EVALUATION OF NUTRITIONAL VALUE OF GINGER (*Zingiber officinale*)

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CERTIFICATION

This is to certify that this project was carried out by **Vivian Oghenevbare Inana** with Matriculation Number **PSC1707199** in partial fulfilment of the requirements for the award of of the Department of Chemistry, Faculty of Physical Sciences, University of Benin, Benin City.

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DEDICATION

This project work is dedicated to God almighty who made this research work a success, also to my parents, Mr and Mrs. Inana and my beloved siblings.

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I want to express my profound gratitude to the Almighty God for the strength and enablement to complete this work and for making my academic sojourn a success.

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ABSTRACT

The result for proximate analysis on Ginger(*Zingiber officinale*) showed carbohydrates 59.97± 0.41, crude fibre 3.65± 0.05, Ash 6.23 ± 0.10, Crude fat 8.66±0.35, protein 11.90 ±0.15 and moisture 9.47±0.09. From the results, ginger has high carbohydrate content and contain low value of moisture indicating a longer shelf life.The Phytochemical screening of ginger showed the presence of alkaloid, flavonoid, phenolics, terpenoids, saponin, glycoside,steroids and the absence of tannin, phlobotanin and anthraquinone. Antimicrobial, anti-oxidant, anti-inflammatory property can be attributed to the presence of the phytochemicals present.

CHAPTER ONE

1.0 INTRODUCTION AND LITERATURE REVIEW

1.1 INTRODUCTION

1.1.1 BACKGROUND OF STUDY

Several plants are known to offer nutrients and phytochemicals necessary to maintain a healthy living in humans. It has been proven by various researchers that eating food rich in phytochemicals may reduce the risk of having diseases like cancer, high blood pressure and heart disease. Ginger (*Zingiber officinale*) is one of the most widely cultivated food spice worldwide and has been proven to offer a lot of health benefit. Ginger is of the family plant, zingiberacea, other members include turmeric (*Curcuma longa*). It has long been used as medicinal plant for treatment of common cold. Ginger health benefits include anti-inflammatory, anti-tumorigenic, anti-oxidant, anti-platelet, anti-emetic effect. The fresh and dried rhizomes of ginger yields an essential oil known as ginger oil and oleoresin(ginger extract). Other than its health benefits , it is used as ornamental plant due to its colourful flowers. Studies show that the cultivation practices and post-harvest treatment has a major impact on the quality and quantity of ginger(Singletary, 2010). Ginger is constrained severely by the absence of seed set, and the breeder is left with the alternative of clonal selection or induced mutations (Yadav *et al.,* 2021). The focus of this study is to evaluate the nutritional value of ginger.

1.1.2 STATEMENT OF PROBLEM

The prevailing incidence of health failure among young and old people such as obesity, heart disease, paralysis and finally death could be ameliorated by consuming natural plant. Traditionally, in Nigeria , ginger is consumed in local herbs to treat various illness without prior knowledge to what constituent are responsible for the the actions. As chemist research on plant is necessary to ascertain the overall chemical composition responsible for the health benefits and therefore profer solutions to minimize or eliminate the increasing health failure.

1.1.3 JUSTIFICATION/ RELEVANCE OF THE RESEARCH WORK

Some synthetic drugs have been banned from usage due to the adverse effects accompanied with them after administration or prolonged usage. It is meant to prevent or treat the diseases it is synthesized for but it goes further to cause other health problems for the user. It has been proven that natural plant especially medicinal plants are as effective as synthetic drugs in preventing and combating these chronic diseases with little or no side effects. This research will cover ginger health benefits.

1.1.4 SCOPE OF WORK

This research involves the peeling and washing of fresh ginger. The ginger was cut into pieces, dried and blended to powder. The powdered form was stored in an airtight container for proximate and phytochemical analysis.

1.1.5 AIM AND OBJECTIVES

The aim of this research work is to evaluate the nutritional value of ginger

OBJECTIVES

The objectives of this studies are :

a) The determination of the macro nutrient composition in ginger
b) The conduction of qualitative phytochemical screening on ginger
c) The determination of the nutritional significance to health related problem

1.2 LITERATURE REVIEW

1.2.1 DESCRIPTION OF GINGER PLANT

Ginger is identified to be a perennial creeping plant with thick tuberous rhizome holding an erect stem(30-100cm) tall with light green lanced shape leaves(15-20cm) long, having a prominent longitudinal rib enclosing clusters of small yellow-green flowers with distinct purple speckles(Ugwoke and Nzekwe, 2010). Further description indicates that sliced thin rhizome has a short branched edge and reverse egg shape(3-4cm) in length and (1.6 - 5mm) in thickness (Pramono, 2019). The unpeeled ginger rhizhome has a brownish colour while the freshly peeled ginger has a yellowish-white appearance which slightly turn light green after exposure to air.

Fig 1.1: Pictorial representation of ginger plant

Fig 1.2: Ginger rhizome

1.2. 2 CLASSIFICATION/ TAXONOMY OF GINGER

Kingdom - plantae

Subkingdom - Tracheobionta

Superdivision - Spermatophyta

Division - Magnoliophyta

Class - Liliopsida- Monocotyledons

Subclass- Zingiberidae

order - Zingiberales

Family - Zingibericeae

Genus - zingiber p. mill

Species - *Zingiber officinale* Roscoe

1.2.3 HISTORY OF GINGER

The first written record of ginger was found in the analects of Confucius, written in China during the warring states era (471- 221BC) (Pickersgill and Barbara, 2005). It was recorded that Confucius ate ginger with every meal. The Monk faxian in 406AD, wrote that ginger was grown in pots and carried on Chinese ships to obviate scurvy (Yadav *et al.,*2021). During the song Dynasty(960-1279), it is recorded that ginger was being imported to China from southern countries.

Another record has it that ginger originated from Maritime southeast Asia and earliest cultivation was among the Austronesia people. During the Austronesian expansion, ginger was among the goods transported. As a result of that ginger spread throughout indo-pacific, then to India and to other part of Asia (Wikipedia).

Raw and preserved ginger was imported into Europe during the middle ages where it was characterized in the official pharmacopeias of several countries.

Large producers of ginger include India, Bangladesh, China, Nigeria, mostly Asian countries and tropical Africa.

1.2.4 CHEMICAL COMPOSITION OF GINGER (*Zingiber officinale*)

Scientific research on the chemical constituents of ginger shows over 400 different compound. Ginger rhizome majorly contains carbohydrate(50-70%), lipids (3-8%), terpenes and phenolic compound with the presence of some vitamins and mineral elements such as Phosphorus, calcium, iron, magnesium,sodium and zinc and extractive oleoresins(Prasad and Tyagi, 2015; Ajagun *et al.,* 2017) . The compounds have been distinctively grouped into volatile and non-volatile compounds (Ramakrishan, 2013). The volatile oil components consist mainly of sesquiterpene hydrocarbon, primarily Zingeberene(35%), farnesene(10%) and curcumene(18%) with smaller amounts of bisabolene and β-sequiphellandrene(Ramakrishnan, 2013). There are at least 40 different monoterpenoid hydrocarbon present in smaller amount of which are, citral, limonene, citronellol, camphene, phellandrene with 1,8-cineole, neral, borneol, linalool and geraniol being the most abundant (Adel and Prakash, 2010; Ramakrishan, 2013).

Aliphatic aldehyde and alcohol are also observed(Adel and Prakash, 2010). The phenolic component which are known to be non-volatile includes gingerols (6-gingerol, 8-gingerol, 10-gingerol), 6- shogoal, 6 - paradol and Zingerones. They are the major bioactive constituent of ginger responsible for it's anti-inflammatory, anti-oxidant and anti-apoptic effects. The series of chemical homolog of gingerol

are differentiated by the length of their unbranched alkyl chains and are identified to be the major active component of fresh ginger rhizhome(Govindaranjan , 1982). Paradol is formed by the hydrogenation of shogaol while shagoal are dehydrated form of gingerol and are identified to be the major pungent component in dried ginger (Connol and Sutherland, 1969; Ramakrishnan, 2013). Chemical analysis indicate that some chemical constituents are lost from fresh ginger when dried. In a comparison between oil from dried rhizome and fresh rhizome, it is observed that dried rhizome possess less of the low boiling point volatile compound as most of them are evaporated during the drying process(Jakribettu *et al.,* 2016). The concentration of citral was analysed and observed to be lower in the oil from dried material than raw ginger (Jakribettu *et al.* 2016). Analysis on fresh ginger oil shows a 29% increase in oxygenated compound when compared to dry oil which was about 14% (Sasidharan and Menon, 2010). The rhizome also contain a proteolytic enzyme known as Zingibain which is cysteine protease similar to rennets in characteristics (Jakribettu *et al.,* Yadav *et al.,* 2021). More importantly, the extractible bioactive compound on ginger is primarily dependent on the the type of solvent used (Arawande *et al.,* 2018).

1.2.5 REPORTED USES OF GINGER

1.2.5.1 CULINARY USE

Ginger is consumed fresh, dried and processed. It is used as condiment in both local and international cuisine. It is used in dietary supplement, beverages e.g ginger ale and food products e.g curry powder, baked goods like ginger bread, ginger biscuits, jams(Singletary, 2010).It is added to a local drink in Nigeria called Zobo to give it a somewhat peppery taste.Ginger is used as a food preservative and can increase food safety and shelf life of fatty and processed food products.The oils and bioactive components of ginger(at concentration levels 20 - 100 μg/ml) could be employed as natural food preservatives to prevent lipid peroxidation causing food spoilage (Bhatt *et al.,* 2014)

1.2.5.2 PHARMACOLOGICAL USE ACCORDING TO RESEARCH

The bioactive constituents of ginger are responsible for the medicinal properties of Ginger. The following are therapeutic uses of ginger;

1. TREATMENT OF COMMON MIGRAINE : Migraine is brain disorder accompanied with severe headaches, nausea and sensitivity to light. A comparison between the efficacy of ginger and sumatripan in a clinical trial of 100 patients showed that ginger is as effective as sumatripan in treating common migraine and possess a better side effect profile than sumatripan(Maghbooli, 2014).
2. TREATMENT OF CANCER/ TUMOR GROWTH : In 2020, about 10 million death were recorded nationwide owing to cancer(WHO) . The common amongst them are breasts, lung , colon, prostate, skin and stomach cancer. Several research shows the ability of ginger in treating cancer. A pharmacokinetic evaluation on ginger extract in treating human prostate tumor showed a 2.4-fold higher tumor growth inhibitory efficacy than artificial mix of ginger indicating the need of a whole consumption of ginger for better effectiveness (Gundala *et al.,* 2014). Ginger and it's components 6-gingerol are said to be active against ovarian cancer from in vivo studies (Ramakrishnan, 2013). In vitro studies on the anti-metastasis activity of 6-shogaol, an active constituent of ginger showed efficiency in combating

breast cancer (Ling *et al.,* 2010). Studies have shown that daily in-take of ginger can reduce the risk of having cancer.

3. Treatment of diabetes : A clinical trial involving administration of 1.2g ginger for 90days to people with type 2 diabetes milletus showed decreased values of total cholesterol (Tc), fasting blood sugar(FBS) and Low density lipoproteins LDL(Carvalho, 2020). Another research revealed that ginger aqueous extract possess hypoglycaemic and hypolipidaemic effects in lowering the increased level of total serum cholesterol, total serum lipids and blood glucose level in aloxan induced diabetic rats and may be protective against hyperlipidemia, hyperglycaemia, atherosclerosis common in diabetes milletus (Ozougwo and Eyo, 2011).
4. PREVENTION OF NAUSEA, VOMITING AND MOTION SICKNESS : From clinical studies, 1g of fresh ginger root was administered per day for 4 days to pregnant women experiencing nausea and vomiting, a significant decrease in nausea and vomiting was observed with no potential risk factor to mother and child (Stanisiere,2018). Ginger helps in reducing nausea, vomiting and motion discomfort(singletary,2010).
5. ANTIMICROBIAL ACTIVITY : Ginger is reported to be effective against Gram positive and Gram negative bacteria(Chinedu and Jivini, 2019). In vitro studies on ginger extract and its active component has been reported to

repress the growth of different common infectious bacteria including staphylococcus aureus and Listeria monocytogenes (Norajit *et al.,* 2007). It is also said to possess antifungal and antiviral activity but studies on this are inconsistent (Singletary, 2010).

6. ANTI-INFLAMMATORY EFFECT, ANTIOXIDANT EFFECT AND RHEUMATOID ARTHRITIS RELATED PAIN REDUCTION : Ginger extract has been used to reduce acetic acid- induced ulcelarative colitis in rats due to its antioxidant and inflammatory property (El.Abhar *et al.,* 2008). Ginger's anti-inflammatory effects is suspected to come from its inhibition of cyclooxygenase, inducible nitric oxide, synthase, lipoxygenase activity together with interference in cytokine signaling and inhibition of inflammatory prostaglandin synthesis (Singletary, 2010). Ginger has long been used for treatment of rheumatoid conditions and research shows ability to reduce pain related with rheumatoid arthritis and osteoarthritis. Ginger oil is known to possess powerful antioxidant property which has protective effect on DNA(Chinedu and Jivini, 2019). Ginger is studied to protect the gastric mucosa against several ulcerogenic agents(Dugasani *et al.,* 2010). Ginger active constituent possess antioxidant property resembling that of superoxide dismutase which is an important antioxidants catalase essential for breaking down potentially harmful hydrogen peroxide in the cells to

glutathione peroxide (Bhatt *et al.,* 2014). They help against reactive oxygen species (ROS) that are caused by free radicals in the body leading to oxidative stress

OTHER KNOWN USES (Bhatt *et al.,* 2014).

1. Used to eradicate common cold and cough
2. Used to regulate menstrual irregularities and dysmenorrhea
3. Helpful in preventing the progression of cataracts in the body.

1.3 CHEMICAL CONSTITUENTS IN PLANTS

Chemical compounds in plants are known as phytochemicals. They are naturally occurring compounds in plants and are significant for various biological roles in human and animal health. They are available in plants for defense against predators or competitors and help in resisting diseases that may infect them which include fungus, viral and bacteria infections. Some of these phytochemicals have been isolated and used in traditional medicine due to their therapeutic ability. Others are toxic and have been used as poisons. Phytochemicals are secondary metabolites which are required in very small amount in the body and they perform critical functions to the well-being of life forms. Some of them are responsible for plant colours and shied plants from harmful ultraviolet rays. Examples of these

secondary metabolites include alkaloids, terpene/terpenoid, saponin, flavonoids , Tannins., steroids, glycosides (Monday and Ukhun, 2019)

1.3.1 ALKALOIDS

Typical alkaloids are derived from plant, are basic , contain one or more nitrogen atoms in a heterocyclic ring and are known to have physiological action in man and animals (Trease and Evans, 2009). Alkaloids are one of the largest plant secondary metabolite present in several significant plants families (Matsuura and Fett-Neto, 2015). The name alkaloids are derived from the alkaline and are used to describe nitrogen containing base. Alkaloids are able to defend plants from predators and microbial infections (saxena *et al.,* 2013). Majority of alkaloids are known to have very bitter taste.The alkaloid quinine is one of the most bitter tasting substances known with a significant bitter taste of $1x10^{-5}$ molar concentration(Mishra, 1989). Toxic effect in both man an animals depends on specific dosage, exposure time and individual characteristics such as sentivity, site of action and developmental stage (Matsuura and Fett-Neto, 2015). About 300 alkaloids of 24 classes have been identified to occur in the skins of amphibians while alkaloids derived from mammal include indol and isoquinoline classes (Trease and Evans, 2009). Most alkaloids are crystalline in nature. They react with acids to form salts. They are classified into;

1. Non- heterocyclic or Atypical alkaloids e.g Mescaline B- Phenyl ethyl amine, Benzedrine, Epinephrine.
2. Heterocyclic or Typical alkaloids : They are grouped into;

a) Iso-quinoline group e.g papavarine, berberine, morphine,codeine
b) Pyrollidine e.g Hygrine
c) Pyridine and and Piperidine e.g coniine, Trigonelline
d) Pyrolidine–pyridine e.g Nicotine, myosmine
e) Quinoline e.g Quinine, quinidine, cinchonine, cinchomidine.

FUNCTIONS OF ALKALIOD

pharmacological effects include antiarrhythmic, anticancer, antihypertensive and antimalaria. Some alkaloids are used as stimulant and poisons. They are useful in producing insecticide. They are important in plants for protection against microorganisms and other harmful conditions. They are incorporated as co-enzyme in the human system e.g NAD(Nicotinamide Adeninedinucleotide) from nicotinic acid.

1.3.2 TERPENIOD(TERPENE)

This class of phytochemical is present in plant to give their odour, flavours and sometimes their colours. Terpenoids are identified as the largest and most

widespread secondary metabolite occuring majorly in plants and lower invertebrates (Villar *et al.,* 2003). Terpene are classified according to the number of isoprene unit C-5 in their structure. All terpenoids are chemically derived from the basic C-5 branched isoprene unit (2-methyl-1,3-butadiene). Terpenes general formula (C5H8)n. They are further classified according to the number of rings present in them where mono, bi, tri, polyterpenes are 1,2,3 and 4 or more respectively. The straight chain terpenes are referred to acylic terpenes.

CLASSIFICATION ACCORDING TO ISOPRENE UNIT

1. Hemiterpene : consist of one isoprene unit. Example is isoprene itself and oxygen containing derivative of isoprene e.g Isovaleric and prenol(Saxenal *et al.,* 2013)
2. Monoterpene : Two isoprene unit e.g Camphor
3. Sesquiterpene : Three isoprene unit e.g Fernesol and bisabool, zingiberine (ginger oil)
4. Diterpenes : Four isoprene unit e.g cembrine and texadiene
5. Triterpenes : six isoprene unit e.g Lanosterol and squalene
6. Tetraterpenes : Eight isoprene unit e.g Lycopene

FUNCTIONS OF TERPENOIDS (TERPENES)

Volatile terpenes are produced in plants to attract insects for pollination or to expel certain animals from consuming them as food . They are said to play a vital role as

signal and growth regulators(phytohormones) of plants as observed from several precursory investigations (Saxenal *et al.,* 2013). It has biological function in humans and animals when consumed. Xeudanencins G and H, which are under the class of triterpenes were evaluated for cytotoxic activity against Hela human cancer cell line and it was concluded to show significant cytotoxicity with IC50 value at 1.82 and 2.45 μM, respectively (Nailang *et al.,* 2018). Therefore indicating it's anticancer activity. There are also report of its anti-ulcer, anti-malaria(e.g artimisinin), antimicrobial and hepaticidal activity.

1.3.3 PHENOLICS

Phenolic phytochemicals are identified to be the largest class of phytochemicals and it's largely distributed in the plant kingdom. Plant phenolics cosist of simple phenols, coumarins, lignins, lignans, condensed and hydrolysable tannins, phenolic acids and flavonoid(Khoddami *et al.,* 2013). The three most essential groups of dietary phenolics are flavonoids, phenolic acids, and polyphenols(Saxena *et al.,* 2013). Phenolic compounds contains at least one aromatic ring with one or more hydroxyl groups,and may be classified as flavonoids and non-flavonoids (Del Rio *et al.,* 2012).Phenolics have hydroxyl group (-OH) bonded directly to an aromatic hydrocarbon group where phenol (C_6H_5OH) is considered the simplest form of phenolics. Phenolic compounds structurally differ from simple molecules, such as phenolic acids, and from highly polymerized compounds, such as

proanthocyanidins (tannins), found commonly in edible plants consumed as food like fruits, vegetables, cereal and in bevarages (Santos-Buelga and Sacalbert, 2000; Lima *et al.,* 2013). Flavonoids are the largest and most studied group of plant phenolic compounds. More than 4000 flavonoids have been characterized within the parts of plants usually consumed by humans and approximately 650 flavones and 1030 flavanols are known(Harbone and Baxter, 1999). Flavonoids is part of the chemical constituent in plants responsible for diverse colours(e.g red, yellow, purple) in fruits and it occurs usually in back of fruits. All flavonoids generally represented as three-ringed structures and are derived from the aromatic amino acids, phenyalanine and tyrosine (Routary and Orsat, 2012)..Phenolic acids, one of the other main phenolic classes within the Plant Kingdom, occurs in the form of esters, glycosides or amides, but rarely in free form. Phenolic acids varies from one another by the number and location of hydroxyl groups on the aromatic ring (Pereira *et al.,* 2009).

FUNCTIONS OF PHENOLIC COMPOUNDS

They have wide range of biological and pharmacological activity which includes cytoxicity,anti-oxidant, anti-tumor and and anti-inflammatory. Phenolic acids are reported to increase bile secretion, reduce blood cholesterol and lipid levels. phenol acids posses anti-depressanr property. Flavanoids helps fight against free radicals

and reactive oxygen species. Tannins are used as caustics in the production of cationic dyes in dyestuff industries.They are also used in the production of inks. Phenolic compounds are studied to influence the quality of fruits, contributing to their organoleptic and sensorial quality (Lima *et al.,*2014).

1.4 PROXIMATE ANALYSIS

Proximate analysis is used to evaluate the macro nutrients present in food and feed material. It was designed by two German scientist over 100 years ago. Proximate analysis involves experimental procedures to obtain four or five components where one is calculated by subtracting the total value of the other parameters from 100. The categories of chemical components studied under proximate are; Moisture content, crude protein, crude fat, crude fibre, ash and nitrogen free extract(carbohydrates). Carbohydrates is gotten by subtracting the total values of the other parameters (ash, moisture, crude fat, crude protein and crude fibre) from 100. There are standard used in obtaining the analysis usually the Association of Official analytical (AOAC) method.Proximates accounts for closely 100% of a food product; any deviation from 100% displays the resolution of the chemical test, as small variations in the way each test is performed accumulate or overlap the compositional value(Wikipedia)

CHAPTER TWO

2.0 MATERIALS AND METHOD

2.1 APPARATUS

1. Beakers
2. volumetric flask
3. test tubes
4. Uv/vis- spectrophotometer
5. soxhlet apparatus
6. Muffle furnace
7. Hot air oven
8. Conical flask
9. Dessicator
10. crucible

2.2 REAGENTS

1. Hexane
2. Sulphuric acid
3. NaOH
4. Chloroform

5. HCl
6. Dragendorff reagent
7. Ferric chloride solution
8. Millions reagent
9. Seliwonoff's reagent
10. Ammonia solution
11. Ammonium sulphate
12. Sodium potassium Tartrate
13. Sodium hypochlorite
14. Alkaline sodium phenate solution
15. Selenium catalyst
16. Potassium dichromate

2.3 METHODOLOGY

2.3 1 SAMPLE COLLECTION AND PREPARATION

Fresh ginger rhizome was bought from New Benin market, Benin city, Nigeria and was authenticated by the Department of Plant Biology and Biotechnology, Faculty of life science University of Benin, Benin City Nigeria.

Ginger was peeled, washed and chopped into smaller pieces before sun-drying for 5 days. Dried sample was blended in a mechanical blender to fine powder. Fine powder sample was stored in plastic air-tight container for analysis.

2.3.2 DETERMINATION OF ASH: The ash content in food denotes the minerals and inorganics left after the food sample has been heated to a very high temperature removing moisture, volatiles, and organics. Ash may contain minerals from organic origin such as sulphur from proteins. Volatile materials like sulphur, phosphorus sodium may also be lost after ignition.

PROCEDURE

AOAC standard method was used

crucibles were preheated to remove any form of moisture and was placed in a dessicator to cool. The weight of crucibles were taken while 2grams of ginger sample were measured into the already weighed crucibles. The muffle furnace was set at 550°C. The measured crucibles containing the weighed powdered was placed to Ash for 550°C for 3hours. After ashing, it was placed in a dessicator to cool. The weight of ash and crucible was taken. This was done in triplicate.

$$\%\, Ash = \frac{weight\ of\ ash}{weight\ of\ sample} \times 100$$

2..3.3 DETERMINATION OF MOISTURE : Moisture indicates the water components of a food material.Moisture rich foods are easily susceptible to the

microbial attack resulting in food spoilage. Therefore the shelf life of the food material is determined by the moisture content in the food. Low moisture foods usually slow down growth of microorganisms hence the need for analysis and control of food moisture.

PROCEDURE

AOAC standard method was used

5g of ginger powder was taken into already weighed and dried crucible. The hot air oven was set at 110°C. The crucible containing the ginger was placed in the oven and allowed to stay for 3 hours. It was allowed to dry until a constant weight was known. This was done in triplicate

$$\%\, Moisture\ = \frac{wt\ of\ wet\ sample - \ wt\ dry\ sample}{weight\ of\ sample}\ \times 100$$

2.3.4 DETERMINATION OF CRUDE FIBRE : Crude fibre represent the insoluble fibre found in the edible portion of the plant cell wall. They are not digestible in the human system. Its health benefit is to aid bowel movement.

PROCEDURE

AOAC standard method was used

2g of ginger powder was weighed into a 500ml conical flask. 200ml of boiling 1.25% H_2SO_4 was added into the conical flask containing the ginger powder. It was allowed to boil gently on a hot plate for 30mins while a constant volume was maintained. The solution was filtered using a poplin cloth over a funnel on a conical flask. The residue was rinsed with hot distilled water. The residue was scraped using a spatula back into the conical flask. 200ml of boiling 1.25% NaOH was added into the conical flask containing the residue and was heated gently for 30mims maintaining a constant volume. After boiling, it was filtered with a poplin cloth and the residue washed with hot distilled water. The residue was rinsed once with ethanol and with petroleum ether three times. The residue was allowed to drain dry. It was scraped with a spatula into already weighed crucible. It was heated in the hot air oven at 105°C for 2hrs. The crucible was cooled in a dessicator. weight of dried sample was taken. The crucible containing the dried residue was placed in a muffle furnace at 550°C for 90mins to ash. On completion, it was placed in a dessicator to cool. After cooling, the weight of ash was taken.

$$\%\, Crude\ fibre\ = \frac{Oven\ wt\ -\ Furnace\ wt}{weight\ of\ sample}\ \times 100$$

2.3.5 CRUDE FAT DETERMINATION : Crude fat consist of the triglycerides, phospholipids, sterols, alcohols, fat soluble vitamins, pigments and various lipids like sphingomyelins and waxes and organic oils. It is called crude fat because it contains other substance that are not true fat. It is extracted with any fat solvent like petroleum ether, hexane, pentane in a regulated period of time.

PROCEDURE

AOAC standard method was used

2g of ginger powder was weighed into a cellulose filter paper formed into the shape of thimble and placed on a thimble. The tip of the cellulose filter paper was blocked with a cotton wool. The weight of the flat bottom flask was taken. The soxhlet apparatus was was set up. Hexane was used as the solvent for extraction. The heating mantle was set at 68°C. The soxhlet apparatus was run through a manual condenser. The extraction was allowed to take place for 6hrs. After extraction, the flask was swirled to let out any left over hexane. The flask containing the fat was heated in a hot air oven at 110°C for 30mins. After heating, the flasked was cooled in dessicator. After cooling the weight of fat was taken.

$$\%\, Crude\ fat\ = \frac{wt\ of\ fat}{weight\ of\ sample} \times 100$$

2.3.6 CRUDE PROTEIN DETERRMINATION : Crude protein is estimated from the determination of the total nitrogen content in the food or feed sample using Kjeldahl method. The amount of crude protein is obtained by multiplying 6.25 with nitrogen content.

PROCEDURE

AOAC standard method was used with slight modification

Preparation of sample for digestion : 0.2g of ginger sample was weighed into the digestion tube, 2ml of distilled water was added and was allowed to stand for 30mins. A tablet of selenium catalyst and 5ml of conc. H_2SO_4 was added. It was heated in time hood until frothing observed ended. The solution was boiled continuously until digestion was cleared. It was allowed to cool for 30mins. 10ml of distilled water was added to digest and was swirled steadily. It was filtered through a whatmann filter paper No. 42 into a volumetric flask and was made to 100ml mark with distilled water .

Preparation of sample for absorbance reading : 10ml of the filtrate was pipetted into three 100ml volumetric flask for the triplicate analysis. 6ml Potassium tatrate was added, 2ml sodium phenate was added, 2ml of sodium hypochlorite solution was added to each flask and was made to 100ml mark with distilled water. Each sample absorbance was taken.

Ammonium sulphate was used as standard. 0.9439g was dissolved and made to 100ml with distilled water. The prepared 100ppm was used to prepare 0,1,2, 3, 4 and 5ppm stock solution and was made to 100ml by adding 6ml potassium tatrate, 2ml alkaline sodium phenate and 2ml of sodium hypochlorite solution. It was made to 100ml mark with distilled water. The absorbance was taken. The slope reciprocal of the standard was used to obtain the nitrogen content in ginger

$$\%\ Nitrogen\ = \frac{Abs\ \times\ SR\ \times\ ER\ \times CR}{10000}$$

where Abs= Absorbance

SR = Slope reciprocal

ER = Extraction ratio

CR = Colour ratio

% crude protein = % N × 6.25

2.3.7 Determination of Nitrogen free extract (carbohydrate) : This is calculated by suming the values of other parameters analysed and substracting from 100.

% carbohydrate = 100 - (Ash + crude fat+ crude protein + moisture + crude fibre)

2.3.9 PHYTOCHEMICAL SCREENING

PREPARATION OF SAMPLE FOR PHYTOCHEMICAL SCREENING:

Ginger sample was subjected to maceration using methanol as solvent for 24hrs. Analysis was carried out on the extract.

The phytochemical screening was carried out according to method described by Shaikh and Patil, 2020 and Arawande *et al.*

Alkaloid test : 2ml dragendorff reagents was added to 3ml ginger filtrate.

Carbohydrate test : 3ml of Seliwonoff's reagent was added to 1ml ginger extract. It was heated on water bath for 1mins.

Protein test : 2 drops of million reagent was added to 2ml of ginger extract.

Phenolic compound test: Few drops of potassium dichromate solution was added to 1ml ginger extract.

Glycoside test : 1ml of ginger extract was dissolved in1ml of water. few drops of aqueous NaOH solution was added.

Tannin test : ginger extract was dissolved in 5ml distilled water. 1% gelatin solution and 10% NaCl was added to the solution.

Phlobotannin test : 2ml of 1% HCl was added to 2ml ginger extract and boiled.

Saponin test : 2ml of water was added to 0.5g ginger extract and was shaken vigorously.

Anthraquinone test : 10ml of 10% ammonia solution was added to 5ml of ginger extract and shaken vigorously for 30seconds

Flavonoid test : 2ml of of 2% NaOH solution and few drops of dilute HCl was added to 1ml of ginger extract

Terpenoid test : 2ml chloroform was added to 5ml of ginger extract. The solution was heated to evaporation in a water bath. About 3ml concentrated H_2SO_4 was added and was allowed to boil

Steriod test : 2ml of chloroform was added to 0.2g of ginger extract. 2ml of concentrated sulphuric acid was added to form a layer.

CHAPTER THREE

3.0 RESULT AND DISCUSSION

3.1 RESULT

Table 3.1: Proximate composition of Ginger(*Zingiber officinale*)

NUTRIENTS	COMPOSITIONS
Moisture	9.47 ± 0.09
crude protein	11.90 ±0.15
Crude fat	8.66 ±0.35
Ash	6.23±0.10
Crude fibre	3.65 ± 0.05
Carbohydrate	59.97 ± 0.41

Data are mean and standard value of triplicate determination

Table 3.2: phytochemical screening of Ginger(*Zingiber officinale*)

phytochemical constituent	**observation**
Alkaliod	+++
Anthraquinone	-
Glycosides	+
Carbohydrate	+++
Flavonoids	+++
Tannins	-
Steriod	++
Saponnins	+
Terpinoides	++
Phenolics	+
Phlobotannins	-
Protein	++

+++ High concentration, ++ Moderate concentration, + Low concentration, - Absence

3.2 DISCUSSION

It can be inferred from the proximate analysis on ginger that carbohydrate is highly present. The ash, crude fibre, crude protein, crude fat and moisture content is comparatively low . Ginger has a long shelf life deduced from it's low moisture content. The methanol extract of ginger showed the presence of alkaloid, flavonoid, phenolics, terpenoids, steroids, glycoside, saponnin.They are responsible for the therapeutic nature of ginger (*Zingiber officinale)*.

CONCLUSION

Ginger is generally recognized as safe for use as food supplement by the food and drug administration (FDA) (Singletary, 2010). There are minor risk associated with excessive intake of ginger per day, although there is no regulated standard of ginger to be taken in Adult. Some report states that ginger should not be given to children from 0-2 in age. some side effect are stomach upset, heart burn and mouth irritation. Ginger health benefits is immensely relevant to maintaining healthy living in humans and animals.

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