending upon the variety and a taste that is aromatic, pungent and hot. The constituents of ginger are numerous and vary depending on the place of origin and whether the rhizomes are fresh or dry. The powdered rhizome of ginger has long been used in traditional medicine for alleviating the symptoms of gastrointestinal illnesses (1). The effectiveness of ginger in motion sickness (2) and cancer chemotherapy (3) has been reported. The antioxidant action of ginger has been proposed as one of the major possible mechanisms for the protective actions of the plant against toxicity (4-5).

Turmeric or Curcuma longa is an Indian spice and has been described as a treatment for inflammatory diseases andis referred by different names in different cultures (6). Turmeric has a peppery, warm and bitter flavor and a mild fragrance slightly reminiscent of orange and ginger, and while it is best known as one of the ingredients used to make curry, it also gives mustard its bright yellow color. Turmeric has long been used as a powerful anti-inflammatory in both the Chinese and Indian systems of medicine. Turmeric has been used throughout history as a condiment, healing remedy and textile dye.The effect of curcumin on serum cholesterol and lipid peroxide levels in 10 healthy volunteers was studied (7). Daily administration of curcumin (500 mg) for 7 days led to a significant 33% decrease in serum lipid peroxides, a 29% increase in serum HDL cholesterol, and a nearly 12% decrease in total serum cholesterol. On the other hand, there is scarcity of data regarding nutritional composition, minerals, dietary fiber and functions. Because of the many potential health benefits of Zingiberofficinale and Curcuma longa, it is of interest to study both plants grown in the Philippine soil as potential functional food/ingredient.

2. Objectives

The study characterized Zingiberofficinale and Curcuma longa as functional food/ingredients in terms of nutrient compostion, mineral availability, dietary fiber content and its fermentability in vitro as well as its phytonutrients and antioxidant activity.Zingiberofficinale and Curcuma longa as potential functional food/ingredients can also be made into value-added products for human consumption and may play significant roles in the prevention for risk of chronic diseases and mineral deficiency.

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3. Methods

Test Foods, Sampling and Preparation of Samples

The test foods used are the ordinary ginger (Zingiberofficinale) and the yellow ginger known in the Philippines as "luyangdilaw" (Curcuma longa).The samples were obtained from different markets in Metro Manila.Metro Manila was divided into four parts according to primary directions (north, south, east and west). The municipalities and cities that falls in northern direction were: Caloocan and Valenzuela; south: Muntinlupa, Las Pinas and Paranaque; west: Manila, Malabon, and Pasay; east: Quezon City, Marikina, Pasig, Taguig-Pateros, San Juan, and Makati which are the sampling sites. The purchased samples were stored in the refrigerator for pooling and sample preparation. Ordinary and yellow ginger rhizomes were washed to take away the soil and air dried.The samples were peeled and cut into small pieces. Freshly cut samples were analyzed for proximate composition, beta-carotene and total dietary fiber. The remaining samples were freeze dried and pulverized after desired dryness was achieved.

Analytical Methods:

The fresh samples were analyzed for ash, moisture, fat, protein, and carbohydrates (8), dietary fiber (9) ß-carotene (10). The freeze-dried samples were analyzed for calcium, iron, and zinc (11), phytic acid (12) tannic acid (13) total polyphenols (14), flavonoids (15) and anthocyanidins (16).

Dietary fiber fermentation of test samples simulating conditions in the large intestine (colon) was determined in vitro (17). The antioxidant activity was determined using diphenyl-1-picrylhydrazyl(DPPH)(18) and ferric reducing antioxidant power (FRAP)(19) assays.

4. Results

Curcuma longa has greater ash, fat, protein, carbohydrates and dietary fiber than that of Zingiberofficinale. However, Zingiberofficinale has greater moisture and ß-carotene(Table 1)Although both samples are good sources of dietary fiber, when fermented in vitro, the only short chain fatty acid produced was propionate (Tables 1 and 2). Both samples are also good sources of minerals, Zingiberofficinale with significantly greater iron and calcium than Curcuma longa but not for zinc (Table 3; P<0.05). The availability of zinc and calcium for absorption was significantly higher in Curcuma longa but not for iron Iron availability was significantly greater in Zingiberofficinale (Table 3; P<0.05). The low phytic acid and tannic acid content from both samples may not affect the availability of minerals (Table 4)

Curcuma longa has significantly greater total polyphenols, flavonoids and anthocyanidins and anti-oxidant activity than that of Zingiberofficinale. The high level of polyphenols and antioxidant activity of Curcuma longa was also observed in another study (19)

Table 1. Proximate composition, dietary fiber (g/100 g sample) and ß-carotene (µg/100G) content of test foods

FOOD SAMPLES	MOISTURE ASH	FAT	PROTEIN	CHO	DIETARY	FIBERß	CAROTENE
Zingiberofficinale	85.8	1.1	0.4	1.3	11.4	3.4	11
Curcuma longa	82.7	1.4	0.6	1.7	13.6	6.1	2

Table 2. Short chain fatty acid content of test foods, mg/g

FOOD SAMPLES	TOTAL SCFA	ACETATE	PROPIONATE	BUTYRATE
Zingiberofficinale	37.9±12.3 a	0	37.9±12.3 a	0
Curcuma longa	9.4±1.6 b	0	9.4±1.6 b	0

ab denotes significant differences between samples at P<0.05.

Table 3. Mineral content and mineral availability of test foods

FOOD SAMPLES	Total Iron mg/100g	% Iron Availability*	Total Zinc mg/100g	% Zinc Availability*	Total Calcium mg/100g	% Calcium Availability*
Zingiberofficinale	3.3±0.5 a	21.5±3.3 a	22.4±0.2 a	4.6±0.1 b	50.1±0.3 a	7.0±0.2 b
Curcuma longa	2.4±0.4 a	1.7±0.1 b	22.6±0.2 a	11.9±0.4 a	8.2±0.2 b	56.9±4.7 a

ab denotes significant differences between samples at P<0.05.
* estimated amount of mineral that can be potentially absorbed in the small intestine.

Table 4. Phytic and tannic acid content of test foods

FOOD SAMPLES	PHYTIC ACID, mg/100 g	TANNIC ACID, mg/100 g
Zingiberofficinale	11.0±0.1b	4.3±1.0 a
Curcuma longa	18.4±0.2 a	3.0±0.6 a

ab denotes significant differences between samples at P<0.05.

Table 5. Phytonutrients and antioxidant activity of test foods

FOOD SAMPLES	TOTAL POLYPHENOLS mg gallicequiv/ 100 g sample	FLAVONOIDS mg gallicequiv /100 g sample	ANTHOCYANIDINS mg catechinequiv / 100 g Sample	DPPH % inhibition	FRAP mM reduced iron
Zingiberofficinale	55.0±0.1 b	37.0±0.1 b	22.0±0.1 b	32.0±0.1 b	0.26±0.03 b
Curcuma longa	174±0.5 a	125.0±0.2 a	129.0±0.1 a	54.0±0.1 a	0.63±0.04 a

ab denotes significant differences between samples at P<0.05.

5. Discussion

The fermentable dietary fiber from Zingiberofficinale and Curcuma longa was shown to produce only the short chain fatty acid, propionate which was significant for both samples indicating protective effect for cholesterol-lowering. Propionate release in the colon after dietary fiber fermentation is readily taken up by the liver. Its action is to inhibit the limiting enzyme HMG Co-enzyme reductase for cholesterol synthesis(20). The cholesterol lowering effect of Curcuma longa was studied in humans in another study(7).

There is a scarcity on the data on mineral composition and the availability of minerals for potential absorption in the small intestine from Zingiberofficinale and Curcuma longa. The study showed that both samples are good sources of iron, zinc and calcium. However, differences in their mineral availability for absorption were observed and may be due to its mineral content and/or mineral-mineral interaction (21-23). For example, when iron availability is high, both zinc and calcium availability is low, and when iron availability is low, zinc and calcium availability is high.The differences in mineral availability from both samples may not be due to phytic and tannic acid due to its low content (Table 4).

The non-flavonoid polyphenol curcumin is the major phenolic compound found in Curcuma longa which has long been used as a traditional Indian medicine(24). Many studies on curcumin have shown anti-cancer agent, anti-inflamatory actions and significant anti-microbial ability(6, 25-27).In a recent study conducted on Curcumin longa, it was observed that it contained high levels of polyphenols and strong antioxidant activity(19).This was similar to the results obtained from thisstudy.According to the present study, aside from the non-flavonoid polyphenol curcumin found in other studies, flavonoid and anthocyanidin are also present in Curcumin longa.

On the other hand, Zingiberofficinale although found to contain lesser amounts of total polyphenols, flavonoids and anthocyanidins than that of Curcuma longa may have other phenolic constituent that was not determined in this study. In some studies it was shown that the phenolic constituent found in Zingiberofficinale, 6-gingerol was found to suppress carcinogenesis in the skin gastrointestinal tract, colon and breast(28-31). Also, ginger extracts have been tested for both anti-tumor promotion and apoptotic potential in several in vitro cell lines, including leukemia, gastric, prostate, ovarian, and lung carcinoma (31-35).

6. Conclusions

Zingiberoficinale and Curcoma longa are potential functional food/ingredients not only because of being known as good sources of antioxidants but also as a good source of dietary fiber and minerals.Food supplementation with both Zingiberofficinale and Curcumin longa may be considered as a novel nutritional approach to reduce chronic diseases as well as mineral deficiency.

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