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Evaluation of the phytoconstituents, proximate composi- tion, Some essential nutrients of *Curcuma longa* root and it's biological activities against some clinical pathogens

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Abstract
The plant Curcuma Longa belongs to zingiberaceae family and is commonly called turmeric. The root of the plant are used by various traditional medical practitioners to treat several dis- eases such as inflammation, diarrhea, skin infection, minor cut or open wound, sore feet and others. The phytochemical screening of Curcuma Longa root extract revealed the presence of some secondary metabolites such as alkaloid, flavonoids, saponin, cardiac glycoside, tannins and many others. Quantification of phytochemicals by a Buck M910 gas chromatographic equipment with a flame ionization detector showed the root contained more of flavonoiod like Narigenin, Anthocyanin, Kaemfferol in combined concentration of (140.58ug/g) and Nari- genin recorded the concentration of (40.260) as the highest of the flavonoiod compound and steroids recorded the lowest concentration of (7.926). The proximate analysis revealed the presence of moisture, Ash, Fibre, fat, protein and carbohydrate content. Carbohydrate record- ed the highest concentration while Fibre recorded the lowest concentration. Elemental analysis was conducted using Agilent FS240AA Atomic Absorption Spectrophotometer revealed the presence of iron, sodium, magnesium, potassium and calcium. Potassium recorded the high- est concentration while Iron recorded the lowest concentration. The antimicrobial assay indi- cated resistance for S. enteric, E. Coli, A. Niger P. aeruginosa, C. albicans and A. Fumigatus and was susceptible to only the S. aureu, at 1000mg/L concentration. The minimum inhibitory concentration (MIC) showed moderate growth for staphylococcus aureus at 15mm. The pres- ence of the detected secondary metabolites in the plant confirmed the usefulness of the plant Curcuma Longa root against some pathogenic strain, which makes the plant a potential drug development candidate for treatment of diseases caused by this pathogen.

Key words: curcuma longa, phytochemical, antimicrobial pathogen

Introduction

Any plant in which one or more of its organ compounds may be employed therapeutically or serve as building blocks for the production of effective pharmaceuticals is considered a medicinal plant. It is feasible to discern between characteristics and components that have been proven by science thanks to this description. There are several plants that are thought to have therapeutic properties but have not yet undergone a full scientific investigation**.** There is a long history of using medicinal plants to cure human illnesses. Researchers from all around the globe now believe that due to the scientific study of many plants throughout the years, the world's variety of plants may hold the key to curing a number of unsolved human diseases (Newman & Cragge, 2007). The study of various medicinal plants using cutting-edge biological techniques has benefited significantly from the vast traditional wisdom that is valued all over the globe**.**

Follow-up research has revealed a significant fraction of the physiologically active plant-derived compounds used commercially, confirming the validity of traditional knowledge. The plant has been used as a source of bioactive compounds for both research and the production of commercial pharmaceuticals from different plant parts or from the whole plant. Numerous bioactive substances found in the plant's ground-pinning roots have the potential to heal a number of human diseases, including cancer, diabetes, ulcers, and liver ailments. Thanks to scientific investigation, a large number of phytochemicals were discovered in plant roots; some of these compounds are currently employed in medicine, and many more are undergoing various preclinical and clinical studies. The great diversity of plants that exist on the planet provides an effective way to move the study and treatment of many illnesses ahead. Medical plants have been used in healthcare since the dawn of humanity. Studies have been conducted all around the globe to verify their efficacy, and some of the findings have inspired the creation of plant-based medicines**.** The value of medicinal plant products on the worldwide market exceeds $100 billion each year to assess their effectiveness and some of the discoveries have sparked the development of herbal medications.

The value of medicinal plant products on the world market exceeds $100 billion annually. The Zingiberaceae family of plants includes the commercially significant genus Curcuma Longa (turmeric), which has both culinary and medicinal uses. The Curcuma genus has 70 perennial rhizomatous species, which may be found all across the tropical and subtropical regions of the world, according to Xia *et al*. (2010) [34]. The Curcuma plant's rhizome generates a yellow colour and has been used as a spice and food preservation for a long time, flavouring ingredient, and home cure for treating a variety of illnesses. In terms of their traditional medical applications, they have been used to treat rheumatism, diabetes, stomach ulcers, hepatic illnesses, skin conditions, boils, and enlarged liver. Additionally, according to (Larsen *et al*., 2011) [17], different parts of these plant species are reportedly eaten in Asian countries either raw or cooked as vegetables**.**

The plants are also recognised as nutrient-dense food items since they are a fantastic source of carbohydrates, carbs,

proteins, lipids, vitamins, and minerals. Reports on the pharmacological effects, essential oils, and phytoconstituents have previously been reported. As a consequence, plants from the genus Curcuma are becoming more and more important globally and have been the focus of several studies and explorations in recent years. It has been shown that the plants contain bioactive compounds with pharmacological qualities including antibacterial, antinociceptive, antirheumatic, anti-cancerous. antivenomous, antihepatotoxic, antidiabetic, hypocholesterolemia antifibrotic, anti-inflammatory, and antiviral, (Agarwal *et al*., 2006; Garodia *et al*., 2007) [11]. Medicinal plants are crucial for human health because they include vitamins, minerals, phytochemicals, and dietary fibre. Particularly important for preserving human health are dietary fibre levels and the antioxidant vitamins (vitamins A, C, and E). A sufficient vegetable intake may lower the risk of contracting a number of chronic diseases, including as diabetes, cancer, obesity, metabolic syndrome, and cardiovascular problems.

Medical plants are important for human nutrition in terms of bioactive nutrient molecules such dietary fibre, vitamins, and minerals, as well as non-nutritive phytochemicals (phenolic compounds, flavonoids, bioactive peptides, etc.). These molecules, both nutrient- and non-nutrient-containing, reduce the risk of chronic diseases including obesity, diabetes, certain cancers, and heart conditions (Lieberman, 2001).

As awareness of the connection between food and remaining healthy and keeping excellent health increased recently, people started to alter their eating habits. Diets of the "Western" kind are distinguished by higher intakes of calories, sugar, saturated fats, and animal protein and lower intakes of vegetables and fruits. The incidence and occurrence of illnesses including obesity, diabetes, and cardiovascular pathologies are rising when this sort of diet is coupled with inactivity.

It is suggested in nutrient-dense diets (the editerranean diet model) to consume plant-based meals such as fruits, vegetables, grains, legumes, and nuts, swap butter for healthy oils like olive and canola oil, season food with herbs and spices rather than salt, limit red meat to a few times a month, and eat fish and chicken at least twice a week. According to data from epidemiological studies and clinical trials, the Mediterranean diet is connected to multiple positive health outcomes, including a lower risk of several chronic illnesses, a decreased overall mortality rate, and a better likelihood of healthy ageing. One of these diets' most important features is the high consumption of vegetables, fibre, vitamins, minerals, phytoestrogens, flavonoids, sulphur compounds, phenolic compounds like monoterpenes, and bioactive peptides, all of which have positive effects on health.

Prior until now, the focus on using medicinal herbs has been on illness treatment rather than prevention. Medicinal herbs are used in almost 90% of traditional medicines

Materials and method

Reagents and chemical

HCl, H_2SO_4, FeCl3, NaOH, acetic acid, distilled water, detergent, chloroform, Mayer's reagent, spray reagent, nutrient, and dimethyl sulfoxide (DMSO), among other substances.

Sample collection and preparation

The curcuma longa root sample was purchased in the Mile 3 market in Port Harcourt, Rivers State. The roots was cut into small pieces and spread on a tray, sun dried for two weeks. The dry roots was pulverized using pestle and mortar and then grinded with the aid of a grinding machine.

Sample extraction (Cold Maceration)

About 100g of powdered sample was poured into a glass (Bama container) bottle with 250ml ethyl acetate. The mixture was corked, shaken and allowed to stay for 48 hours with occasional shaking after which it was filtered and the filtrate was evaporated at room temperature to obtain crude ethyl acetate extract (Agber *et al*, 2019).

Preliminary phytochemical screening

Based on the methods outlined by (Linus *et al*. 2016) [19] and, qualitative phytochemical screening of the curcuma longa roots' ethyl acetate extract was done (Satheesh *et al*., 2012) [29]

Test for cardiac glycosides (Keller-Killiani Test)

Three drops of conc were added to three milligrams of the extract. Mixture of ferric chloride solution with glacial acetic acid**.**

The application of concentrated sulfuric acid was seen as two layers formed. A layer of bottom reddish brown and an upper layer of acetic acid that becomes blue green would indicate a positive test for glycosides.

Test for phenol and tannins (ferric chloride test)

Four drops of a solution of ferric chloride were added after each extract had been dissolved in 2ml of ethyl acetate as a solvent. If a blue-black colour starts to form, tannins or phenols are present**.**

Check for triterpenoids and steroids (Liebermann-Burchard test)

Three drops of acetic anhydride were added to around 3 mg of the extract, which was then heated and cooled. Concentrated sulfuric acid was poured into the test tube from the sides, and the development of a brown ring at the intersection of two layers was watched for. A positive test for steroids or triterpenoids is indicated by the top layer becoming green and the bottom layer developing a deep red hue**.**

Test for alkaloids

Three millilitres of the extract and one millilitre of 10% HCl were heated in a test tube for 20 minutes. This was processed with a few drops of Mayer's reagent in 1 ml of the filtrate after filtering and letting it cool. When a precipitate has a creamy look, alkaloids are present**.**

Test for flavonoids (alkaline test)

The extract was diluted in 5ml of sodium hydroxide solution to a concentration of around 5mg. When mixed with a few drops of weak hydrochloric acid, flavonoids become colourless, which is a sign that they are present.

Test for saponins

In a test tube, the extract (5 mg) and distilled water (5 ml) were mixed and shaken ferociously. The development of a large number of froths that last for around 30 minutes is an indication that there are flavonoids present**.**

Test for anthraquinone
In a test tube, 0.2 mg of an extract was mixed with 10 cm3 of benzene for 5 minutes before being filtered using filter paper. After that, 5 cm3 of a 10% ammonia solution was added to the filtrate. A pink, crimson, or violet hue in the ammoniacal (lower) phase is a sign that free anthraquinone is present**.**

Test for phenolics
In a test tube, 0.2 mg of an extract was mixed with 5 cm3 of distilled water before being filtered. To 1 cm3 of the filtrate, two drops of a 5% ferric chloride solution were added. A greenish precipitate is a sign of the presence of phenolics (Harbone, 1998) [13]

Quantitative Phytochemical Screening by GC-FID
Using a BUCK M910 Gas Chromatography (BUCK Scientific, USA) for the identification of free steroids, the phytochemicals in the extract were quantified. The gas chromatography equipment, RESTEK 15m MKT-1 column (15m 20m 0.15um), and flame ionisation detector. A 2Cl splitless sample injection is used, the injection temperature was adjusted to 280℃ and the injection speed was 30 cm/s. 40ml/min of helium (5.0pa) was employed as the carrier gas. The oven was heated from a starting temperature of 200℃ to 330℃ over the course of 3 minutes, with the detector being run at 3200℃. The quantity of phytochemicals was determined by dividing the area and mass of the internal standard by the area of the newly found phytochemicals. Each phytochemical concentration was shown in g/mL. (Nna *et al*., 2018) [23].

Some Extracts' antimicrobial efficacy against a few chosen test microorganisms
Test Bacteria
Three fungus, Candida albicans, Aspergillus fumigatus, and Aspergillus niger, as well as Pseudomonas aeruginosa, Staphylococcus aureus, Escherichia coli, and Salmonella enteric, were acquired from the Reference Laboratory Section of Conig- Simonne Laboratories, Akwa, Anambra State, Nigeria. The organisms were kept alive for 24 hours on nutrient broth**.**

Standardization of test micro-organisms
The test bacteria and the yeast candida albicans were standardized by using a sterile wire loop, to pick 3-5 pure cultures of the test micro-organisms and emulsified in 3-4 of sterile physiological saline. The turbidity reading of the 0.5McFarland standard was recorded as Absorbance in a Spectrophotometer at 540 nm, while the turbidities of the test organisms were adjusted to match the absorbance of the 0.5 McFarland contains $1.5x10^8$cfu/ml. While the molds (Aspergillus niger and Aspergillus fumigatus) were plated on Sabouraud Dextrose Agar for 48 hours. Thereafter, the developing colonies were counted and plated. The dilution tube yielding confluent or semi-confluent growth was used for the test. Total Fungal Plate Count calculated thus:

$$TFC(CFU/ml) = \frac{N}{VD}$$

330^{o}_{C} was achieved, while the detector was operated at 320℃

Where
TFC = Total Fungal plate Count
V= Volume of inoculums plated
N= Number of colonies, developing on plate, that were counted
D= Dilution factor
CFU/ml= Colony Forming Unit per mililitre

Antimicrobial susceptibility test
The antibacterial activities of the extracts against the test bacteria were evaluated by modified disc diffusion methods (Agu *et al*., 2013; Adindu *et al.*, 2016; Awah *et al.*, 2017) [4]. Exactly 25 l of 0.5 McFarland standardzed suspension of test bacteria ($1.5x10^8$ cfu ml^{-1}) were cultured onto the Mueller-Hinton plates by pour plate method. Exactly 50 l of the extracts were used to impregnate the 6mm filter paper discs and placed on two portions of the agar plate. The sizes of the inhibition zones on the different plates were measured and noted in millimetres. Three copies of each experiment were performed. Positive controls were made up using 50 l/ml of Ciprofloxacin, while negative controls were built up using sterile physiological saline. 0.1ml of the appropriate dilution is added next (10^{-2}) of the mold was plated out on SDA using pour plate technique and the antifungal susceptibility screening performed by modified disc diffusion methods (Agu *et al*., 2013; Adindu *et al*., 2016; Awah *et al*., 2017) [4, 1, 8]. Exactly 50 l of the extracts were used to impregnate the 6mm filter paper discs and placed on two portions of the agar plate. The inhibition zone diameters of the various plates were measured and recorded in millimeters. Mold was incubated for 48 hours at room temperature. The discs' clear zones of inhibition revealed that the extracts were having an antibacterial impact on the test organisms. The diameter of the zone of inhibitions was determined and recorded in millimetres. Each experiment was run two times. 50uINystatin for mould was utilised as a positive control, while sterile saline served as a negative control**.**

Determination of minimum inhibitory concentration (MIC)
Modified broth dilution methods of (Pallota *et al*. 2007; Agu *et al*., 2013 Ubaoji *et al* 2020) [4, 33] was used for this study. Two-fold serial dilution for the extracts in Mueller- Hinton broth for bacteria and SDA for fungi was done as follows 500mg/ml, 250mg/ml, 125mg/ml and62.5mg/ml. exactly 0.1 ml of the 0.5 McFarland standardized cultures were each seeded into the various tubes. (After preparing the 0.5 McFarland, incubate for 2 hours before use), while 0.1 ml of the 10^{-2} dilution tube was seed onto SD broth for mold. Controls (negative and positive) were set up using sterile DMSO (negative control) for both bacteria and fungi; and Nystatin (positive control) for (fungi) mould and yeast and ciprofloxacin (positive control) for bacteria. Both bacteria and fungus were cultured in the tubes for 24 hours at room temperature using a metabolic reciprocal shaker (220 rpm). The lowest dose of an anti-microbial that would prevent a bacterium from growing visibly after being incubated for one night is known as a minimum inhibitory concentration (MIC). It is the least concentration of the samples with no visible growth. Thereafter, the incubated test tubes were then sub cultured onto sterile freshly prepared plates and incubated for 24 hours. At the end of the incubation period, the plates were counted and the total microbial count record

in CFU/ml. the plates with no growth were recorded as the MBC and MFC respectively.
The lowest antimicrobial concentration that will stop an organism from growing following subculture on to antibiotic-free medium after 24 hours is known as the Minimum Fungicidal Concentration (MFC) or Minimum Bactericidal Concentration (MBC)

Methods for the elemental analysis of samples
Elemental analysis was performed using an Agilent FS240AA Atomic Absorption Spectrophotometer and the APHA 1995 method (American Public Health Association).
When the light beam from the atomic absorption spectrometer is focused through the flame, the monochromator, and onto the detector, the sample is atomized. The detector then measures the amount of light absorbed by the atomized element in the flame. Since metal source lamps use their own distinct characteristic absorption wavelengths, the method is relatively free from spectral or radiational interferences. How much energy of the particular wavelength is absorbed in the flame directly correlates with the element's concentration in the sample. Before being added in 100 ml increments into a 250 ml glass beaker with 5 ml of conc, the substance is well mixed by shaking. Nitric acid is added and heated to boiling until the volume is reduced to approximately 15-20 ml by adding conc. Add nitric acid in 5ml increments once the whole residue has been fully dissolved. The mixture is cooled, transferred, and dilute to a volume of 100ml with metal-free distilled water. The sample is inhaled into the air-acetylene flame, which is oxidising. The sensitivities for 1% absorption is shown when the aqueous sample is aspirated**.**

Moisture Content
Procedure
- The oven was used to clean and dry a petri dish.
- A sample weighing between one and two grammes was placed in a petri plate.
- The sample and petri dish were weighed before drying.
- The sample and petri dish were heated in the oven for 2 hours at 1050°C, with the results noted, and then heated for an additional hour to obtain a consistent result and record the weight.
- The drying process was carried out repeatedly until the weight remained consistent**.**

% moisture content = W1-W2 x 100Weight of sample

Where
W1=weight of petri dish and sample-before drying
W2=weight of petri dish and sample after drying.
Carbohydrate Determination (Differential method)
100– (% protein + Moisture + % Ash + %Fat + % Fibre) Ash content (AOAC, 1984)

Principle
- Food ash is the inorganic material that is left behind after all of the organic material has been burned up. However, it should be noted that not all of the ash produced will be the desired composition since some may have volatilized**.**

Procedures
- A cleaned, dried, and weighted empty platinum crucible was used**.**
- The platinum crucible was filled with 1-2g of sample and heated to 5500C for three hours in a muffle furnace.

The sample was cooled in a desiccate afterburning and weighed Calculation

$$\frac{w_3 - w_1}{w_2 - w_1} \times 100$$

% Ash content = Where
W1 = Weight of empty platinum crucible
W2=Weight of platinum crucible and sample before burning
W3 = weight of platinum and ash

Crude fibre procedure
1. Using petroleum, defat 2g of material (if the substance's fat content is more than 10%).
2. For 30 minutes, boil at reflux 200 ml of a solution containing 1.25g of H_2SO_4 per 100 ml of solution**.**
3. Use linen to filter the mixture**.**
4. Wash in hot water until the washings are no longer acidic**.**
5. To the residue in the beaker, add 200 ml of a solution containing 1.25g of NaOH free of carbonate per 100 ml, and boil for 30 minutes**.**
6. Use a thin but thick pad of cleaned and lighted asbestos to filter the final residue before placing it in a Gooch crucible**.**
7. Dry in a power oven, then weigh
8. burn, cool, and weigh

The proportion of crude fibre is equal to the weight loss after incineration multiplied by 100**.**

$$\% \text{ crude fibre} = \frac{\text{weight of fibre x 100}}{\text{Weight of sample}}$$

Crude fat
Soxhlet Fat Extraction Method
The process involves continually extracting a meal for at least an hour using a non-polar organic solvent like petroleum ether**.**

Procedure
1. Boiling flasks of 250 ml should be dried in an oven at 105 to 1100 c for approximately 30 minutes**.**
2. Place in a desiccator and let cool
3. Weigh the cooled, appropriately labelled boiling flasks.
4. About 300ml of petroleum ether should be added to the boiling flasks (boiling point 40- 600c)
5. Lightly insert cotton wool into the extraction thimble.
6. Put the soxhlet apparatus together and let it reflux for about six hours.
7. Carefully remove the thimble, collect the petroleum ether in the setup's top container, and then drain it into another container for later use.
8. Flask should be removed after petroleum ether is nearly completely gone and dried for an hour at 1050–1100°C.
9. After transferring from the oven into a desiccator to cool, weigh the item. % fat is calculated as follows % fat = wt of flask + oil – wt of flask x 100 Wt of sample

Crude proteins (AOAC, 1990)

Principle

The procedure involves digesting the sample in the presence of a metallic catalyst in hot, concentrated sulfuric acid. The sample's organic nitrogen is converted to ammonia. This is preserved as ammonium sulphate in the mixture. The solution is made alkaline, and after that, distilled to get off the ammonia. The ammonia is then titrated after being captured in mild acid.

Procedures

A digesting rack over fire was used to carefully heat the mixture after adding 0.5g of the Kjedahl catalyst combination until a clear solution materialised. The precise 0.5g of the sample was placed in each 30ml kjehdal flask before being stopped and shook to prevent the sample from contacting the flask walls.

To avoid caking after cooling, 1000 ml of distilled water was added to the clear solution. After that, 5 ml of the clear solution and 5 ml of 40% sodium hydroxide were added to the Kjedahl distillation apparatus.

A 100 ml receiver flask holding 5 ml of 2% boric and an indicator mixture made up of 5 drops of bromocresol blue and 1 drop of methlene blue was put under the condenser of the distillation equipment. Distillation began immediately, proceeded until 50 drops reached the receiver flask, and then calculations were done**.**

% Nitrogen = Titre value x 0.01 x 14 x 4

% Protein = % Nitrogen x 6.25.

Result and discussion

Qualitative photochemical screening

Phytochemicals are bioactive naturally occurring chemical compounds that protect plants from diseases and damages, and contributes to the plants colour, aroma and flavor (Sexana *et al*, 2013) [31].

They are secondary metabolites from plants which constitute the therapeutic benefits or properties in Medical plants (Philipson, 2001).

For both conventional and contemporary medicine, as well as the food and pharmaceutical sectors, phytochemicals are significant sources of raw materials**.** They include;

1. Akaloids
2. Flavonoids
3. Tannins
4. Saponins
5. Steroid
6. Phenol
7. Cardial glycoside Anthrauinones
8. Quinine 10. Lunamarine 11. Terpenoides etc.

Table 1: Qualitative Phytochemical Screening

Compounds	Result
Alkaloids	+
Tannins	+
Saponins	+
Flavonoids	+
Anthraquinone	-
Steroids	-
Cardiac glycosides	+
Phenols	-

Key: + = Present - = Absent

Alkaloids, sapanins, cardiac glycoside, and flavonoids were found in table 1 qualitative screening of the root extracts of Curcuma longa, while anthraquinone steroids and phenols were confirmed absent. These phytochemicals are what give the extract its bioactivity; they contain traits like antibacterial, antihypertensive, antioxidant, anti-inflammatory, and analgesic, among others.

Quantitative phytochemical analysis

Table 2: Quantitative Phytochemical Analysis

Compound	Amount (Ug/g)	Class of compound
Dihydrocytisine	0.356	Alkanoids
Ribalinidine	16.910	Alkanoids
Catechin	31.450	Flavonoid
Epihedrine	12.826	Alkanoids
Falvonnones	25.466	Flavonoid
Aphyllidine	37.716	Alkanoids
Cardiac glyco- Side	7.928	Steroid
Kaempferol	15.100	Flavonoid
Oxalates	1.586	Alkanoids
Naringenin	40.260	Flavonoid
Ammodendrine	20.376	Alkanoids
Tannin	23.453	Tannins
Anthocyanin	28.306	Flavonoid
Spartein	36.006	Alkanoids
Phytate	43.923	Phenol

The quantification of phytochemicals was carried out using gas chromatography equipment. This equipment is sensitive that can detect even minute quantity of a metabolite present in a given sample. This experiment confirmed the presence of 15 metabolites and their concentration was recorded in table 2. The study showed that flavonoids combine total has the highest quantity of all the metabolites present in the root extract of *curcuma longa* and steroids recorded the lowest concentration. Flavonnones, catechins, kaempferols, anthocynins, and naringenin are only a few of the individual flavonoid members that are present.

One of the most researched plant compounds, flavonoids have a wide range of medicinal as well as business applications. The majority of flavonoids, which are organic compounds with varying phenolic groups, are found in vegetables, while they may also be found in certain grains, stems, and flowers. They are well known for their positive health benefits, mainly because to their abilities to regulate enzymes and their anti-oxidative, anti-mutagenic, anti-inflammatory, and anti-carcinogenic properties (Grotewold, 2006) [12].

Narigenin's overall concentration was calculated to be 40.260 ug/g. The majority of this flavonoid, which predominates in the extract, is found in tomatoes and citrus fruits. It aids in the treatment of osteoporosis, heart disease, and cancer (Patel *et al*, 2012) [26]. Furthermore, it inhibits the dengue virus in a dose-dependent way. The significant content of flavonoids in Curcuma longa roots raises the possibility that they possess potent antiviral properties.

The overall concentration of anthocyanin was (28.306 ug/g). Due to its powerful antioxidant activity, it is a pigment that is extensively distributed in land plants, where it functions as a stress protectant and a component that promotes health (Butelli *et al*., 2008) [9].

The overall concentration of catechins was (31.450 ug/g). Red wine and green tea both contain large amounts of this

flavonoid, which has the capacity to scavenge free radicals and provide advantages including anti-obesity and anti-diabetes as well as the ability to suppress eicosanoid production and platelet aggregation (Pace-Asciak *et al*., 1996) [24].

According to reports, catechins are crucial to red wine's ability to protect against atherosclerosis and cardiovascular illnesses (Kinsella & Taeuber, 1993) [16].

The total content of kaempferol was measured as 15.100 ug/g. It has been found that this dietary flavonoid contains antibacterial and anti-inflammatory properties (Harborne & Baxter, 1993) [14]**.** Given the concentration of kaempferol in the root extract of *Curcuma Longa*, it could be speculated therefore that this could have a strong anti-inflammatory potential which justified cure for Arthrities by the extract.

Alkaloids also represented a high fraction of the total secondary metabolites. Individual member of the alkaloids present includes; spartein, Ribalindine, Ephedrine, Aphillidine Oxalates and Ammaodendrine. These demonstrated anti-inflammatory, anti-cancer, analgesic, local anaesthetic, pain alleviation, antimalarial, antibacterial, antifungal, and several other actions. Alkaloids have several uses in human life, including as food additives, dietary supplements, and pharmaceuticals**.**

Spartein recorded total concentration of (36.006 ug/g). Studies has showed that spartein inhibit the viability of cervical cancer cells and thus proven beneficial in cervical cancer chemotherapy (Liargs, 2019). Therefore given the concentration of spartein in the extract of *curcuma Longa*, it could be speculated that Curcuma Long could be used as the precursor in anticancer drugs..

Ribalinidine recorded total concentration of (16.910 ug/g). This has been reported to have radical scavenging function (Rahmani *et al*, 2010) [28].

Ephedrine recorded total concentration of (6.556 ug/g). According to reports, this may improve mental performance and temporarily relieve symptoms of bronchial asthma, including shortness of breath, chest tightness, and wheezing (Lieberman, 2001).

Aphyllidine recorded total concentration of (37.711 ug/g), This has been reportedly used in the treatment of bronchial asthma, tuberculosis, colds and flu etc. (Ashok *et al*, 2020).

Oxalate recorded total concentration of (1.583 ug/g). Low oxalate intake prevent kidney stores and stone-like materials that form on the walls of the kidney, this make the extract very save for food or consumption because it contain very low concentration of oxalate.

Tannins recorded total concentration of (23.453 ug/g). Many plant meals include tannins, which are mostly water-soluble polyphenols. Tea, chocolate, vegetables, legumes, and certain immature fruit all contain them (Sharma *et al*, 2019). There is a significant percentage of tannins in the extract. Tannins are utilized as a diuretic and astringent. They are used to treat tumours and gastrointestinal ulcers in diabetic patients. Additionally, they have anti-inflammatory, anti-cancer, and antioxidant properties (Maharaj *et al*., 2022) [20].

Total concentration of cardiac glycoside was 7.928 ug/g. A steroid-like substance called cardiac glycoside has long been used to treat congestive heart failure).

The testicles and ovaries produce the hormones known as steroids. This may support male sex hormones, keep female reproductive tissues healthy, and encourage the estrous phase of the mate-ready process (Nkosinathi *et al*., 2017) [22].

The overall content of phenols was 43.923 ug/g. When compared to nutrients, which are thought to have positive impacts on human health, phenols are known as anti-nutrients**.**

Anti-nutrients, on the other hand, interfere with the absorption of minerals and are therefore seen as less beneficial, but some have significant health benefits, like those of phytic acid, which plays a role in the release of insulin by the beta cells of the pancreas. Additionally, it has been hypothesised that phytic acid may stop plaque from forming, reduce blood cholesterol, and triglycerides (Schlemmer *et al*, 2009) [30]

Table 3: Concentration of Mineral contents

Parameters	Concentration
Iron	0.470
Sodium	7.787
Magnesium	9.989
Potassium	10.566
Calcium	6.673

A total number five (5) mineral contents were detected, the result showed that potassium has the higher concentration (10.566) why iron recorded the lower concentration (0.470) . The mineral contents detected were iron (0.470), Sodium (7.787), magnesium (9.989), potassium (10.566) and Calcium (6.673) respectively.

Plasma, erythrocytes, and blood haemoglobin all contain iron. It performs cellular respiration, oxygen transport, and serves as a crucial building block for enzymes like cytochromes that are involved in biological oxidation**.**

Magnesium strengthens the bones nerve, aids enzyme and heart functions (Ishfaq *et al*, 2022) [15]. The high level of magnesium content in the root extract of *Curcuma Longa* indicates it could probably be added to the supply of the needed magnesium for children and adult to boost their daily magnesium intake.

Sodium observed in the root extract was lower compare to that of potassium recorded which consequently might be imperative in diet recommendations for patients with high blood pressure sodium also helps with function of nerves, muscle and keep the right balance of fluids in our body.

Calcium is a valuable nutritional mineral capable of enhancing resistance to tissues which makes it possible for stem of plants to be upright. Calcium is vital in the development and proper functioning of bones and teeth ((Ishfaq *et al*, 2022) [15].

One mineral that is essential for the efficient operation of our cells, neurons, and muscles is potassium. It supports digestion and assists with blood pressure, heart rhythm, and cell water balance regulation in the body.

Table 4: Proximate Analysis

Proximate Content	Percentage Yield
Moisture	8.275
Ash	7.446
Fibre	0.197
Fat	4.300
Protein	8.05
Carbohydrate	71.732

A total number of six (6) proximate constituents were detected. The result showed that carbohydrate recorded the highest concentration (71.732%) why fibre has the lowest

concentration (0.197%). The proximate constituents detected were moisture, fibre, crude fat, protein and carbohydrate.

The high content of carbohydrate in the root extract of *curcuma Longa* indicate that it is a good sources energy and can be eaten as food plants, supplementary food and drinks to give energy.

Since foods with a high moisture content are more likely to spoil, the high moisture level in the Curcuma Longa root extract demonstrated that the root are more susceptible to degradation, because dietary fats absorb and maintain taste, they help make food more appealing, as seen by the crude fat content that was discovered for the roots (Fennema and Tannenhaum, 1996).

Ash and crude fibre content were also found in significant amounts. Because high fibre level in food aids in digestion, they are flavorful forage thanks to their crude fibre content. The ash concentration of the Curcuma longa root extract revealed a reflection of the mineral content maintained in the extract's components**.**

Table 5: Preliminary Antimicrobial Susceptibility Screening of Extracts Mean Inhibition Zone Diameters ± Standard Deviation

Test Bacteria	Minimum zone of inhibition in triplicates (mm)				Standard drug ciprof- Loxacin
	X	y	Z	Mean SD	
Salmonella enteric	R (0)	R (0)	R (0)	-	S (50)
Escherichia coli	R (0)	R (0)	R (0)	-	S (45)
Staphylococcus aureus	S (15)	S (15)	S (15)	15.00	S (60)
Pseudomonas aeruginosa	R (0)	R (0)	R (0)	-	S (50)
Candida albicans	R (0)	R (0)	R (0)	-	S (40)
Aspergillus Niger	R (0)	R (0)	R (0)	-	S (36)
Aspergillus fumigatus	R (0)	R (0)	R (0)	-	S (30)

Key: S = Susceptible,
R = Resistant numeric value in brackets Diameter of zone of inhibition in millimeters (mm)

The bioactivity of the root extract of *curcuma longa* samples on pathogenic organisms (salmonella enteric, Escherichia coli, staphyloccus aureus, pseudomonas aeruginosa, can did barbicans, Aspergillus Niger, and As perilous fumigatus) was determined. The activity of the extracts on the pathogens was compared to standard antimicrobial drugs (ciprofloxacin) used in the control of these pathogens. From the results obtained from the study, it was observed that almost all of the pathogens were resistant to the root extract of *Curcuma Longa* sample except staphylococcus aureus which was susceptible at 1000mgL^{-1} concentration of the extracts.

Their levels of susceptibility (sensitive) to the extracts were however lower than that of the control microbial agent (the standard drug).

This could be explained by the disparity between their purity levels.

At the concentration of 1000mgL-1, the extracts had its highest activity

Table 6: Minimum Inhibitory Concentration (MIC) of the Extracts on the Various Test Organism Sample cmgm1-1- vectrl (mgml-g)

Test Bacteria	500	500	250	125	62.5	500	250	125	62.5	500	250	125	62.5
Salmonella Enteric	-	-	-	-	-	-	NT	NT	T	T	T	T	T
Escherichia Coli	NT	-	-	-	T	NT	NT	NT	T	T	T	T	T
Staphylococcus Aureus	-	NT	T	T	T	NT	NT	NT	T	T	T	T	T
Pseudornonas Aeruginosa	NT	-	-	-	T	NT	NT	NT	T	T	T	T	T
Candida Albicans	NT	-	-	-	-	NT	NT	NT	T	T	T	T	T
Aspergillusniger	-	-	-	-	-	-	NT	NT	T	T	T	T	T
Aspergillusfumi- gatus	-	-	-	-	-	-	NT	NT	T	T	T	T	T

Key: T= Turbidity (Light growth)
NT = No Turbidity (No growth) = Not performed

The minimum inhibition concentration (MIC) of the extract showed potent inhibition of test bacterial at different concentration that varied between 62.5 mgml^{-1} to 500mgml $^{-1}$ At 500mgl^{-1}, there was no growth (No turbidity) for all the test bacterial. Only staphylococcus aureus a gram positive bacterial showed light growth (Turbidity) at 250mgml^{-1}.

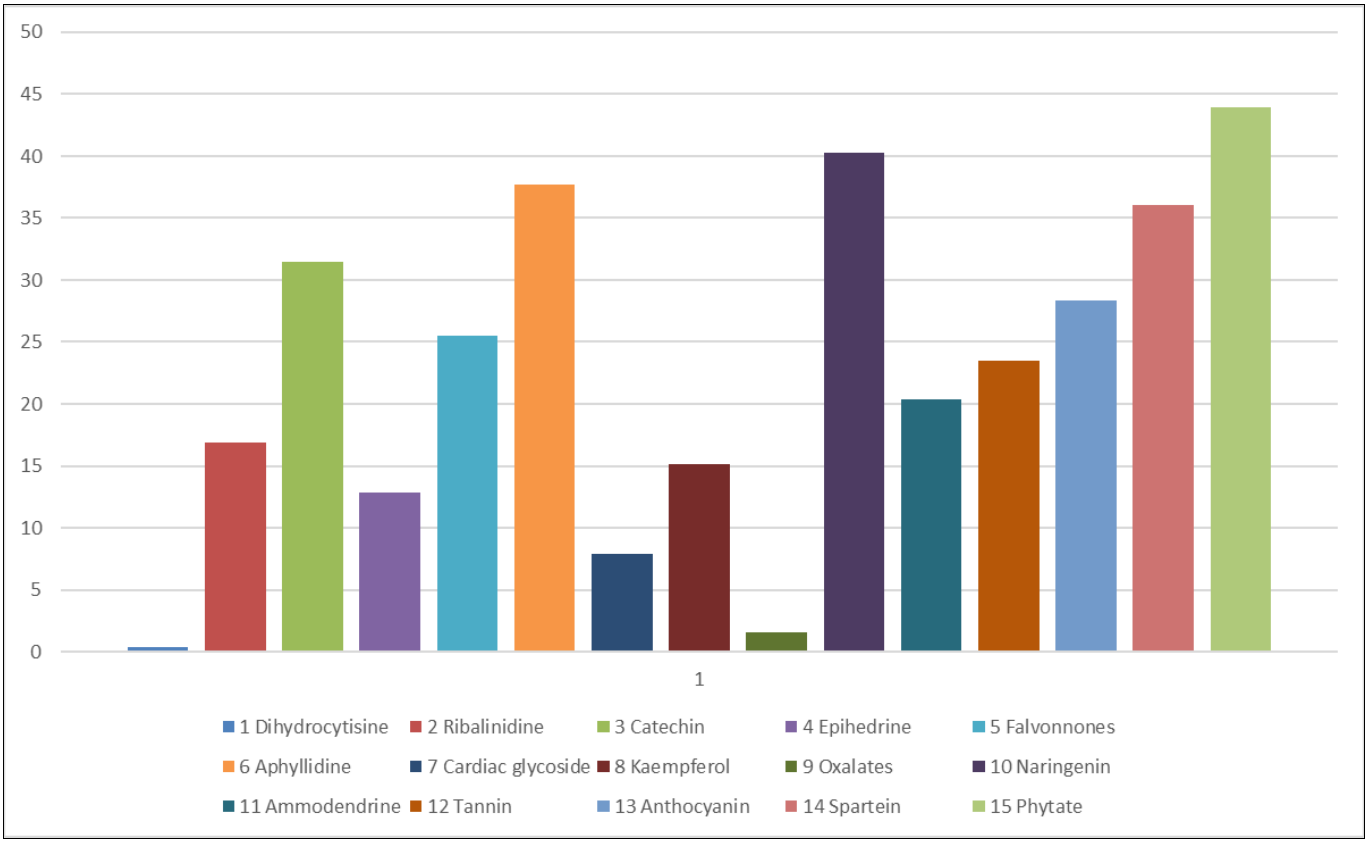

Fig 1: Quantitative Phytochemical Analysis

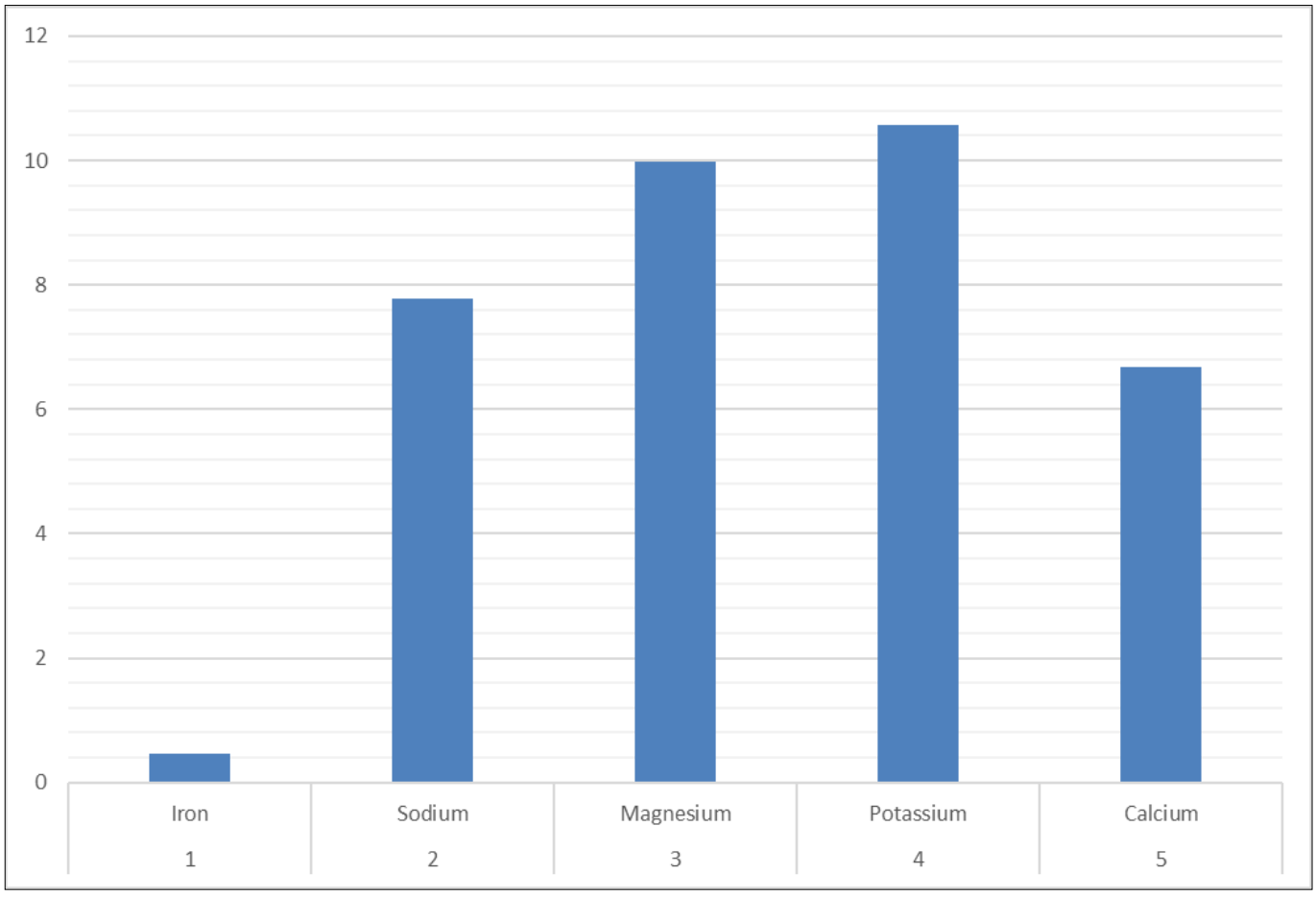

Fig 2: Concentration of Mineral contents

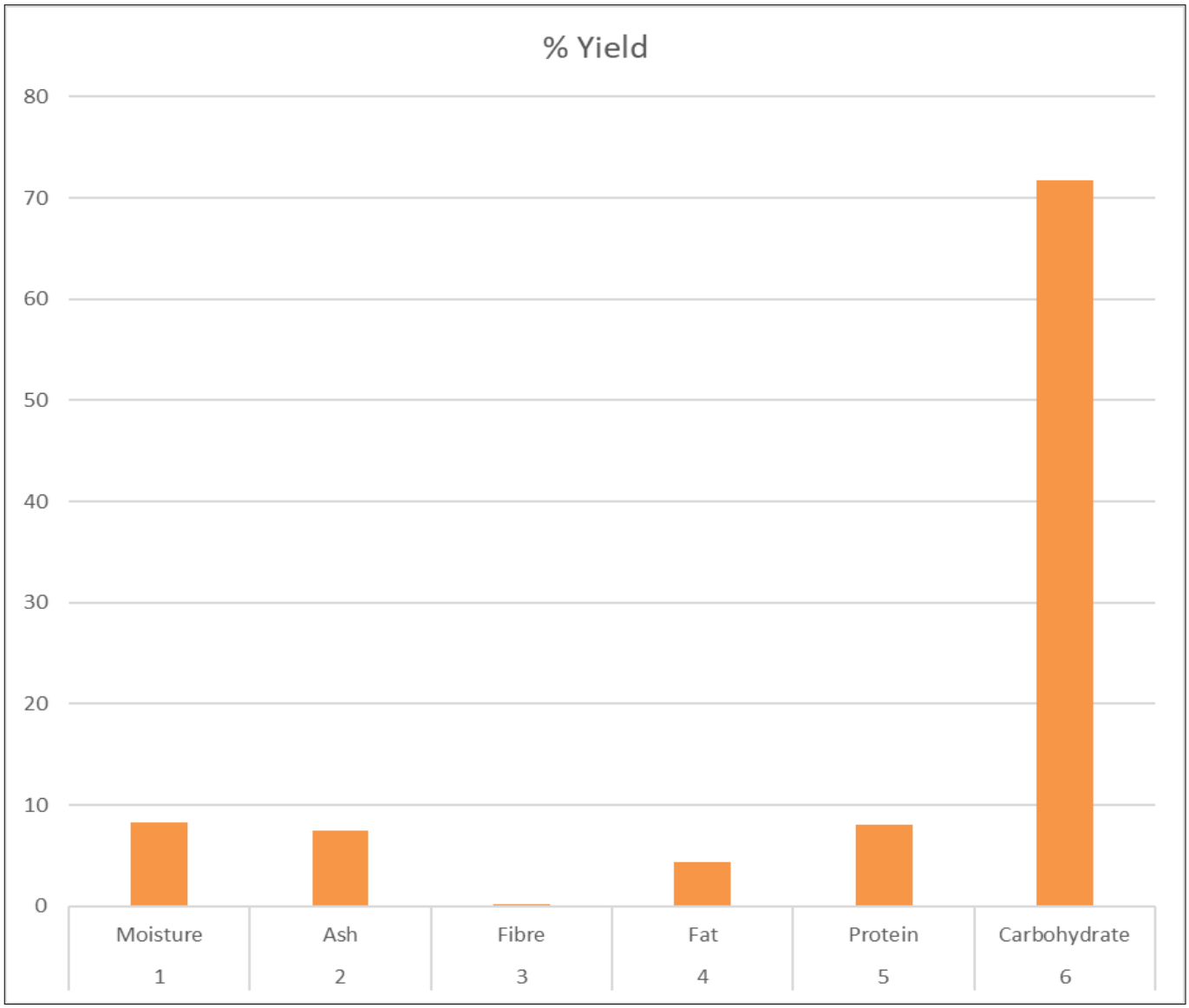

Fig 3: Proximate Analysis

Summary
The study evaluated the phytoconstituents, mineral elements, proximate constituents and biological activity of the root extract of *Curcuma Longa.*
Qualitative and quantitative determination of the phytochemical constituents of the root extract of *Curcuma Longa* reveals the presence of saponin, alkaloids, flavanoid tannins, and steroid, phenols and anthraquinone were confirmed absence. The quantitative pytochemical showed the presence of Alkaloids, Saponins, Tannis, Cardiac glycoside, Flavonoids. The flavonoid recorded the highest amount of concentration and steroid recorded the lowest concentration. The antimicrobial assay indicated resistance for S. enteric, E. Coli, A. Niger P. aeruginosa,C. albicans and A. Fumigatus and was susceptible to S. aureu, at 1000mg/L concentration. The minimum inhibitory concentration (MIC) showed moderate growth for staphylococcus aureus at 15mm.

Conclusion
The findings of this study suggested that Curcuma longa's roots extract is a reliable source of both bioactive phytochemicals and nutritional components. The roots were excellent providers of fat, protein, and carbs, all of which are beneficial to one's diet. The therapeutic capabilities of the extracts may also be inferred to be due to the measurable presence of bioactive phytochemicals. The study's findings supported the Curcuma longa's use in conventional medicine for the prevention of infections and the treatment of various disorders**.**

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