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# Quantitative Study on the Phytochemical of *Zingiber officinale* (ginger) and *Allium Cepa* (onion) Spices Used as Condiments in Katsina State.

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## Abstract

The present study aimed to screen for qualitative and quantitative bioactive constituents of ethanolic extract of two commonly used spices across Katsina State; namely Ginger (*Zingiber officinale*) and onion (*Allium cepa*) The qualitative phytochemical screening of these spice extracts confirms the presence of various phytochemicals like alkaloids, phenol, glycosides, terpenoids, flavonoids, saponin, anthraquinone, reducing sugar, steroids, and tannins. The quantitative phytochemical screening of the aqueous extract of the studied spices revealed that alkaloids were found to be the most abundant phytochemical in all the spices. Zingiber officinale (12.30 %) Allium cepa (11.30 %). The spices were potential sources of phytochemicals which could encourage their use as dietary Supplements to maintain and promote a healthy life. the quantitative study of the phytochemicals in Zingiber officinale and Allium cepa reveals a complex interplay of bioactive compounds that contribute to its health-promoting properties.

**Keywords:** *Zingiber officinale; Allium cepa*; phytochemical; phenols

## Introduction

Over the years, they have assumed a very central stage in modern civilization as a natural source of chemotherapy as well as amongst scientists in search of alternative sources of drugs. According to the World Health Organization (WHO, 2004), a medicinal plant is any plant that in one or more of its organs, contains substances that can be used for therapeutic purposes, or which are precursors for chemo-pharmaceutical semi-synthesis (Sarker and Nahar, 2007). Such a plant will have its parts including leaves, roots, rhizomes, stems, barks, flowers, fruits, grains, or seeds, employed in the control or treatment of a disease condition and therefore contain chemical components that are medically active (Doughari, 2012). Phytochemicals are bioactive chemicals of plant origin. They are regarded as secondary metabolites because the plant that manufactures them may have little need for them. They are naturally synthesized in all parts of the plant body; bark leaves stem, root, flower, fruits, seeds, etc. i.e. any part of the plant body may contain active components Spices, which include leaves (coriander, peppermint), buds (clove), bulbs (garlic, onion), fruits (red chili, black pepper), stem (cinnamon), rhizomes (ginger) and other plant parts have been defined as plant substances of indigenous or exotic origin, aromatic or with strong taste, used to enhance the taste of foods (Tiwari et al., 2010; Pundir et al., 2010). Spices are products of plants (seeds, kernels, bulbs, stalk, roots, fruits, bark, leaves, pods, or buds) which are used in various forms such as fresh, ripe, dried, broken, or powdered mostly to contribute to colour, taste, aroma, flavour, and pungency of food Spices are widely used as condiments and ingredients in food preparation (Parveen et al., 2014). In Nigeria, some spices are useful in the preparation of certain soups which are delicacies and also recommended for rapid relief of ailments such as cold, malaria fever, etc (Sofowara, 1993; Valko et al., 2007). These spices are also said to be therapeutically useful in the management of stomach ache, leprosy, cough, loss of appetite, rheumatoid pain, convulsion, and inflammation (Calucci et al., 2003). These properties are due to many substances, including some vitamins, flavonoids, terpenoids, carotenoids, phyto estrogens, minerals, etc., and render spices and some herbs or their antioxidant components as preservative agents in food (Trease & Evans, 2002). The study aimed to quantitatively determine the phytochemical composition of two selected spices widely consumed across Katsina State: *Zingiber officinale* and *Allium cepa*.

**Materials and Method**

**Plant Materials**

Fresh rhizomes of *Zingiber officinale* (Family: Zingiberaceae), bulbs of *Allium cepa* (Family: Amaryllidaceae), and were purchased from Dutsinma and Chiranchi Market in Katsina State, Nigeria. The plant materials were identified in the Department of Plant Science and Biotechnology at Federal University Dutsin-Ma (Table 1).

**Preparation of Extracts**

The collected rhizomes, bulbs, leaves, buds, and seeds of the plant materials were washed with distilled water, air-dried for two weeks, and ground into a fine powder using a sterile pestle and mortar under laboratory conditions. Fifty (50) grams of each powder was mixed with 500ml of Distilled water in a sterile conical flask and stood for 3 days with intermittent shaking. The mixtures were filtered using filter paper and concentrated in a water bath at 600°C for 3 hours. Each extract was kept in a sterile container and refrigerated at 400C for further experiment.

**Phytochemical Screening**

The phytochemical screening of the plant materials for various phytochemical constituents reveals the presence of secondary metabolite alkaloids, reducing sugars, steroids, glycosides, phenol, Anthraquinones, saponin, and tannin was conducted using standard methods as described by Sofowora, 2003 and Trease & Evans, 2003 as shown in Table 1

**Table 1:** Phytochemical Screening of the Spices

| Phytochemicals | *Z. officinale* | *A. cepa* |
|---|---|---|
| **Alkaloids** | + | + |
| **Flavonoid** | + | + |
| **Glycosides** | + | + |
| **Reducing sugar** | + | + |
| **Saponin** | + | + |
| **Steroids** | + | + |
| **Phenols** | + | + |
| **Terpenoid** | + | + |
| **Anthraquinones** | + | + |
| **Tannin** | + | + |

*Key: + = Presence of phytochemical, - absent of phytochemical*

**Quantitative Phytochemical Analysis**

Different methods were used in evaluating the quantity of phytochemical constituents of the plant materials used. The spectrophotometric method was used to determine Terpenoids, tannins, steroids, anthraquinone, and glycosides. The folin-Ciocalteu procedure was used to determine phenol content. Flavonoids, alkaloids, and saponins were determined by the methods described by Adeniyi et al., 2012.

**Qualitative Phytochemical Screening**

The phytochemical constituents of the aqueous rhizome of *Zingiber officinale* and bulb of *Allium cepa* are tabulated in **Table 2**. The quantitative phytochemical constituents of aqueous of rhizome of *Zingiber officinale* and bulb of *Allium cepa*.

**Table 2:** Qualitative Phytochemical Screening

| Phytochemicals | *Z. officinale* | *A. cepa* |
|---|---|---|
| **Alkaloids** | 12.15±0.04 | 11.30±0.09 |
| **Flavonoid** | 4.50±0.02 | 4.00±0.01 |
| **Glycosides** | 0.08±0.01 | 1.80±0.02 |
| **Reducing sugar** | 0.10±0.01 | 3.62±0.05 |
| **Saponin** | 1.20±0.01 | 5.30±0.03 |
| **Steroids** | 0.07±0.00 | 0.05±0.00 |
| **Phenols** | 0.10±0.01 | 0.08±0.01 |
| **Terpenoid** | 0.15±0.00 | 0.09±0.01 |
| **Anthraquinones** | 1.20±0.01 | 1.30±0.01 |
| **Tannin** | 3.70±0.04 | 4.50±0.02 |

**Discussion**

*Zingiber officinale*, commonly known as ginger, has garnered significant attention in recent years due to its rich phytochemical profile and potential health benefits. A quantitative study on the phytochemicals of *Zingiber officinale* typically involves the extraction, identification, and quantification of various bioactive compounds, such as gingerols, shogaols, and phenolic compounds, which are known for their antioxidant, anti-inflammatory, and antimicrobial properties. The phytochemical analysis of *Zingiber officinale* has revealed a diverse array of compounds. For instance, gingerols and shogaols are the primary bioactive constituents, with gingerols being responsible for the pungent flavor and many of the health benefits attributed to ginger (Amir et al., 2011; Ojubanire et al., 2022). A study by Ghasemzadeh et al. highlighted that the total phenolic and flavonoid content in ginger varies significantly depending on the extraction method and the part of the plant used, with methanolic extracts showing the highest concentrations (Ghasemzadeh et al., 2010). A study conducted by Momoh and Olaleye utilized GC-MS to identify and quantify thirty-six compounds in the rhizome of Zingiber officinale, with tridecane being the most abundant (Momoh & Olaleye, 2022). Such detailed profiling not only contributes to the understanding of ginger's medicinal properties but also aids in the quality control of ginger products in the market. The antioxidant capacity of Zingiber officinale is another critical aspect of its phytochemical profile. Studies have demonstrated that the antioxidant activity of ginger extracts is significantly correlated with their total phenolic content (Nweze et al., 2020; Ibukun & Oluwadare, 2021). For instance, the DPPH (1,1-diphenyl-2-picrylhydrazyl) assay is frequently used to evaluate the free radical scavenging ability of ginger extracts, revealing that higher concentrations of flavonoids and phenolic compounds enhance this activity (Amir et al., 2011; Nweze et al., 2020). Furthermore, the presence of quercetin and other flavonoids in ginger has been shown to inhibit lipid peroxidation, further supporting its role as a potent antioxidant (Nweze et al., 2020). In addition to antioxidant properties, Zingiber officinale exhibits antimicrobial activity against various pathogens. Research has indicated that ginger extracts possess significant antibacterial effects, particularly against Escherichia coli and Staphylococcus aureus (Kaushik & Goyal, 2011; Samuel-Penu & Baridakara, 2021). The antimicrobial properties are attributed to the presence of bioactive compounds such as gingerol and shogaol, which disrupt bacterial cell membranes and inhibit growth (Shareef et al., 2016). Quantitative studies often measure the minimum inhibitory concentration (MIC) of ginger extracts to establish their effectiveness against specific bacterial strains. Moreover, the health benefits of *Zingiber officinale* extend to its anti-inflammatory properties. Ginger extracts have been shown to modulate inflammatory pathways, potentially reducing the risk of chronic diseases (Li et al., 2011; Nammi et al., 2010). For instance, gingerols have been reported to inhibit the activation of NF-κB, a key regulator of inflammation, thereby contributing to its anti-inflammatory effects (Li et al., 2011). Quantitative studies often assess the levels of inflammatory markers in biological samples following ginger supplementation to elucidate these effects.

Phytochemical analysis of *Allium cepa* has revealed a rich composition of bioactive compounds. For instance, a study by Dalhat et al. demonstrated that aqueous extracts of Allium cepa contain significant amounts of flavonoids, alkaloids, glycosides, saponins, and tannins, which are known for their health-promoting properties Dalhat et al. (2018). Similarly, Chukwudi et al. reported that extracts from Allium cepa exhibited antibacterial activity against *Escherichia coli* and *Staphylococcus aureus*, with the extent of inhibition correlating with the concentration of the extracts used (Chukwudi et al., 2021). Momoh et al. 2023 conducted a comprehensive analysis of red onion extracts using GC-MS, identifying various phytochemicals, including flavonoids and terpenoids, which are known for their antioxidant properties (Momoh et al., 2023). The study found that the total phenolic content in the onion extracts was significantly correlated with their antioxidant activity, underscoring the importance of these compounds in combating oxidative stress (Momoh et al., 2023). The antioxidant capacity of Allium cepa is a critical aspect of its phytochemical profile. Research has shown that the antioxidant activity of onion extracts is primarily attributed to their high flavonoid content, particularly quercetin, which has been extensively studied for its health benefits (Raj et al., 2021; Sharma et al., 2015). The presence of antioxidants in Allium cepa can help neutralize free radicals, thereby reducing the risk of chronic diseases such as cancer and cardiovascular diseases (DK et al., 2016; Teshika et al., 2018). Furthermore, the antioxidant potential of onion extracts has been confirmed through various assays, including DPPH and ABTS, which measure the ability of the extracts to scavenge free radicals (El-Saied et al., 2021). In addition to antioxidant properties, Allium cepa exhibits notable anti-inflammatory effects. The bioactive compounds in onions, particularly flavonoids and organosulfur compounds, have been shown to modulate inflammatory pathways, potentially reducing the risk of inflammation-related diseases (AYANNIYI et al., 2022). For instance, a study by Ayanniyi et al. highlighted the anti-inflammatory properties of Allium cepa extracts, suggesting their potential use in the management of inflammatory conditions (AYANNIYI et al., 2022). This anti-inflammatory activity is likely due to the inhibition of pro-inflammatory cytokines and enzymes, which are implicated in various chronic diseases. Moreover, the antimicrobial activity of Allium cepa is well-documented. Several studies have demonstrated that onion extracts possess significant antibacterial and antifungal properties. For instance, Enejiyon reported that ethanol, aqueous, and acetone extracts of *Allium cepa* showed considerable activity against foodborne pathogens, including *E. coli* and *Candida albicans* (Enejiyon, 2020). The antimicrobial effects are attributed to the presence of organosulfur compounds, which disrupt microbial cell membranes and inhibit growth (DK et al., 2016; Ortiz, 2015).

The secondary metabolites contribute significantly towards the biological activities of medicinal plants such as hypoglycemic, anti-diabetic, antioxidant, antimicrobial, anti-inflammatory, anti-carcinogenic, anti-malarial, anticholinergic, anti-leprosy activities, etc (Doughari, 2012). This research work was conducted on the two selected medicinal plants used as spices in Katsina State, to determine the qualitative and quantitative of some phytochemical present in them. The results show that phytochemical constituents of the selected spices include; terpenoids, flavonoids, alkaloids, reducing sugars, steroid, glycoside, phenol, Anthraquinones, saponin, and tannin. Several studies were conducted to determine the phytochemical constituents of spices (Harsha et al., 2013; Tacouri et al., 2013; Akeem et al., 2016; Okwu, 2001; Noble, 1990). These plants are used as food preservatives and folk medicines. So, their value depends on the phytochemicals they possess (Madziga et al., 2007). The spices, herbs, plant extracts, and their phytoconstituents have been reported for anti-inflammatory, antidiarrheal, antimicrobial, antioxidant, and insecticidal activities (Inas & Ahmed, 2017). Alkaloids comprising a large group of nitrogenous compounds are widely used as cancer chemotherapeutic agents, anaesthetics, and Central Nervous Stimulants (Parveen et al., 2014; Ene-Obong et al., 2015). Alkaloids are known to play some metabolic roles and control development in living systems (Sofowora, 1993). It also interferes with cell division, hence the presence of alkaloids in ginger, clove, onion, garlic, and black pepper could account for their use as antimicrobial agents. Aboaba et al. reported that the antimicrobial properties of substances are desirable tools in food. The phytochemical content of the aqueous extract of the studied spices in this study is presented in (Table 3). Alkaloids were found to be the most abundant phytochemicals in all the spices. *Zingiber officinale* (12.30%) and *Allium cepa* (11.30%).

**Conclusion**

In conclusion, the quantitative study of the phytochemicals in *Zingiber officinale* and *Allium cepa* reveals a complex interplay of bioactive compounds that contribute to its health-promoting properties. The use of advanced analytical techniques for the extraction and quantification of these compounds is essential for understanding their roles in health and disease. Future research should continue to explore the therapeutic potential of ginger while standardizing methodologies to enhance the reliability of findings across studies.

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