Phytochemical Properties of Three Selected Plant Species in Yola, Nigeria

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Abstract: A research was conducted to examine the phytochemical properties of Three (3) selected plant species in Yola, Nigeria. The leaves, stem-bark and roots of *Guiera senegalensis*, *Terminalia glaucescens* and *Ziziphus maiuritania* were collected from plant community within the University. The specimens were identified at the Department of Forestry and Wildlife, Modibbo Adama University of Technology, Yola. Each sample was dried at room temperature until a constant weight was obtained before grinding into fine powder using mortal and pestle. The samples were qualitative and quantitatively analysed and the data obtained were statistically analysed using SPSS package. Results revealed the presence of saponins, tannins, alkaloids, flavinoids and phenols were present in all the species analysed. One-way analysis of variance was used to test if there are significant differences (P=0.5). The results implied that the species had potentials in pharmaceutical, agrochemical and allied industries.
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1. Introduction

Phytochemicals are compounds that occur naturally in plants. They contribute to the colour, flavour and perfumery/scent/smell of plants. In addition, they form part of a plant's natural defense mechanism against diseases and competition. Their therapeutic values to human health and disease prevention have been reported (Okwu, 2004). They are grouped into two main categories namely primary and secondary constituents, according to their functions in plant metabolism. Primary constituents comprise amino acids, common sugars, proteins and chlorophyll. The secondary constituents consist of alkaloids, essential oils, flavinoids, terpenoids, tannins, saponins, and phenolic compounds. Terpenoids exhibit various important pharmacological activities (anti-inflammatory, anti-cancer, anti-malarial, inhibition of cholesterol synthesis, anti-viral and anti-bacterial activities). Terpenoids are very important in attracting useful mites and consume the herbivorous insects. Alkaloids are used as anaesthetic agents and are found in medicinal plants. Majority of phytochemicals have been known to bear valuable therapeutic activities such as insecticidal, antibacterial, antifungal, anticonstipative, spasmolytic, antiplasmodial and antioxidant activities. The plants thus, find their medicinal value due to respective constituents they contain (Krishnaiah *et al*., 2009).

The plant kingdom has proven to be the most useful in the treatment of diseases and they provide important source of al the world's pharmaceuticals. Plants in all facets of life have served as valuable starting materials for drug development (Ajibesin, 2011). The phytochemicals which are phenols, anthraquinones, alkaloids, glycosides, flavinoids and saponins are antibiotic principles of plants. Plants are now occupying important position in allopathic medicine, herbal medicine, homoeopathy and aromatherapy. Medicinal plants are the sources of many important drugs of the modern world. Many of these indigenous medicinal plants are used as spices and food plants; they are also sometimes added to foods meant for pregnant mothers for medicinal purposes (Akinpela and Onakoya, 2006). Medicinal plants are of great importance to the health of individuals and communities. It was the advent of antibiotics in the 1950s that led to the decline of the use of plant derivatives as antimicrobials (Marjorie, 1999).

There are a large number of medicinal plants whose scientific importance has not been explored. All over the world, plants have served as the richest source of raw materials for traditional as well as modern medicine, particularly, in Africa and Asia (Tsakala *et al*., 2006). Diseases are best controlled through pharmacotherapy. The study of the many chemical constituents of plants is very essential because most drugs used as medicines were later synthesized after a careful study of their constituents and structures (Ghani, 1990).

This study was therefore, designed to determine the presence of five phytochemical components present in the selected medicinal plats, evaluate the quantity of these components, and compare the concentration of the these phytochemicals in eachpart of the selected plants.

2. Materials and Methods

2.1 Study area:

Modibbo Adama University of Technology, Yola, is located within latitude 9°29' and longitude 12°38' E at an altitude of 158.8m above sea level. It covers an area of about 54 ha (Department of Geography, 2016). The dominant tree species in the study area comprise of *Terminalia glaucescence*, *Parkia biglobosa*, *Azadirachta indica* among others; while the shrubs include *Guiera senegalensis*, *Terminalia mantaly* and many others.

2.2 Materials

The materials used for both quantitative and qualitative analysis include high performance liquid chromatography (HPLC) machine, machete, polythene bags, conical flask, pipette, water bath, filter paper, mortar and pestle, reagents (ammonia, H_2SO_4, Dragendoff's ferric chloride.

2.3 Sample Identification

The species collected were first identified on the semi-natural forest, Modibbo Adama University of Technology, Yola during the preliminary investigation.

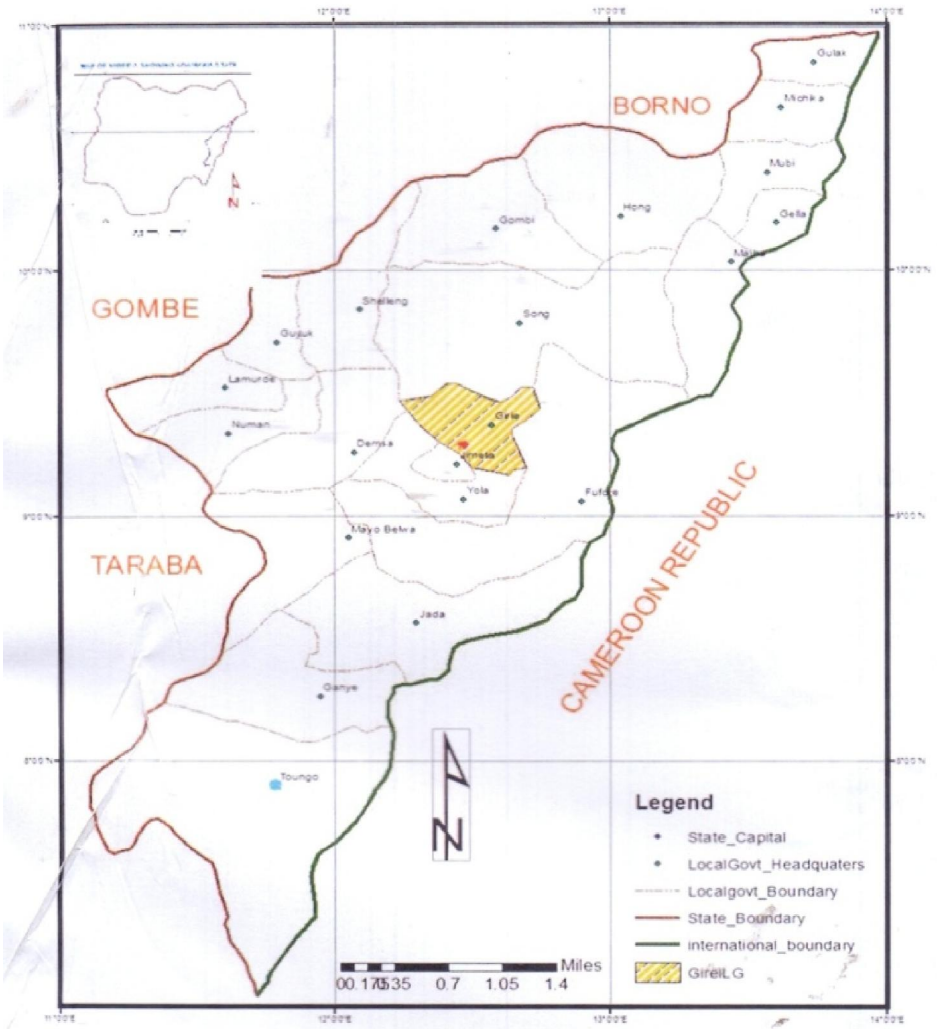

Figure 1: Map showing Adamawa state and the study area.

Source: Department of Geography, Mautech 2016.

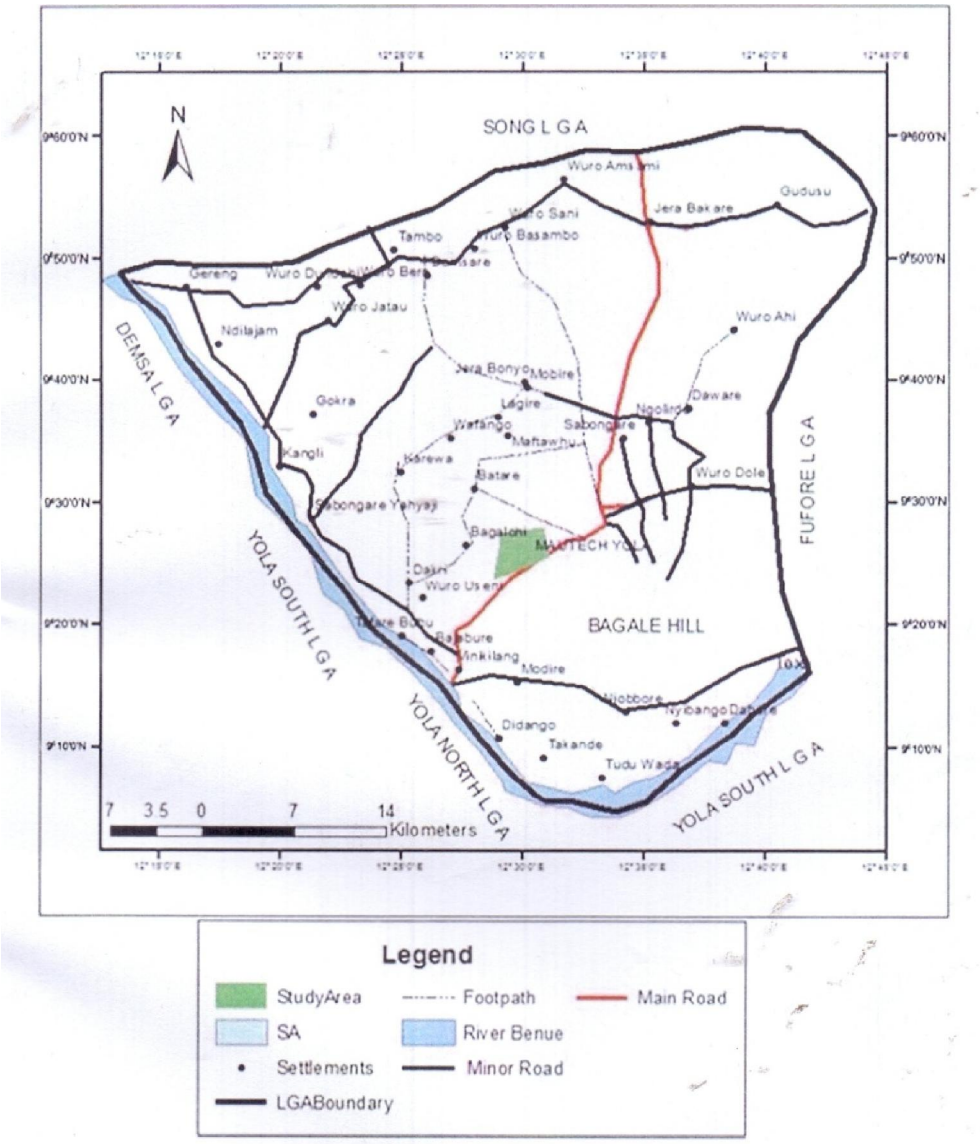

Fig 2: Map of Girei Local Government Showing the Study Area
Source: Geography Department, MAUTECH (2016)

2.4 Method of Sample Collection

The leaves, stem-barks and roots of the sample of *G. senegalensis*, *Z. Mauritania* and *T. glaucescens* were collected rom the identified plant community and taxonomic confirmation was done in the Department of Forestry and Wildlife Management, MAUTECH, Yola. The plant materials were dried at room temperature for four (4) weeks until all the water molecules evaporated and the plant became well-dried for grinding. The dried sample was then grounded into fine powder using mortar and pestle before transferring into and air-tight bag.

2.5 Qualitative Analysis

The qualitative test was conducted on the extract of the leaves, stem-bark and root of the selected plant species in the laboratory using the standard methods as reported by Edeoga *et al*. (2005).

i. *Test for Tannins*: 0.5g of powdered *G. senegalensis* sample was boiled in 20ml of distilled water in a test tube and filtered using a conical flask and filter paper. 0.1% $FeCL^2$ was added to the filtrate and observed for brownish-green or blue-black colouration which indicates the presence of tannins.

ii. *Test for Saponins*: 2g of powdered *G. senegalensis* sample was boiled in 20ml of distilled water in a water bath and filtered. 10ml of the filtrate was mixed with 5ml of distilled water in a test tube and shaken vigorously to obtain a stable persistent froth. The frothing was then mixed with 3 drops of

olive oil and observed for the formation of emulsion which indicates the presence of saponins.

iii. *Test for Flavinoids:* Three (3) drops of 1% ammonia solution was added to 10ml aqueous extract of the *Guiera senegalensis* sample in a test tube. A yellow colouration observed indicates the presence of flavonoid compounds.

iv. *Test of Alkaloids*: 0.2g of the *G. senegalensis* sample aqueous extract was warmed with 2% H_2SO_4 for two minutes, filtered and three drops of Dragendoff's reagent was added. Formation of orange-red precipitate indicates the presence f alkaloids.

v. *Test of Phenosl*: *G. senegalensis* sample was mixed with distilled water; 2ml of ethanol was added to the test solution and few drops of ferric chloride solution and observed for colouration.

The same procedures were repeated for *Z. mauratania* and *T. glaucescens* samples.

2.6 Quantitative Analysis

The analyses for the quantitative phytochemicals of the three sample wer carried out at the Animal Nutrition Laboratory, Department of Animal Production, Faculty of Agriculture, Adamawa State University, Mubi in 2016 using High Perfomance Liquid Chromatography (HPCL) machine.

3. Results

3.1 Qualitative Analysis of the Selected Plant Species

i. Qualitative phytochemical profile of *Guiera senegalensis*

Table 1 shows the results of the qualitative phytochemical test on the root, stem-bark and bark of *G. senegalensis*. The result indicates that all the five classes of phytochemicals tested for, were present in the three parts o the plant.

ii. Qualitative phytochemical profile of *Ziziphus Mauritania*

The result of the qualitative phytochemical composition of *Z. Mauritania* is presented in Table 1. The results shows that all the five components (tannins, saponins, flavonoids, alkaloids and phenols) tested for in the leaves, stem-bark and roots were present.

iii. Qualitative phytochemical profile of *Terminalia glaucescens*

Table 1 shows the qualitative phytochemical test on the root, stem-bark and root of *T. glaucescens*. The result indicates that all the five classes of phytochemicals tested were present in the three parts of the plant.

Table 1: Qualitative phytochemical Profile of the Plant Species Tested

Phytochemical	*G. senegalensis*	*Z. mauritania*	*T. glaucescens*
Tannins	x	x	x
Saponins	x	x	x
Flavonoids	x	x	x
Alkaloids	x	x	x
Phenols	x	x	x

x = indicates presence of phytochemical

3.2 Quantitative Analysis of the Selected Plant Species

The results of the quantitative analysis on the five groups of phytochemical constituents in the selected plant species are present in Tables 2, 3 and 4.

3.2.1 Quantitative estimates of Guiera senegalensis

Table 2 shows the quantitative of the five phytochemical constituents in the leaves, stem-bark and root of *G. senegalensis* in three replications. The results obtained from this study revealed that the three plant parts have a preponderance of tannin. From the results, saponin shows the highest with a mean of 2.77 in the stem-bark and has the lowest with 1.34 in the root. Tannin shows the highest mean of 20.08 in the leaf and lowest with 9.99 in the root. Alkaloid has the highest mean of 2.09 in the stem-bark and lowest with 0.11 in the root. Flavinoid shows the highest mean of 1.02 in the leaf with the lowest mean of 0.34 in the root. Phenol shows the highest mean of 0.97 in the root and revealed the lowest mean of 0.05 in the stem-bark.

3.2.2 Quantitative estimation of Ziziphus mauritania

Table 2 shows the quantity of the five phytochemical constituents in the leaves, stem-bark and root of *Z. mauritania* in three replications. The results obtained from this study revealed that the three plant parts have a preponderance of tannins. From the results, saponins shows highest mean of 4.28 in the leaf while the lowest mean of 1.33 was found in the root. Tannins showed the highest mean of 10.22 in the leaf while the lowest of 8.05 was in the root. Alkaloids showed the highest mean of 3.62 in the stem-bark and revealed the lowest mean of 2.35 in the leaf. Flavinoids shows the highest mean of 2.06 in the stem-bark and revealed the lowest mean of 1.46 in the root. Phenols showed the highest mean of 0.97 in the root and lowest mean of 0.05 in the stem-bark.

Table 2: Quantitative phytochemical tests on *G. senegalensis* (%)

Sample	Saponins	Tannins	Alkaloids	Flavonoids	Phenols
Leaf	1.56	20.08	0..11	1.02	0.15
	1.55	20.07	0.12	1.04	0.17
	1.57	20.09	0.14	1.05	0.19
Stem-bark	2.75	13.52	2.09	0.96	0.05
	2.77	13.54	2.10	0.98	0.06
	2.78	13.53	2.12	0.99	0.07
Roots	1.33	9.97	0.21	0.34	0.97
	1.34	9.99	0.23	0.36	0.98
	1.36	10.01	0.24	0.33	0.99

Source: Analysed results (2016)

Table 2: Quantitative phytochemical tests on *Z. mauritania* (%)

Sample	Saponins	Tannins	Alkaloids	Flavinoids	Phenols
Leaf	4.26	10.22	2.34	1.72	2.77
	4.27	10.24	2.35	1.74	2.78
	4.29	10.21	2.36	1.76	2.79
Stem-bark	2.75	9.42	3.61	2.06	1.40
	2.77	9.44	3.62	2.08	1.43
	2.74	9.45	3.64	2.09	1.45
Roots	1.33	8.03	3.22	1.45	0.98
	1.34	8.05	3.24	1.46	0.99
	1.35	8.07	3.20	1.49	0.96

3.2.3 Quantitative estimation of Terminalia glaucescens

Table 3 shows the quantity of the five phytochemical constituents in the leaves, stem-bark and root of *T. glaucescens* in three replications. The results obtained from this study revealed that the three plant parts have a preponderance of tannins. From the results, saponins show high mean of 3.96 in the leaf and indicated lowest mean of 1.01 in the root. Tannins show the highest mean of 10.76 in the leaf and revealed the lowest mean of 6.42 in the root. Alkaloids show the highest mean of 3.86 in the stem-bark and indicate the lowest mean of 2.69 in the leaf. Flavinoids show the highest mean of 2.69 in the stem-bark and reveal the lowest mean of 1.67 in the root. Phenols show the highest mean of 2.27in the leaf and reveal the lowest mean of 1.02 in the root.

Table 3: Quantitative phytochemical tests on *T. glaucescens* (%)

Sample	Saponins	Tannins	Alkaloids	Flavinoids	Phenols
Leaf	3.96	10.76	2.69	1.83	2.28
	3.97	10.78	2.71	1.85	2.27
	3.94	10.77	2.74	1.81	2.29
Stem-bark	2.88	10.02	3.86	2.26	1.19
	2.90	10.04	3.88	2.27	1.20
	2.91	10.04	3.87	2.29	1.17
Roots	1.01	6.42	3.00	1.67	1.00
	1.03	6.45	3.01	1.68	1.02
	1.05	6.47	3.03	1.69	1.05

4. Discussion

The result of the phytochemical components from this study shows that all the three selected plant species contain the five phytochemicals tested for and the leaves of these plants have more concentrations of these phytochemical constituents. Phytochemicals are very important content of medicinal plants. They act in different ways, and serve different purposes in human health. Alkaloids, which are used for analgesic, antispasmodic, bactericidal effects and raw

material for synthesis of useful drugs, were present in the plants. This agrees with Somboro *et al*. (2011) whose work revealed the presence of alkaloids and tannins in *G. senegalensis*. Phenols, which are weakly acidic, hydroxyl-group, attached directly to the aromatic ring, serves an antiseptic, anti-inflammatory, anti-microbial, ant-tumor, and also a good disinfectant were found in the plant parts sampled. This is in agreement with Okwu (2004). Flavinoid is water soluble, super anti-oxidant and free radical scavenger. It is used in the prevention of oxidative cell damage, allergies free radicals, microbesits active as antioxidants, anticarcinogens, antimicrobial, anti tumor. Saponins were observed to have bitter taste, foaming property, haemolytic effect on red blood cells and emulsifying agent. It was also observed that saponins containing plants plant are good expectorants, cough suppressants, and in hemolytic activity (Okwu, 2004).

The presence of tannins, saponins, alkaloids flavinoids and phenols as shown from the results of this study is in agreement with Ayepola (2009) who reported that *T. glauscescens* is an antimicrobial agent use in the treatment of bacterial infected diseases. It also inhibits the growth of bacteria like *Staphylococci aureus, Bacillus anthracis,* and *Salmonella typhi* due to the presence of tannins, saponins, alkaloids, Flavinoids and phenols. *T. glaucescens* is one of the plants used in the preparation of the "wonder cure" concoction used in the treatment of tuberculosis in Nigeria. The activity of the plant extract on *Mycobacterium tuberculosis* was confirmed by Adeleye and Opia (2003). The leaf rich in phytochemicals is used in the treatment of malaria because of its effectiveness in killing malaria parasites as reported by Koffi *et al*. (2015).

Phytochemical screening of the extracts of leaves, stem-bark and root of *Z. mauritania* revealed the presence of the various phytochemicals of which alkaloids, saponins and tannins were most prominent. The leaf, stem-bark and root have shown the presence of high amount of tannins. Almost all phytochemicals are found to possess antioxidant properties and they act as scavengers of free radicals, that is, Reactive Oxygen Species (ROS) and T=Reactive Nitrogen Species (RNS) (Rice-Evans *et al*. 1997), which is in agreement with this study and many of them are used for a wide range of treatments such as inflammation, kidney problems, stomach disorders and many others. Tannins are known to have antibacterial activity. They are also found be active against pathogen causing diarrhea. Tannins specially are a group of certain phytochemicals with wide range of properties such as antiviral, antiparasitic, anti-inflammatory and anti-ulceric. This confirm the medicinal value of *Z. mauritania*. Alkaloid, a wonderful group of phyto-compounds have been well-studied for their anti-arrhythmic, analgesic, anti-hypertensive, antipyretic, anti-malarial and antitumor. Varieties of Flavinoids have been reported for their antiviral, anti-inflammatory and cytotoxic activities. They are very common in the treatment of capillary fragility, retinal haemorrhage, hypertension, diabetes, retinopathy, rheumatic fever and arthritis. Saponins are well-known expectorants. In plants, they are active in the action of traditional medicines as diuretic and remedy for cough (Choi *et al*., 2009). The implication of this study is that, he leaves of *Z. mauritania* can also serve the same purpose as the stem-bark and roots mostly used for the treatment of common diseases. This is because the secondary metabolite contained in the stem-bark and roots are present in the leaves and in high proportion as observed from the study.

Nowadays, endemic infections and opportunist fungal become an important medical problem. The usage of *G. senegalensis* for medicinal purpose has been reported by several researchers. The filamentous fungi tested with the disk diffusion assay showed variable sensitivity to the extract of *G. senegalensis*. The intensity of antifungal activities depended on the type of fungus and extracts or fractions used. The result is in agreement with Shetima *et al*. (2012) who reported the medicinal activities of *G. senegalensis* in the treatment of fungal infection diseases and also used against diarrhea. The antifungal property of *G. senegalensis* could be due to Flavinoids, tannins and alkaloids present in the plants. Galangin, a flavinol commonly found in propolis samples, has been shown to have inhibitory activity against *Aspergillus tamari*, *A. flavus*, *Cladosporium sphaerospermum*, *Penicillium digitatum* and *Penicillium italicum.* The bioactive compounds in *G. senegalensis* were responsible for the antidiarrheal effect recorded. Studies have shown that anti-dysentric and diarrheal properties of medicinal plants were found to be due to the presence of this phytochemicals which are the mechanisms for action against diarrhoeal activities.

5. Conclusion

Based on the findings of this research, it could be concluded that different types of secondary metabolites are present that have effective functions on different types of diseases. It shows very effective function against pathogens. Going by the presence of many chemical groups and scientific results available, it confirms that these plants showed interesting pharmacological activity. This study was conducted in the context implementation of innovative initiatives that can lead in the future to the manufacture of improved traditional medicines for the treatment of common diseases.

6. Recommendations

From the forgoing, following recommendations are made: -

i. Similar phytochemical screening should be extended to other tropical plants particularly by ones used by local healers.

ii. Planting of plat species with phyto-constituents should be encouraged as this will help in conservation of important plant species.

iii. More enlightenment should be carried out as to educate the populace on the need to conserve plant species.

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