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# Comparative Analysis of Phytochemical and Proximate Composition of *Allium sativum* L. and *Zingiber officinale* Rosc.

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## ABSTRACT
*Allium sativum* and *Zingiber officinale* are spices with great potentials as food additives and medicinal values. In this study, the phytochemical and proximate composition of the two spices were evaluated and compared. The results of phytochemical screening revealed the presence of saponins, tannins, terpenoids, flavonoids, glycosides and phenols in both the bulb of *Allium sativum* and rhizome of *Zingiber officinale*. The bulb of *Allium sativum* contained significantly higher amount of saponins, tannins and phenols when compared to the rhizome of *Zingiber officinale. Zingiber officinale* is rich in glycosides and flavonoids as compared to *Allium sativum* bulb. Terpenoids was the highest phytochemical detected in both spices while phenol recorded the least amount. The proximate composition of both spices showed moisture, protein, ash, fat fibre, and carbohydrate contents with values that ranged between 60.35 ± 0.23-76.48 ± 0.05%,7.52 ± 0.10-10.15 ± 0.02%, 1.51±0.05-1.54 ± 0.05%,1.02 ± 0.02-4.29 ± 0.06%, 2.13 ± 0.06-2.64 ±0.08%, 7.59 ± 0.23-24.82 ± 0.08% respectively. Protein and carbohydrate were significantly higher in *Allium sativum* bulb as compared to the rhizome *Zingiber officinale.* Significant differences were not recorded for all constituents analysed except for moisture. The energy content of *Allium sativum* bulb was higher than that observed for the *Zingiber officinale* rhizome. The present investigation therefore indicated that variations exist in both the phytochemical and proximate composition of the two spices, thus their use in food recipe should be encourage.
**Keywords**: Saponins, Tannins, Flavonoids,*Allium sativum* and *Zingiberofficinale*

## INTRODUCTION
Natural food ingredients particularly those that are readily available are highly patronized and relished in most homes and restaurants all over the world since they stimulate appetite by increasing the flow of gastric juice as well as enhancing food taste Nwinuka *et al.*, 2005). Spices are a large group of natural ingredients. They include dried seeds, fruits, roots, rhizomes, barks, leaves, flowers and any other vegetative substances used in a very small quantity as food additives to colour, flavour or preserve food (Birt, 2006). They are any of vegetables substances either indigenous or exotic origin, aromatic, fragrant or with pleasant strong taste used to enhance tastes of foods (Harsha *et al.,* 2013). The bulk of the spices consist of carbohydrates such as cellulose, starch, pentosans and mucilage, and some amount of protein and minerals (Ogutimein *et al*., 1989). Only very small fractions of dry matter of these spices such as the phytochemicals are responsible for the flavouring, colouring, preservative and health-promoting characteristics (Cowan, 1999).

The beneficial health effects of spices is well documented (Mensah *et al.,* 2009; Bhattacharjee and Sengupta, 2008; Soetan and Aiyelaagbe, 2009). Many spices have been reported to have antimicrobial properties, cholesterol lowering effects, anti-diabetic and anti-inflammatory properties (Kwada and Tella, 2009). The consumption of garlic for example has the potential of boosting immunity, reduction of arterial plaque and as an antioxidant agent against skin cancer (Koscienly *et al.*, 1999; Rivlin, 2001; Das and Saha, 2008). Garlic is also used as a digestive stimulant, diuretic and anti-spasmodic (Nwinuka *et al.,* 2005). The chemical constituent of garlic has also been used for the treatments of cardiovascular disease, cancer, diabetes, blood pressure, atherosclerosis and hyperlipidemia (Gebreselema and Mebrahtu, 2013). Locally, garlic is often paired with ginger to make stews and soups. Generally, garlic is used as condiment and in the preparation of baked goods, puddings, gravies, soups, stew, meat products, non-alcoholic beverages and soft candy.

Ginger has been used as a spice and natural food additive for more than 2000 years (Bartley and Jacobs, 2000). The plant has been identified as a herbal medicinal product with pharmacological effect. According to Thomson *et al.* (2002), the consumption of ginger led to reduction in blood cholesterol and also served as a potential anti-inflammatory and antithrombotic agent. Studies have shown that, the long term dietary intake of ginger has hypoglycaemic and hypolipidaemic effect (Ahmed and Sharma, 1997). It suppresses prostaglandin synthesis through inhibition of cyclooxygenase-1 and cyclooxygenase-2 (Song *et al*., 2001). In traditional Chinese and Indian medicine, ginger has been used to treat a wide range of ailments including stomach aches, diarrhea, nausea, asthma and respiratory disorders (Grzanna *et al*., 2005). In Ayurveda, ginger is reported to be useful in treating inflammation and rheumatism (Ghosh *et al*., 2011). Ginger is used as flavor in locally prepared drinks especially in Northern Nigeria.

As the plants are widely used as spices and in the treatment of several ailments that threaten the existence of mankind, the present study was undertaken to compare the phytochemical and proximate composition of the two spices.

## MATERIAL AND METHODS

### Collection and Preparation of Plant Samples

Garlic bulbs and the ginger rhizome were purchased from Ipata market within Ilorin metropolis, Kwara State, Nigeria. The plants were authenticated at the Herbarium unit of the Department of Plant Biology of the University of Ilorin, Ilorin, Kwara State, Nigeria. They were then washed, chopped into pieces and oven-dried at 80ºC for 3 hours and ground using blender till a uniform powdery form was achieved.

### Extraction Procedure

The ethanolic extract of the samples were obtained by soaking 20 g each of powdered samples of garlic bulbs and ginger rhizome in 100 ml of ethanol in different air-tight, properly labelled glass containers. These were left undisturbed at a temperature of 28 ± 2°C for 120 hours (5 days). Thereafter the extracted samples were filtered with a clean white sieving cloth into separate 100 ml conical flasks. Further flitration was done for each sample using Whatman filter paper. The filtrates were then poured into separate 100 ml beakers and were approratiately labelled. Afterwards, the extracts were concentrated to 15ml by placing in an oven set at 45°C. Each concentrated extract was poured into different 3 ml glass bottles, labelled and the yield of each extract was then subjected to qualitative and quantitative phytochemical screening.

### Qualitative and Quantitative Phytochemical Examination

Qualitative and quantitative phytochemical screening carried out by adopting the methods as described by Odebiyi and Sofowora (1979) and Onwuka, (2005). The bioactive substances determined were flavonoids, saponins, tannins, phenols, terpenoids and glycosides. Each of the constituents was calculated in milligram per 100 g of the sample and in triplicates for each of the samples.

### Proximate Composition

The proximate composition of the samples with respect to moisture, protein, fat ash, fibre and carbohydrate were determined following the standard methods of Association of Official Analytical Chemists (AOAC, 2002).The calorific value of each sample was also estimated by multiplying the percentage protein and carbohydrate contents by 4 and percentage fat content by 9.

**Data Analysis**
Data were analyzed using Statistical Package for Social Sciences (SPSS) software version 16. Results were expressed as the mean ± standard error (SE). The data were analysed using student's T-test at $p \leq 0.05$ level of probability.

## RESULTS
Results of qualitative analysis showed the presence of flavonoids, tannins, terpenoids, saponins, phenolic compounds and glycosides in the ethanol extracts of *Allium sativum* bulb and the rhizome *Zingiber officinale* (Table 1).

**Table 1**: Qualitative phytochemical screening of ethanol extracts of *Allium sativum* bulb and *Zingiber officinale* rhizome.

| Chemical Constituents | *Allium sativum* bulb | *Zingiber officinale* rhizome |
|---|---|---|
| Saponins | + | + |
| Terpenoids | + | + |
| Flavonoids | + | + |
| Tannins | + | + |
| Glycosides | + | + |
| Phenols | + | + |

Key: + detected - not detected

The terpenoid content was highest in *Allium sativum* bulb (44.26 ± 0.03 mg/100g) as presented in Table 2, followed by glycosides, saponins, flavonoids, tannins and phenols with respective mean values of 3.46 ± 0.02 mg/100 g,1.93 ± 0.03 mg/100 g 1.16 ± 0.03 mg/100 g, 0.31 ± 0.01 mg/100 g and 0.19 ± 0.01 mg/100 g. Glycosides was highest in the rhizome (4.78 ± 0.01), followed in decreasing order of magnitude by terpenoids, flavonoids, saponins, tannins and phenols with mean values of 4.19 ± 0.01 mg/100g, 4.00 ± 0.01 mg/100g, 48 ± 0.01%, 0.25 ± 0.01 mg/100 g and 0.11 ± 0.01 mg/100g respectively.

**Table 2**:Quantitative phytochemical screening of *Allium sativum* bulb and *Zingiber officinale* rhizome

| Chemical Constituents mg/100g | Bulb of *Allium sativum* | Rhizome of *Zingiber officinale* |
|---|---|---|
| Saponins | 1.93 ± 0.03[a] | 0.48 ± 0.01[b] |
| Terpenoids | 4.26 ± 0.03[a] | 4.19 ± 0.01[a] |
| Flavonoids | 1.16 ± 0.03[b] | 4.00 ± 0.01[a] |
| Tannins | 0.31 ± 0.01[a] | 0.25 ± 0.01[b] |
| Glycosides | 3.46 ± 0.02[b] | 4.78 ± 0.01[a] |
| Phenols | 0.91 ± 0.01[a] | 0.11 ± 0.01[b] |

Means followed by the same letter in the column are statistically similar

Table 3 shows the results of proximate composition of the ethanol extract of bulbs of *Allium sativum* and rhizomes of *Zingiber officinale.* Significant differences were recorded in all the proximate composition except for the ash and fibre contents. Moisture content was high both in the bulb of *Allium sativum* and rhizome of *Zingiber officinale* with respective mean values of 60.35 ± 0.23% and 76 ± 0.05%. Bulbs of *Allium sativum* had significantly higher protein content (10.15 ± 0.02%) compared to the rhizome (7.52 ± 0.10%). Higher crude fat value (4.29± 0.06%) was recorded for the rhizome, however, the carbohydrate and the energy values of *Allium sativum* were significantly greater than those observed for the rhizome.

## DISCUSSION
The phytochemical screening of bulb of *Allium sativum* and rhizome of *Zingiber officinale* indicated the presence of saponins, flavonoids, phenols, tannins, terpenoids and glycosides in varying concentrations. Some of these phytochemicals have been established to be of high medicinal values (Oloyede, 2005). High concentrations of terpenoids in both spices could be used to explain the anti-microbial, anti-inflammatory, sedative, insecticidal and neurotoxic activities of these plants (Alan and

Miller, 1996; Doughari, 2012; Doughari *et al.,* 2009). The glycosides are useful as cardiac stimulant and diuretic. Flavonoids are important group of polyphenols widely distributed among the plant flora. Numerous reports support their use as antioxidants or free radical scavengers as well as quenchers of singlet oxygen formation (Kar, 2007; Ali and Neda, 2011). Saponins are important therapeutically as they are shown to have hypolipidemic and anticancer properties. They are also important source of steroidal hormones (Sarker and Nahar, 2007). Tannins are useful in wound healing (Kar, 2007), as astringents and antimicrobials. Phenols are used as nutraceuticals probably for their cancer combating role and are also thought to prevent heart ailments as well as possess anti-inflammatory properties (Doughari *et al.*, 2009). Phenols also play a role in plant defence against pathogen and herbivores (Paiva and Russel, 1999). Tannins, which are widely distributed in plants are useful in wound healing (Kar, 2007), as astringent and antimicrobial (Singhal *et al.*, 2001).

**Table 3**: Proximate composition of bulb of *Allium sativum* and rhizome of *Zingiber officinale*

| Proximate Composition (%) | Bulb of *Allium sativum* | Rhizome of *Zingiber officinale* |
|---|---|---|
| Moisture | 60.35 ± 0.23$^{b}$ | 76.48 ± 0.05$^{a}$ |
| Protein | 10.15 ± 0.02$^{a}$ | 7.52 ± 0.10$^{b}$ |
| Ash | 1.54 ± 0.05$^{a}$ | 1.51 ± 0.05$^{a}$ |
| Fat | 1.02 ± 0.02$^{b}$ | 4.29 ± 0.06$^{a}$ |
| Crude fibre | 2.13 ± 0.06$^{a}$ | 2.64 ± 0.08$^{a}$ |
| Carbohydrate | 24.82 ± 0.08$^{a}$ | 7.59 ± 0.23$^{b}$ |
| Energy value (Kcal) | 149.05 ± 0.59$^{a}$ | 99.02 ± 0.54$^{b}$ |

Means followed by the same letter in the column are statistically similar

The proximate analysis had shown that the bulbs and rhizome of galic and ginger respectivelty and roots were low in carbohydrates when compared to plants such as *Acalypha sp.*and *Tithonia diversifolia* where the carbohydrate contents ranged between 38.2 and 52.3% (Iniaghe *et al*., 2009; Olayinka *et al*., 2015). The carbohydate contents of Allium sativum is higher than those recorded for *Curcuma longa* with mean value of 16.23% (Taoheed *et al.,* 2017). The moisture contents of the two spices were very high and this would made them sucesptibele to the growth of microorganisms and therefore reduce their shelf life (Adeyeye and Ayejuyo, 1994). Proteins was found to be high in amount but lower to those recorded for pepper (11.70% ± 0.13) (Otunola *et al*., 2010). The ash contents which is a reflection of the mineral elements preserved in any food materials (Iniaghe *et al*., 2009). were relatively lower in both spices than those recorded for *Tithonia diversifolia* (8.1-12.5%) and some vegetables such as *Occimum graticimum* (8.0%) and *Hibiscus esculentus* (8.0%) (Akindahunsi and Salawu, 2005; Olayinka *et al*., 2015). Non-starchy vegetables are the richest sources of dietary fibre (Agostoni *et al*., 1995) thus the spices can be ranked to be poor sources of fibre as demonstrated in this study.

## CONCLUSION

The foregoing investigation had revealed that the bulb of *Allium sativum* is a rich source of saponins, tannins, phenols, protein and carbohydrates with low amount of glycosides and flavonoids when compared to the rhizome of *Zingiber officinale.*

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