International Journal of Sciences: Basic and Applied Research (IJSBAR)

ISSN 2307-4531
(Print & Online)

http://gssrr.org/index.php?journal=JournalOfBasicAndApplied

Nutritional Potentials *of Zingiber officinale, Allium sativum* and *Malus domestica* Dried Fleshy Portion as Additives in Diet

Mariama Salihu[a] , Sarah Onyenibe Nwozo [b*]

[a] *Biochemistry Unit, Department of Biological Sciences, Faculty of Natural Sciences,Al-Hikmah University, Ilorin, Kwara State, Nigeria.*

[b]*Nutritional/Industrial Biochemistry unit, Faculty of Basic Medical Science, College of Medicine, University of Ibadan, Ibadan, Oyo State, Nigeria.*

[a]*Email: tsmariama@yahoo.com*

[b]*Email: sonwozo@yahoo.com*

Abstract

Epidemiological studies had shown that increased intake of fruits, vegetables, herbs and spices reduce the risk of cancer, cardiovascular diseases and mortality. The spices (ginger and garlic) and fruit (apple) were evaluated for the nutritional values of important body defense nutrients, phytochemical, minerals and vitamin C. All nutrients are present in the three samples in various proportion with lipids found significantly ($P<0.05$) highest in garlic and crude fibres predominantly obtained in ginger rhizomes. Saponins, flavonoids, minerals (potassium, iron, copper and zinc) and vitamin C are obtainable in these plants in significant ($P<0.05$) proportions. Considerable amounts of macro-nutrients such as carbohydrates, proteins and lipid and preventive micronutrients and bioactive substances present in these plants, should form nutritional intakes especially for the ailing and elderly member of society, to mediate health challenges associated with diseases and ageing.

Keywords: *Allium sativum*; *Malus domestica* ;nutrients; phytochemical; *Zingiber officinale***.**

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* Corresponding author.

1. Introduction

Spices have been used to for the flavor, colour and food preservative role in both traditional cooking and in the industry. Most spices are either whole dried aerial parts of plants, or parts of plants such as seeds, leaves, roots and root bark [1]. Food additives are added to food to improve nutrient quality or alter flavor, such food accessories or adjuncts have the ability to stimulate appetite, enhance salivation, increase the flow of gastric juice, improve digestion, reduce nausea and help with colds [2]. Quantity of the spices and adjuncts added to food is dictated primarily by the content of essential oils and oleoresins. The current trend now is towards preference for minimally processed foods, these traditional spices which have been eaten over the centuries are choice ingredients as the colour, organoleptic properties and safety are certain. Furthermore most spices have the ability to improve food safety by retarding microbial proliferation thus aiding food preservation [3].

Ginger (*Zingiber officinale*) is a very important cash crop. Powdered ginger is used in the preparation of meat, soups and ginger drinks [4]. Among other spices that are being used in Nigeria e.g. garlic, onion and pepper, it is the one that is majorly grown on a commercial scale for export and it is highly valued in the international market due to its aroma and pungency that arise from its oleoresin (non-volatile) and essential oil (volatile) contents [5]. Studies have shown that the acetone extracts of ginger, consisting of the essential oils and the pungent principles produce an increase in bile secretion. Bile acids facilitate the absorption of fat, electrolytes and peristalsis of the small intestine [6].

Garlic (*Allium sativum*) is a specie of the onion family and is used as flavouring agent in cooking and pickling, which could be whole, grated cloves or as extract in sauces and dressing [7]. Medically, garlic is used as a digestive stimulant, diuretic, anti-spasmodic problem and as curative agent for respiratory problems, poor digestion and low energy. Garlic also helps in preventing heart disease (including atherosclerosis, high cholesterol and high blood pressure) and cancer [8].

Apple (*Malus domestica*) is one of the most widely cultivated tree fruits that are eaten raw. The whole fruit including the skin is suitable for human consumption but the core is often not eaten because the seeds are slightly poisonous. Its components are essential for normal growth, development and overall well-being. Apples have the highest portion of free phenolic compared to other fruits [9,10].

The aim of this study is to evaluate the proximate, phytochemicals, mineral composition and vitamin C contents of ginger, garlic and apple marketed in North-Central Nigeria. The outcome is to provide a possible scientific reason to encourage consumption of these natural plants in planning our family meals which was predominately cultivated in up Northern part of the country but now found sold across the cities.

2. Materials and methods

2.1 Sources of materials

The samples of Ginger, garlic and apple fruit were purchased by random selection from the three different shops in Ilorin, Kwara State, Nigeria. The vitamin C tablets was purchased from a reputable pharmacy

2.2 Preparation of samples

The ginger rhizomes were washed, the outer skin removed and cut into pieces. The light scaly leaves of the garlic cloves were also removed and the naked bulb and cloves washed in water before being chopped into tiny pieces. The light outer skin of the apple fruit was peeled off and the naked fruit was washed with water and chopped into tiny pieces, dried. All the samples so prepared (oven including the vitamin C tablets) were ground into fine powder, sieved and stored in air-tight sample containers and kept in the refrigerator until required for analysis.

2.3 Assays

The proximate composition of the samples was determined using the methods of AOAC (2002)[11]. Phytochemical screening for tannins, alkaloids, saponins, steroids, phlobatannins, flavonoids, terpenoids and glycosides were carried out using standard procedures to identify the bioactive constituents as described by Harborne (1998)[12] as follows:

Tannins: A small quantity of each extracts were mixed with water and heated on water bath and filtered. A few drops of ferric chloride were added to the filtrate. A dark green solution indicates the presence of tannins. Alkaloids: About 0.2 g of the extracts was wormed with 3 ml of 2 % H_2SO_4 for two minutes. It was filtered and a few drops of Dragondorff reagent were added. Orange red precipitate indicated the presence of alkaloids. Saponins: About 0.2 g of the extract was shaken with 5ml of distilled water and then heated to boil. Few drops of olive oil were added. Frothing (appearance of creamy mist of small bubbles) shows presence of saponins. Steroids: 2 ml of acetic anhydride was added to 0.5 g of the extract of each with 2 ml of H_2SO_4. The colour changed from violet to blue or green in some samples indicate presence of steroids. Phlobatanins: The extract (0.5 g) was dissolved in distilled water and filtered. The filtrate was boiled with 2 % HCl solution. Red precipitate shows the presence of phlobatanins. Flavonoids: Extract of about 0.2 g was dissolved in diluted NaOH and HCl was added. A yellow solution that turns colourless indicates the presence of flavonoids. Terpenoids (Salkowski Test): 0.2 g of the each extract was mixed with 2 ml of chloroform ($CHCl_3$) and concentrated H_2SO_4 (3 ml) was carefully added form a layer. A reddish brown coloration of the interface was formed to indicate positive results for the presence of terpenoids. Glycosides: 5 ml of each extract was treated with 2 ml of glacial acetic acid and one drop of ferric chloride solution. This was underlayed with 1 ml of concentrated H_2SO_4. A brown ring of interface indicates deoxy sugar characteristics of cardenolides. A violet ring may appear below the brown ring, while in acetic acid layer, a greenish ring may form just gradually throughout thin layer.

2.4 Minerals content determination

5 g of each sample was digested with a mixture of concentrated nitric acid, sulphuric acid and perchloric acid. The analysis was then conducted using clean glassware that was soaked overnight in 10 % nitric acid solution. The digested samples were used for elemental analysis. Iron, copper, zinc, were determined using atomic absorption spectrophotometer and sodium, potassium, calcium using flame photometer [13].

2.5 Vitamin C Determination

5.0 g of the ground sample was dissolved in water in a 50 cm^3 volumetric flask and made up to mark and filtered 50 cm^3 of this was pipetted into a 100 cm^3 volumetric flask, 25 cm^3 of 20 % metaphosphoric acid was then added and made up with water.

10 cm^3 of the solution was then pipetted into a flask and 2.5 cm^3 acetone added.

This was titrated with the indophenol solution until a faint pink colour persisted for 15 seconds.

The concentration was calculated as mg/g i.e. as mg of ascorbic acid equivalent to 1 cm^3 of the dye solution.

Vitamin C (mg/100 cm^3) = $\underline{T}$ x 2 x Dilution factor.

3. Results

Tables 1 to 4 show the content of the various components present in the two fresh spices and fruit.

The three samples are natural plants which if used in their fresh forms to directly or during preparation of meals and all have the benefit of adding value to our health in body building and defense mechanisms.

Table 1 shows the major nutrient are present in the three samples in various proportion with lipids found significantly ($\rho<0.05$) highest in garlic and crude fibres predominantly higher in ginger rhizomes.

Ginger had higher content of carbohydrate, protein and fibre than apple and gar lic

Table 1: Percentage proximate composition of ginger, garlic and apple fruit

Constituents (%)	**Ginger (*Zingiber officinale*)**	**Garlic (*Allium sativum*)**	**Apple fruit (*Malus domestica*)**
Moisture	49.51 ± 0.10	64.25 ± 0.02	79.31 ± 0.01
Ash	4.50 ± 0.25	5.38 ± 0.13	7.70 ± 0.02
Lipid	13.67 ± 0.02	16.67 ± 0.12	6.31 ± 0.04
Crude fibre	10.00 ± 0.05	6.33 ± 0.17	2.33 ± 0.31
Protein	8.75 ± 0.64	4.52 ± 0.76	1.87 ± 0.13
Carbohydrate	13.57 ± 0.08	2.85 ± 0.11	4.34 ± 2.11

Majority of the phytonutrients which had been found to exhibits body protection potentials as free radicals scavengers (saponins, flavonoids), mineral (zinc) and vitamin C are obtainable in these plants in significant ($P<0.05$) proportions (Tables 2, 3 and 4 respectively).

On Table 2 we have data obtained for the phytochemical screen.

Table 2: Phytochemical content of aqueous extract of ginger, garlic and apple fruit

Constituents	**Ginger** (***Zingiber officinale***)	**Garlic** (***Allium sativum***)	**Apple fruit** (***Malus domestica***)
Tannins	–	–	–
Philobatannins	–	–	–
Terpenoids	+	+	+
Saponins	+	+	+
Glycosides	–	–	–
Flavonoids	+	+	+
Steroids	–	–	–
Alkaloids	+	+	–

+ Indicates present in the sample

- Indicates absent in the sample

Terpenoids, saponins and flavonoid were present in all three samples while alkaloid was only present in both ginger and garlic, while philobatannins, tannins, glycosides and steroids were not detected.

Mineral content of ginger, garlic and apple are shown on Table 3.The only toxic metal assayed for,lead was absent in all three samples. Apple had highest quantity of calcium and sodium while ginger had highest content of potassium, iron, copper and zinc

Table 3: The mineral composition of ginger, garlic and apple fruit

Minerals (mg/100g)	**Ginger** (***Zingiber officinale***)	**Garlic** (***Allium sativum***)	**Apple fruit** (***Malus domestica***)
Ca	2.30 ± 0.43	7.06 ± 1.59	10.09 ± 2.25
Na	3.63 ± 0.84	3.90 ± 0.82	4.53 ± 1.32
K	23.03 ± 1.83	7.73 ± 1.04	20.30 ± 2.52
Pb	ND	ND	ND
Fe	18.15 ± 2.06	16.80 ± 3.43	15.40 ± 2.47
P	ND	ND	ND
Cu	14.03 ± 2.03	5.40 ± 0.90	8.28 ± 1.09
Zn	8.90 ± 1.02	4.95 ± 0.48	7.03 ± 0.64

ND = Not detected

Ascorbic acid content is shown on Table 4 with apple several fold high content while ginger and garlic had low

vitamin c content.

Table 4: Vitamin C content of ginger, garlic and apple

Quantity	**Ginger** (***Zingiber officinale***)	**Garlic** (***Allium sativum***)	**Apple fruit** (***Malus domestica***)
Vitamin C content (mg/100g)	1.14 ± 1.37	0.76 ± 0.50	27.43 ± 0.69

4. discussion

The spices (ginger and garlic) and apple fruit though now recently found almost in every big towns and cities in Nigeria today, their utilization as food additives in meals is still not common in many homes either due to cost or because they are not traditional condiments in this region. Fruit and vegetables have many similarities with respect to their compositions, methods of cultivation, harvesting, storage properties; processing and health benefit which accrues from its consumption. Fruit in general is acidic and sugary and are important sources of both digestible and non-digestible carbohydrates in human diet. Digestible carbohydrates are present largely in the form of simple sugars and starches while the indigestible are hemicelluloses, cellulose, some gums and generally provide roughage, which is important to normal digestion and prevention of colon cancer [14]. Various manufactured seasonings of various products are commonly added to improved foods culinary properties and taste of meals during preparation despites various warnings of negative impacts and sources of some of these items both in the media and learned journals. Foods eaten can cause diseases when it contains too little or too much of a specific nutrient, which are supplied in a well-planned diet [15] or from poor handling or cooking methodologies. However, it is a known fact that treatment of various diseases is a huge economic burden in any country as well as a big business enterprise. Diseases keep people dependent on the health care system, while wellbeing liberates individuals [16].

Ginger and garlic were recently ranked as carbohydrate-rich spices as carbohydrate content was significantly high in garlic followed by ginger [17]. They equally had significantly ($\rho<0.05$) higher content of not only carbohydrate but crude fibre as well as protein (Table 1). Dashak *et al*. (2001)[18], stipulated that the normal daily protein requirement for a normal adult is between 45 – 50 g; therefore, these spices could serve as supplements for proteins, since they are usually combined by humans in preparation of main dishes. However, the ash content which is synonymous with the amounts of minerals present are important in many biochemical reactions where they function as coenzymes and aid physiological performance of major metabolic process in the body. Lipids especially unsaturated form and moisture present these food items are good in the bodysystems in conferring protection as well as contributing to fluid intake. The phytochemical analysis indicated that the samples are rich in phytonutrients. All the samples had terpenoids, alkaloids, saponin and flavonoids while tannins, philobatannins, glycosides and steroids are qualitatively absent (Table 2).

The mineral analysis of the two spices indicated their richness in potassium, iron, zinc, copper while the content of these metals was significantly higher in garlic than ginger, the values for sodium and phosphorous were significantly higher ($P<0.05$) for garlic than apple but apple contained more of these essential minerals than garlic except for iron. Low ash content is usually an indication of low inorganic mineral content [19]; however, the nutritionally important metals such as potassium and iron were found in relatively high amount in the three spices. However, there was no significant difference in zinc, copper and manganese values among the two spices, while calcium, sodium, lead and phosphorus were not present [17]. The reduced moisture content in the spices compared to apples is an indication that their shelf life would be prolonged and that deterioration due to microbial contamination would be limited [18] while values obtained is due to our using freshly harvested samples. Results of this study have shown that fresh ginger, garlic and apple fruit had high moisture content indicating bad shelf life and considerable amounts of macro-nutrients such as carbohydrates, proteins and lipids too. Thus is not surprising that dried ginger and garlic are more readily available in the market.

The nutritional studies provide evidence which indicate that adequate and safe supply of all food materials is required throughout the different life stages to maintain functional capabilities and enablement of healthy ageing as each life stage affects the next in a cumulative manner till death [20]. This life course effect can be seen for instance in relation to intake of vitamins and the essential bone building nutrients such as calcium, magnesium, potassium and zinc [21]. Sufficient intakes of calcium and other bone nutrients during growth as well as in ageing are needed to secure optimal bone mass accumulation which, along with sufficient exercise/activity and continued intake of good nutrition, would help prevent osteoporosis later in life [22]. These plants should form nutritional intakes especially for the ailing and elderly member of society, to reduce health diseases associated with ageing.

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